VITA

Melanie S. Beaver

EDUCATION

2012 Indiana State University, Terre Haute, Indiana
Ph.D., Curriculum, Instruction, and Media Technology

1998 Indiana State University, Terre Haute, Indiana
M.Ed., Elementary Education
Endorsement in Gifted & Talented

1993 Indiana State University, Terre Haute, Indiana
B.A., Elementary Education
Endorsement in Junior High/Middle School Language Arts

PROFESSIONAL EXPERIENCE

2009 – 2010 Indiana State University, Terre Haute, Indiana
Department of Elementary, Early, & Special Education
Clinical Faculty Associate

2004 – Vigo County School Corporation, Terre Haute, Indiana
West Vigo Middle School
7th Grade Language Arts Teacher

2000 – 2004 Vigo County School Corporation, Terre Haute, Indiana
Deming Elementary School
4th Grade Teacher

1994 – 2000 Vigo County School Corporation, Terre Haute, Indiana
West Vigo Middle School
7th Grade Language Arts Teacher
RESOURCES AND INSTRUCTIONAL STRATEGIES EFFECTIVE MIDDLE SCHOOL SCIENCE TEACHERS USE TO IMPROVE CONTENT AREA READING SKILLS

A Dissertation
Presented to
The College of Graduate and Professional Studies
Department of Curriculum, Instruction, and Media Technology
Indiana State University
Terre Haute, Indiana

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Melanie S. Beaver
August 2012
©Melanie S. Beaver 2012

Keywords: Middle school, science teachers, textbooks, reading, content area literacy
COMMITTEE MEMBERS

Committee Chair: Susan Kiger, Ph.D.
  Associate Professor and Chairperson of Curriculum, Instruction, and Media Technology
  Indiana State University, Terre Haute, Indiana

Committee Member: Feng-Qi Lai, Ph.D.
  Associate Professor of Curriculum, Instruction, and Media Technology
  Indiana State University, Terre Haute, Indiana

Committee Member: Lisa M. Cutter, Ph.D.
  Associate Professor of Elementary, Early, and Special Education
  Indiana State University, Terre Haute, Indiana

Committee Member: James H. Speer, Ph.D.
  Professor of Earth and Environmental Science
  Indiana State University, Terre Haute, Indiana
ABSTRACT

This study examined the resources and instructional strategies effective middle school science teachers use to improve content area reading skills. Reading instruction in the middle school years should follow the natural cognitive progression that occurs in the adolescent brain from learning to read to reading to learn. Scientific reading is a different type of reading than most middle school students are accustomed to. It is important to understand that students will continue to be expected to read non-fiction critically for success in the 21st century. Effective teachers know this, and they perceive themselves as teachers of reading regardless of the content area in which their expertise lies. This qualitative research study was conducted at a rural middle school with three science teachers who employ before, during, and after literacy strategies when reading the textbook content with their students. The methodologies used in this study were interviews, observations, and document collection. The results of this study revealed the students’ reading difficulties perceived by the teacher participants, the literacy strategies used by the teacher participants, the instructional resources the teacher participants used to improve comprehension, and the need for professional development in content area literacy.
The research presented here was inspired by my quest to be the most effective teacher I can be. It is a journey, not a destination. Understanding my own philosophy of teaching is not enough; I will forever be in search of the best methods for teaching literacy skills to students of all ages. For the purpose of this study, I investigated the resources and instructional strategies used by effective middle school science teachers to help their students improve content area reading skills. For years I have witnessed the reading struggles my students encounter when trying to comprehend content area reading material. When students come to middle school, they may begin to struggle with reading for the very first time due to reading content that is increasingly difficult. This research study revealed literacy strategies used by effective middle school science teachers to improve their students’ ability to critically read and comprehend the textbook and accompanying content.
ACKNOWLEDGMENTS

Nothing great is ever accomplished alone. I could not have enjoyed learning what I now know about literacy or about myself, much less completed this dissertation, if it were not for a small army of positive thinkers I kept close to me during the process. I share this grand accomplishment with each of them.

My husband Kevin is the deepest thinker I know. He has been the wind beneath my wings since I met him in college three degrees ago. During the past three years when I was largely unavailable, he filled both our roles with ease and nonchalance. Our sons, Sean and Ian, helped me keep a healthy balance of studying and playing while reminding me that the latter is much more important and more fun. Undoubtedly, the most loyal supporter of this journey has been the family dachshund, Joey. He is the only one who could endure the long days and countless nights of reading and writing, researching, and editing. Predictably, Joey is not impressed. He was just there, and our one-sided conversations in the wee hours kept me sane and awake.

The encouragement I received from friends and family near and far has been my lifeline. Whether they knew it or not, time spent with them equaled the respite and renewal I needed in order to continue. Not for a minute did they let me take myself or my work too seriously.

Completing a dissertation is a lonely task. I was lucky to meet Atlanta-based Roddran Grimes along the way. I tethered myself to her via Skype, email, and text and did not let go. She spoke my language every step of the way, and she is now my lifelong friend. She and I were mentored by the amazing Dr. Sue Kiger. Words cannot honor her contribution to our success. I
will forever see her as more than my dissertation committee chair. She’s perched high in a lighthouse, from which she can see clearly through the moving waves of qualitative narratives and the treacherous seas of APA. My editor, Judy Barnes, saved my hideous formatting and pagination attempts from public scrutiny. Her vision is keen, and her magic wand is surely dipped in gold.

I appreciate the critical eye and supportive correspondence from each carefully-selected committee member. I thank Dr. Feng-Qi Laifor her high expectations and advisement throughout my program. She reminded me that quality instruction should be effective, efficient, and appealing. Dr. Lisa Cutter was the elementary education voice on my committee whose passion for all that remains special in teaching was priceless. Dr. Jim Speer provided the scientific perspective I needed. I am thankful for his patient demeanor, generous advice, and wealth of knowledge in science.

The Bayh College of Education at Indiana State University is my home away from home, because of the people in it who truly love what they do. Their passion inspires me. Finally, I will always treasure the friendship I have with Dr. Brad Balch. I am grateful for our chats about great books, his enthusiasm for the stuff that matters, and the crayon-drawings he saved.
# TABLE OF CONTENTS

ABSTRACT................................................................................................................. iii

PREFACE ................................................................................................................ iv

ACKNOWLEDGMENTS ............................................................................................ v

INTRODUCTION ....................................................................................................... 1

  Statement of the Problem ....................................................................................... 2

  Purpose of the Study ............................................................................................... 4

  Need for the Study ................................................................................................. 4

  Significance of the Study ....................................................................................... 7

  Research Questions ............................................................................................... 9

  Definitions of Terms ............................................................................................. 11

  Assumptions .......................................................................................................... 12

  Limitations ........................................................................................................... 12

  Delimitations ........................................................................................................ 13

Conceptual Framework and Literature Review ....................................................... 14

  Nature of Middle School Science Literacy ........................................................... 14

  Nature of Content Area Textbooks ...................................................................... 16

  Nature of Professional Development in Content Literacy ................................... 17

  History and Significance of Content Area Literacy ............................................. 18

  Importance of Adolescent Literacy during the Middle School Years ................ 20

  Need for Scientific Literacy .................................................................................. 23
Summary ......................................................................................................................... 109

REFERENCES .................................................................................................................. 112

APPENDIX A: INTERVIEW QUESTIONS FOR MIDDLE SCHOOL SCIENCE

TEACHERS ......................................................................................................................... 119

APPENDIX B: CONSENT TO PARTICIPATE IN RESEARCH ........................................... 121
LIST OF TABLES

Table 1. Literacy Strategies Used by Participants .................................................................96
CHAPTER 1

INTRODUCTION

It has been clear for a number of years that good teaching lies in the teacher, not in the materials, curriculum, and textbooks. Middle school teachers, specifically, face the challenge of conveying individual subject area content as well as techniques for helping students become better readers within their respective content areas. “All teachers, regardless of subject area, have an obligation to teach both their subject matter and to develop their students’ literacy” (Gallagher, 2003, p. 36). Considering the reading-rich environment in which high school graduates of the 21st century find themselves, Gallagher (2003) posed a thought-provoking question: “Do we really want to place this entire reading burden on the backs of English teachers?” (p. 37).

Even in middle school years, students are still getting to know themselves as learners. This crucial developmental stage helping students define themselves as students cannot be denied them. Effective teachers know this. Effective teachers are capable of fostering greater student success regardless of the curriculum materials or reading programs they employ (Allington, 2002a). Effective teachers foster the growth of metacognitive learners able and willing to monitor and guide their own academic growth. These teachers engage students with multiple strategies and resources so students learn how they learn. Using self-monitoring, students are able to employ learning strategies that work best for them personally to ensure academic growth (Tovani, 2004).
What constitutes an effective teacher is and always will be debatable. Some would argue that being an effective teacher means showing academic improvement in students’ annual standardized test scores or covering the most content in the shortest amount of time. Others define an effective teacher as someone who embraces the learning needs of his or her students on an individual basis.

For the purpose of this investigation, an effective teacher is one who takes the necessary steps to effect meaningful and progressive academic, social, and intellectual growth within his or her students. Specifically, an effective teacher considers the whole child within the learning environment using multiple assessments of that child’s progress based on formal and informal observations as well as formative and summative assessments to promote academic growth. An effective teacher adapts to the changing needs of his or her students, using research-validated instructional strategies and resources to teach them accordingly. Just as students change and grow, so does an effective teacher. Adaptability is essential.

Statement of the Problem

During more than 17 years of teaching middle school, I have heard colleagues in all content areas lamenting repeatedly over the reading obstacles their students continue to face: textbooks that are too challenging for their level of comprehension, challenges of increasingly advanced text features, and unfamiliar vocabulary. Supporting this concern, Antonacci and O’Callaghan (2011) recognized that even proficient students may lack the self-correction strategies good readers use when encountering challenging textual features. The task of demystifying reading for students in all content areas is daunting, yet critical. Topping and McManus (2010) stressed the importance of students seeing all of their teachers, not just their English teachers, as readers and thinkers.
They need to know that their content area teachers have the same knowledge and expectations regarding literacy as their English teachers do and the same willingness to help students apply what they already know about reading to a new subject or grade level. (Topping & McManus, 2010, p. 11)

This leads one to question the level of preparedness and support content area teachers have to teach their students reading skills within the frameworks of their curriculum. Further, what instructional strategies are effective middle school science teachers using to improve their students’ content area reading skills in juxtaposition with the adopted course textbook?

Although it was not the intent of this study to attack the complexity of the content area textbook or the publishers of such, it must be noted that publishers and state adoption committees have been jointly designing the content of textbooks for almost 100 years to deliver acceptable and age-level appropriate content into the classroom (Kirk, Matthews, & Kurtts, 2001). Moreover, larger political influences affect textbook adoptions, as does the revenue that is generated in the billions each year. To be more specific, Kirk et al. (2001) found that in 1996 K-12 textbook sales generated a staggering 3.5 billion dollars. Regardless of the profit and politics, science teachers across America would agree that their content area textbooks are an important learning resource used in middle and high school science instruction (Radcliffe, Caverly, Peterson, & Emmons, 2004). How those textbooks are used to help students become better readers and the instructional strategies that accompany the content the textbooks present were the key issues investigated in this qualitative research study. Allington (2002b) added to the importance of this issue by stating that many students in Grades 5-12 struggle to learn from content area textbooks that do not match their reading levels. Knowing this, effective teachers must approach the task of helping their students effectively read a challenging textbook with
instructional strategies meant for helping students become better readers in their corresponding content areas.

**Purpose of the Study**

The purpose of this study was to determine what resources and instructional strategies effective middle school science teachers use in conjunction with the adopted classroom textbook to help their students become better readers of the content material. This study attempted to give both new and seasoned teachers an idea of what effective middle school science teachers do to supplement their adopted curriculum materials in innovative and resourceful ways to increase reading comprehension. Ultimately, the findings of this qualitative research study were shared with middle school science teachers in hopes of enhancing the existing body of knowledge that all teachers are teachers of reading in service of purposeful knowledge acquisition (Moore, Readence, & Rickelman, 1983). This study identified what effective middle school science teachers believed to be the most useful resources and instructional strategies for increasing their students’ content area reading skills.

Vacca (2002) found evidence of an increased understanding and acceptance that content area reading instruction is the responsibility of all teachers. Because all teachers share a vested interest in helping their students find the ways they learn best, the findings of this research study were shared with middle level teachers in all subject areas to raise awareness and promote effectiveness as teachers embrace their responsibilities as instructors of content area reading.

**Need for the Study**

A study that investigates what effective middle school science teachers are doing to explicitly teach content area reading skills addresses what has been identified in the research as a need (Weingartner, 2008). Dillon, O’Brien, and Moje, (1994) concluded, “Little is known about how reading and other literacy enactments are used in day-to-day learning in science classrooms.
Additional qualitative studies are needed that target how specific literacy enactments are intertwined with learning science” (p. 348). This qualitative study addressed that need.

The process of learning cannot be divorced from the content of learning. “Teaching reading in subject-matter areas is not a divisive activity; it is a complementary learning process, inseparable from the subject matter” (Marksheffel, 1966, p. 30). Students will learn the content better when their teachers attend to their processes of learning as well. Regardless of the subject being taught, the combination of content and process will ensure positive results (Topping & McManus, 2010).

As students enter the middle school years, the features of their textbook content become increasingly more difficult. Students performing on grade level as they begin middle school have moved beyond the stage of learning to read and will be forever refining their skills of reading to learn. This, too, requires a process of necessary and focused reading instruction from teachers in all content areas. This study identified the types of instructional supports used by effective teachers to help their students develop greater science reading proficiency.

Allen (2004) expressed the importance of content area literacy in regard to the emphasis placed on reading and writing in the state and national teaching standards and on state and national high-stakes assessments. The need to study content literacy in middle school science instruction is directly related to the challenging concept-laden structure of the one-size-fits-all textbooks students are using. The concept of content area literacy instruction has been the topic of research studies for decades. In Better Reading in the Secondary School, Marksheffel (1966) identified “the duty every teacher has assumed upon entering the profession of helping students read subject-matter materials in the fullest sense” (p. 30). Both firm and reflective of the time period, Marksheffel proclaimed, “The competent subject-matter teacher should accept his
obligations of teaching students how to understand the written material he assigns as
unhesitatingly as he accepts his salary” (p. 31).

Current research studies have investigated the challenges students face when they
encounter reading the conceptually dense material in science (Barton, Heidema, & Jordan, 2002).
Of all the content area texts that elementary and secondary school students read, mathematics
and science are arguably the most difficult (Kirk et al., 2001). Yet mathematics and science
teachers often say they feel the least prepared to teach students how to read to learn (Barton et
al., 2002). Although most teachers feel confident teaching the content of their subject area,
teaching students how to read and process the content is what stymies them the most (Tovani,
2004). Scientific reading is a different type of reading than what most students have been
exposed to prior to the middle school years (Thier & Daviss, 2002). Unique and precise reading
skills are required, such as comprehending text passages, decoding and comprehending scientific
signs, symbols, and graphics, along with the different organizational reading structures of
science materials (Barton et al., 2002).

Vacca (2002) noted that a student’s prior knowledge is the single most important
acknowledged that explicit instruction, demonstration, and scaffolding are needed to help
teachers meet the vocabulary and concept development needs of their students in their content
area classes. Weingartner (2008) posited that students’ difficulty in comprehending textbooks in
content area classrooms is a well-known issue in education that has been the topic of many
research studies over the last century. Weingartner (2008) explained the need exists for evidence
of middle school classroom teachers’ attention to comprehension issues. This study addressed
that need by examining what effective middle school science teachers do to increase content-area
literacy skills for their students.
Significance of the Study

Students need help to become strategic readers—that is, readers who engage with the reading content by making critical thinking connections to the material before, during, and after reading (Vacca, 2002). As Gallagher (2003) reported, the volume of reading in which young people engage has a direct effect on general cognitive development. Given that the more you read, the more informed you become, it is critical that all teachers recognize the valuable role they play in adolescent literacy skills acquisition. The middle school years are a unique time of change. Aside from the changing physiological needs of the pre-teen student when he or she enters the middle school years, the texts students read in content area classes are changing too (Allington, 2001).

Chall (1983) observed that the demands of reading increase dramatically for students in fourth grade as their reading begins to rely more heavily on textbooks. The vocabulary is less conversational and less familiar, with more specialized and technical terms along with abstract ideas. This is a phenomenon that experienced teachers call the fourth grade slump (Schoenbach, Greenleaf, Cziko, & Hurwitz, 1999). At this age, and exponentially throughout the upper-level school years, greater emphasis is also placed on activating prior knowledge and formulating inferential thinking, two skills middle school students must still be coached and coaxed to utilize (Dillon et al., 1994). D’Arcangelo (2002) noted that as adults, we do this naturally. Good teachers realize that a major part of teaching is helping kids understand themselves as learners (D’Arcangelo, 2002). In the middle school years, this is increasingly important.

The Commission on Adolescent Literacy of the International Reading Association highlighted the importance of adolescent literacy in the following position statement:

Adolescents entering the adult world in the 21st century will read and write more than any other time in human history. They will need advanced levels of literacy to perform their
jobs, run their households, act as citizens, and conduct their personal lives. They will need literacy to cope with the flood of information they will find everywhere they turn. They will need literacy to feed their imagination so they can create the world of the future. In a complex and sometimes even dangerous world, their ability to read will be crucial. Continual instruction beyond the early grades is needed. (Moore, Bean, Birdyshaw, & Rycik, 1999, p. 104)

Also contributing to students’ weakened abilities to comprehend content area textbooks is the decreased amount of time students are spending reading independently. Atwell (1998) and Gallagher (2003) lamented that during the school day class time is rarely set aside for students to simply read. D’Arcangelo (2002) stated that there is just so much out there for students to do instead, and in the classroom, there is great pressure to cover vast amounts of material in shortened periods of time. When students have no experience in reading widely, they do not have the wealth of background knowledge that their teachers assume they have. If students do not know much about the content, they are also going to struggle in reading, because the vocabulary is crucial in reading the text (D’Arcangelo, 2002). To underline the importance of reading time embedded in the school day, Bean (2002) simply stated that time spent reading is crucial for academic success in all content areas.

Considering the amount of pressure high-stakes testing creates on school systems and all stakeholders within them, it is no wonder teachers are scrambling to add authentic learning strategies to their lessons to fill the gaps left by the one-size-fits-all textbooks and curriculum.

Good teaching should not be so difficult. But until more states and school districts dramatically modify their resources and curriculum frameworks and provide teachers with professional development in content area reading strategies, many students will not
receive the support they need to improve their reading for understanding in content area learning. (Allington, 2000b, p. 17)

This study investigated what effective middle school science teachers are doing to help their students become better readers within their content area, within the confines of the textbook, the curriculum, and beyond. Without explicit literacy instruction at all grade levels, Antonacci and O’Callaghan (2011) argued that success for our students in the content areas cannot be expected. Literacy instruction is a necessary component of the content area curriculum, and effective instruction occurs when content area teachers are knowledgeable about adolescent literacy development (Antonacci & O’Callaghan, 2011).

Michaels, Shouse, and Schweingruber (2008) posited that it is critical for science to be taught well. “Science has become a cornerstone of 21st century education. This is evident in the provision that the No Child Left Behind Act calls for assessments in science, along with reading and mathematics, starting in the 2007-2008 school year” (Michaels et al., 2008, p. 2). National standards and benchmarks in science became a catalyst for a “nationwide conversation about what students need to learn in science and how the education system can support student learning” (National Research Council, 1996, p. 3). Current research shows that the findings on best practices in science teaching are not being reflected in most science classrooms today (Michaels et al., 2008). This qualitative research study identified the literacy teaching practices taking place in middle school science classrooms led by effective science teachers.

Research Questions

General Question Guiding This Research

What resources and instructional strategies do effective middle school science teachers use to teach content area reading skills?
Specific Questions Guiding This Research

The original research questions that were developed to guide the participant interviews appear in Appendix A. As I matured as a researcher throughout the course of this study, those original interview questions morphed into the following interview questions that were actually used:

1. Do effective middle school science teachers believe that all teachers are teachers of reading?
2. Do effective middle school science teachers perceive themselves as reading teachers?
3. What content area reading courses and/or professional development experiences have been offered to help effective middle school science teachers grow as teachers of reading?
4. What further professional development is needed to help effective middle school science teachers continue to grow as teachers of reading?
5. Do effective middle school science teachers feel confident teaching reading skills within their content area?
6. What reading difficulties do effective middle school science teachers perceive exist in their students?
7. Do effective middle school science teachers perceive the adopted textbook as a valuable instructional tool?
8. Is the adopted middle school science textbook easy to read for most students’ reading levels?
9. What text features of the adopted science textbook help students understand the content?
10. Why are some chapters (content sections) more difficult than others in the textbook for students to read and comprehend?

11. What instructional strategies do effective middle school science teachers use to complement the textbook and overall content comprehension?

12. What materials and resources are used by effective middle school science teachers to supplement the textbook and cover the content?

13. How do effective middle school science teachers vary their teaching strategies to accommodate a difficult section in the textbook?

14. In what ways do these strategies help students become better readers?

15. How do effective middle school science teachers measure growth in content area reading comprehension?

16. What role does the physical set-up of the science classroom play in demonstrating the importance of reading?

17. What role does the teacher’s attitude about reading play in demonstrating the importance of reading?

**Definitions of Terms**

The following definitions provided focus for this study:

**Effective reader.** “Effective readers interact with the author of the text while they read, work to make sense of the text and how it aligns with what they already know, and apply strategies to stay on task” (Billmeyer & Barton, 1998, p. 6).

**Metacognition** refers to “the ability a reader has to think about and control his or her thinking processes before, during, and after reading” (Billmeyer & Barton, 1998, p. 3).

**Monitoring effective reading** refers to “monitoring the effectiveness of one’s reading behaviors on comprehension means by (1) being able to observe and assess those behaviors, and
(2) being able to select alternative behaviors and strategies as needed to improve comprehension” (Billmeyer & Barton, 1998, p. 45).

**Reflective reading** refers to “making personal connections between the reading and the reader’s life experiences, a thoughtful process that occurs during and after reading by weighing the information in light of the reading purpose” (Billmeyer & Barton, 1998, p. 44).

**Schemata** refers to “knowledge structures and associations triggered by ideas, words, or situations during reading” (Schoenbach et al., 1999, p. 34).

**Spiral curriculum.** “The spiral curriculum concept introduces ideas at a basic level and then later deepens and expands them” (Palumbo & Sanacore, 2009, p. 276).

**Assumptions**

1. It was assumed that teacher participants involved in this study were effective science teachers who employed before, during, and after reading strategies, by the definition of effective embraced in this study.

2. It was assumed that the effective middle school science teachers involved in this study shared truthful information to the best of their ability to convey it.

3. It was assumed that the resources and instructional strategies for increasing comprehension in science reading can also be useful in other content areas, such as social studies, mathematics, and language arts.

**Limitations**

1. This research study was limited to three effective middle school science teachers’ experiences and opinions.

2. This research study was limited to three science teachers currently teaching in one middle school within one school corporation.
Delimitations

1. The selection choice and comparison of particular textbooks, publishing companies, and their accompanying materials were not studied in this investigation.

2. The instructional practices of non-science teachers were not studied in this investigation.

3. Elementary science teachers and high school science teachers were not studied in this investigation.

4. Students’ perspectives and achievement data were not studied in this investigation.

5. Ineffective teachers were not studied in this investigation.

6. Special education teachers were not included in this study.
CHAPTER 2

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

It was helpful to conceptualize this study by examining the evolution of what sound educational practices have looked like in the United States over the last 100 years from rote memory practices and memorization drills to a more student-centered, inquiry-based, active learning methodology. The transformation in this country’s educational research base mirrors constructivism, in that students learn best when they can actively construct new knowledge based on lived experiences.

It is within the paradigm of constructivism that the topic of content area literacy lives. Just as the philosophy of American education has evolved over the last 100 years, so have the teaching practices and methods of effective teachers who want student learning to be lasting and meaningful. This study identified instructional strategies and resources used by effective middle school science teachers for improving content area reading comprehension.

Nature of Middle School Science Literacy

Regarding the literature on scientific content literacy and related teaching practices, it was helpful to understand the dynamics of adolescent literacy in general and where that is situated in middle school philosophy. The teaming structure of the middle school concept in which the content area disciplines are intertwined through thematic units has ensured the existence of literacy instruction across the curriculum. In 2010, the Association for Middle Level Education (AMLE), formerly National Middle School Association (NMSA), identified 16
characteristics essential to educating young adolescents. “The curriculum is challenging, exploratory, integrative, and relevant” (AMLE/NMSA, 2010, p. 23). Middle school design supports the presence of literacy instruction across the content areas. Research has shown, however, that the lines between the content area subjects should continue to be blurred by literacy instruction (Carnine & Carnine, 2004). Rightfully so, content area literacy seeks to allow literacy skills of reading, writing, and discussion to spill over into all the other content areas in order to improve comprehension of the content. The topic of adolescent literacy has been well-researched, and that information will be useful in understanding the very unique literacy needs of adolescents as they move from learning to read to reading to learn.

“Tremendous synergies are possible between the disciplines of science and language literacy because, in their essence, they seek to develop reciprocal skills in students—skills that complement and strengthen each other” (Thier & Daviss, 2002, p. 6).

Unfortunately, teachers must also contend with an issue that has sparked a great deal of discussion in recent years regarding student success in science class called science anxiety. Too often, students feel success in this content area is reserved for those who are highly intellectual and that the content is too difficult for them to understand (Educational Research Service, 2004). By making frequent connections to current events, people, careers, and personal experiences, teachers can lessen the anxiety and apprehension their students feel, enabling students to learn the content more confidently (Educational Research Service, 2004).

Generating excitement in middle school science in spite of challenging content can be difficult but rewarding when effective teachers exercise flexibility within the constructs of their curriculum (Ediger, 2001). Knowledge of scientific content literacy reminds one that reading in the sciences is very interactive and inquiry-based, drastically different than the type of reading in other content areas. “Middle school students face enormous challenges in learning the content
and process skills of science” (Carnine & Carnine, 2004, p. 216). Carnine and Carnine (2004) recognized that these frustrations for students translate into challenges for teachers. For this reason, I chose to study what effective middle school science teachers do to improve reading comprehension within their subject area.

**Nature of Content Area Textbooks**

This section reviews the effectiveness of the most basic content delivery tool used by middle school science teachers, the adopted course textbook. It is necessary to understand the existence of textbook adoption in public school education along with the overall challenge of comprehending content area textbooks even for average, on-grade-level readers. The way the material in the textbook is introduced and covered by the classroom teacher, whether the adopted textbook material is made available in printed or electronic form, can be pivotal in securing meaningful content comprehension. The content is still the content, regardless of its location on paper or on the screen.

I have witnessed students struggling with subject area textbook comprehension in my own seventh grade language arts classroom for years. The benefit of explicitly teaching effective reading strategies juxtaposed with the textbook content is a remedy worth investigating. “When students enter middle school, they encounter increasingly difficult textbooks and instructional materials” (Lawrence, White, & Snow, 2010, p. 23). This is a time when some students begin to struggle with reading comprehension for the first time.

Scientific reading presents an even greater challenge due to its technical nature, unfamiliar vocabulary, and challenging textual features. Current science textbooks contain “too many vocabulary concepts, present too many ideas at once, are unclear, and do not transmit science knowledge” (Carnine & Carnine, 2004, p. 209). This literature review investigates those
crucial before, during, and after reading strategies that have been shown to immediately impact textbook content comprehension for middle school science students.

Nature of Professional Development in Content Literacy

Finally, this literature review examines middle school science teachers’ attitudes about teaching reading skills within their content areas, their preparation and training for doing so, and the ongoing support they receive for continuing and improving their content area reading instruction. For years, middle and high school teachers have been trained solely in the narrow scope of their disciplines, in the rich content of their respective subject areas. This is a good thing, as I want a math teacher to be well-trained in mathematics and a history teacher to know a great deal about historical events, yet it falls grossly short of excellent and effective teaching to divorce literacy skills from content instruction. It is unclear to me how a teacher can successfully parlay the essential knowledge of a particular subject devoid of the literacy skills needed to read and comprehend the material. Content must be read and understood. Students must be able to read the content, write about the content, and discuss the content. These are all vital skills in literacy development growth.

Meaningful change in teaching practices cannot be sustained without systemic support with the promise of lasting benefits for student success. Carnine and Carnine (2004) recognized professional development as an important factor in supporting teachers as they foster literacy development in their content areas. They highlighted the role of effective administrative leadership in monitoring the use of appropriate instructional materials, pedagogy for science and reading instruction, and progress monitoring during the school year (Carnine & Carnine, 2004).

Effective teachers understand the importance of guided content area reading instruction in order to prepare students to become sturdy, lifelong learners and critical readers. For as intensely as the field of content area literacy has been researched over the last several decades,
the implementation of its findings by classroom teachers has been long neglected (Michaels et al., 2008; Weingartner, 2008). Just as teachers sincerely value the seminal role of reading in any type of content area learning, their beliefs do not always translate into action during their day-to-day subject matter lessons (O’Brien & Stewart, 1992). With a closer look at the pressures placed on teachers by administrators, high-stakes testing, and end-of-course assessments, this anomaly is easy to explain. Sturtevant (1996) recognized that a great number of teachers feel pressure to expose their students to vast amounts of content, leaving little time for breadth and depth in any one area, let alone time spent improving reading skills. It was the purpose of this study to bridge the gap between what is known about content area literacy instruction and what is used by practicing teachers, myself included.

**History and Significance of Content Area Literacy**

At the turn of the 20th century, public schools in America experienced an aggressive transformation from the stringent halls of rote text passage memorization to the philosophy of reading and writing for meaning that followed a more student-centered, inquiry-based model. Championed by educational leaders of the period, Horace Mann and John Dewey, American education curricula began to show that school experiences should build upon what students already know, seeking to enrich those experience with discovery and inquiry. Moore et al. (1983) credited Horace Mann as a leading humanist educator of the late 1800s. Mann stated this about the humanist cause of reading for meaning: “To suffer children to read without understanding is one of the most flagrant causes of incompetent teaching” (as cited in Moore et al., 1983, p. 421). Later, John Dewey carried the humanist cause even further by stressing the importance of teachers using instructional strategies that place children at the center of the curriculum, suggesting that school activities be connected with children’s experiences, interests, and problem solving abilities (Moore et al., 1983).
Denzin and Lincoln (2005) situated this kind of progressive educational philosophy within the constructivist paradigm. After all, action in education is shaped by the meaning-making activities that stem from social constructivism (Denzin & Lincoln, 2005). Content area reading instruction emerged from this way of thinking about learning. Herber (1978) wrote the first text solely dedicated to strategies of content area reading skills, *Teaching Reading in the Content Areas*. He added to the field by teaming with noteworthy literacy leaders of the 1970s, including Vacca, concerning what the research continued to find on the processes and successes of content area literacy. Moore et al. (1983) recognized the distinct specialty of content area reading instruction as the natural heir to modern American educational theory framed by humanists, developmentalists, and scientific determinists. Since reading comprehension emerged as one of the measurable abilities that would serve to assess the outcomes of schools, content area reading instruction was quickly becoming a pillar of educational reform and policy (Moore et al., 1983).

The International Reading Association (IRA) took a stand for content area reading skills by publishing seven principles for supporting literacy growth in adolescents in *Adult Literacy: A Position Statement* (Moore et al., 1999). The purpose of this statement was to make clear the belief held by IRA members that literacy instruction cannot and should not be sacrificed in any subject area for the sake of covering more and more content during the middle and high school years. In fact, the content can be covered more meaningfully if explicit literacy instruction is routinely embedded in the delivery of the content material. Moore et al. (1999) revealed that Principle 4 addressed the role of content area literacy instruction by stating, “Adolescents deserve expert teachers who model and provide explicit instruction in reading comprehension and study strategies across the curriculum” (p. 104). Sturtevant and Linek (2004) contended that
true content literacy in any subject area must be modeled by an expert in that subject area—the content area teacher.

For years, educators have yearned to define the best way to teach each subject area. This search led to the creation of the national standards documents in numerous subject areas (Sturtevant & Linek, 2004). “These standards show those who teach science at any grade level that they can combine the two disciplines in activity-centered, inquiry-based science activities that will help strengthen students’ achievement in both areas” (Thier & Daviss, 2002, p. 54).

Within each subject area of the national standards, there seems to be a reciprocal agreement in the delivery style of material—that content delivery should stem from inquiry and experiential roots, mixed with discussion based on relevant and interesting reading materials and culminated with written and oral reflection (Sturtevant & Linek, 2004). “Since each subject area requires reading skills of a specific nature and the content becomes increasingly difficult, so the ability to read becomes more demanding” (Umans, 1963, p. 1). Umans (1963) also reported that improving a student’s reading ability in one content area will transfer to improved reading in other content areas.

In a qualitative case study of seven adolescent students’ literacy needs, Pitcher, Martinez, Dicembre, Fewster, and McCormick (2010) found that although some specific literacy needs such as vocabulary and phonics were being explicitly taught, guided comprehension instruction in the content areas were not. Explicit content area reading comprehension strategies are critical for students. “Most of the reading they will do during the rest of their schooling and in future employment will be in this type of text” (Pitcher et al., 2010, p. 643).

**Importance of Adolescent Literacy during the Middle School Years**

If the expectation for adolescent literacy acquisition is the creation of skillful and strategic readers across the curriculum during the middle school years, then, Ivey and Broaddus
(2001) cautioned, middle schools might be missing the target. Tovani (2004) sympathized with teachers by recognizing how wide the curriculum coverage is expected to span during the course of the academic school year. Middle school teachers must cover vast amounts of reading material with their students in small amounts of time. It becomes somewhat of a dance with prioritization, and the implementation of reading skills instruction generally gets sifted and shifted to the bottom of the priority list. Because of this, Tovani (2001) stressed how critical it is for students not only to be able to read proficiently, but also to have the motivation to do so on their own.

Dillon et al. (1994) defined classroom-based literacy as “any form of engagement with print via reading, writing, and oral discourse constructed as students work within the classroom to learn concepts” (p. 346). D’Arcangelo (2002) observed that middle schools are still struggling with the old model of organization by subject areas. This is not to say that the physical make-up of the middle school daily routine is causing damage to literacy development, but that the explicit teaching practices crucial for success in all subject areas are not transcending the regimented bell schedule. D’Arcangelo explained that it is a continuous struggle to make reading across the content areas a reality at the middle and high school levels. The middle school experience provides fewer opportunities than the elementary years for improving students’ reading skills and less time for independent reading than they enjoyed during the elementary years (Humphrey, 2002).

Adolescent literacy is a natural and sensitive stage of reading development in becoming strong and fluent adult readers, writers, and thinkers. Too often, this is interpreted as a weakness somewhere along the way in a student’s elementary school years, if guided instruction is still needed in reading and writing during the middle school years. Sturtevant and Linek (2004)
stated that the need for reading guidance is not the result of failures in teaching or learning during the preschool or primary years; it is an important part of normal literacy development.

Moore et al. (1999) recognized the middle and high school years as a critical point in guiding adolescents toward advanced levels of literacy. Although reading skills build rapidly for elementary students, they begin to falter in early adolescence (Radcliffe, Caverly, Hand, & Franke, 2008). Humphrey (2002) reported that viewing reading achievement as “the critical link between middle school students and their future success is vital for middle schools to provide the personnel, time, and resources needed to produce successful readers” (p. 755). Middle school students deserve to have explicit and continued instruction in reading, making it critical that all teachers integrate reading instruction in their content areas across the curriculum (Radcliffe et al., 2008). Cognitive ability increases during late childhood and early adolescence. Therefore, as students progress through the middle and high school years, curriculum literacy demands shift from process learning to intensified subject matter knowledge (Palumbo & Sanacore, 2009).

Schoenbach et al. (1999) identified what they called a *quiet crisis brewing* in regard to the reading abilities of adolescent students. This crisis has been recognized by middle and high school teachers across this country, as well as administrators and policymakers. Too many students have difficulty comprehending academic texts due to the range of reading materials they are required to read and comprehend in the middle and high school academic curriculum (Schoenbach et al., 1999). Tovani (2004) added that good readers possess the skills for monitoring their own comprehension. Therefore, it is vital for teachers to incorporate explicit literacy instruction within each subject area to guide students toward this level of reading independence.
Need for Scientific Literacy

The National Science Education Standards (National Research Council, 1996) were created to guide our nation toward higher levels of scientific literacy, exemplary practice, and informed research in science teaching and learning. Although current science curricula and the textbooks that interpret them are more closely aligned with state and federal standards than ever before, students’ abilities to proficiently read those textbooks remain at risk. Radcliffe et al. (2004) reported that “although educators have long debated the role of the textbook for learning, in middle school, the science textbook appears to be an important learning resource” (p. 145). Kroeger, Burton, and Preston (2009) asserted that when teachers are concerned about scientific literacy in middle school science classrooms, they understand their role in making the science textbook content comprehensible for their students. If students are to reach higher levels of engagement and reflect on scientific concepts and processes, then teachers must find ways to support student engagement.

Although most students enter the middle school science classroom knowing how to read functionally, few know themselves as readers well enough to read science content critically. According to Sejnost and Thiese (2010), “science texts require specialized reading skills” (p. 42). Unfamiliar vocabulary and new scientific concepts at the middle school level render the science textbook the most difficult of all subject areas to connect to, to read, and to critically comprehend (Kroeger et al., 2009). Knowing that vocabulary is crucial to comprehension, all unfamiliar terms are not always explicitly defined within the science text (Sejnost & Thiese, 2010).

It is widely known that “unacceptable proportions of middle school students are struggling to read and understand content area textbooks. Science content area texts are particularly difficult for most middle school students, especially those whose reading skills are already below grade level” (Carnine & Carnine, 2004, p. 203). Fang (2006) suggested that the
important expository skills needed for comprehending science content, in particular, are not widely taught in the years leading up to middle school.

Students need to be scientifically literate, now more than ever before. In the introduction of the *National Science Education Standards*, the importance of scientific literacy is explained. “Americans are increasingly confronted with questions in their lives that require scientific information and scientific ways of thinking for informed decision making” (National Research Council, 1996, p. 1). Along with scientific literacy, Sejnost and Thiese (2010) cautioned that “students’ visual literacy is in demand, since science texts often have a multitude of pictures, charts, and tables, which provide additional details about the topic” (p. 43). Although science is largely an empirical subject, the call for infusion of reading into the science classroom reminds us that science is semiotic and rich in written language that we call text (Fang et al., 2008).

Knowing this, Fang et al. (2008) reported that students can strengthen their domain knowledge about science and their ability to participate in scientific inquiry “by reading quality texts in the science classroom in ways that real scientists do” (p. 2068).

**Instructional Strategies for Improving Content Area Reading Skills**

Billmeyer and Barton (1998) stated that early research viewed reading as a passive activity. Current research, however, indicates that learning and reading are active processes in which readers actively construct meaning as they read (Antonacci & O’Callaghan, 2011; Billmeyer & Barton, 1998; Sejnost & Thiese, 2010; Tovani, 2001, 2004). Quite simply, many researchers agree that students must learn to read in all content areas, and every teacher must be a reading teacher (Barton et al., 2002; Billmeyer & Barton, 1998; Tovani, 2004).

Fortunately, this does not mean content area teachers must depart from the content to act as a reading specialist (Barton et al., 2002). The distinction between the two is easy. Barton et al. (2002) suggested that teachers help students by sharing strategies that can be easily integrated
into the science curriculum. Strategic teaching of reading comprehension skills is important. Billmeyer and Barton (1998) outlined three tasks for helping students learn to be self-directed, independent learners. “Specifically, teachers need to help students learn how to (a) prepare for learning through pre-reading activities, (b) ensure comprehension through the use of metacognitive strategies during reading, and (c) extend and refine the new knowledge they require” (Billmeyer & Barton, 1998, p. 57).

Although it sounds promising and natural to simply provide authentic learning experiences, content area literacy instruction can be counterproductive if not fully understood by the classroom teacher and implemented precisely. Schoenbach et al. (1999) cautioned that it is sometimes easy for teachers to fall into the slump of trying to protect their students from failing by shielding them from the challenge to begin with. Schoenbach et al. (1999) considered the misdirected strategy of teaching content without having students read or by asking them to read only small amounts to be a self-perpetuating instructional practice. Teachers know the students’ struggles, so they look for ways to avoid reading assignments that they know for sure students will find troublesome. Instead of taking the extra time to explicitly teach reading skills, teachers often look for ways to teach the content without using the challenging text material provided. Inherently, this creates students who cannot access and interpret written information independently, reinforcing dependence on the teacher year after year to simplify reading tasks. Schoenbach et al. (1999) warned, “To perpetuate such dependence on teachers is to deny students opportunities they can gain only through intensive, independent reading of texts” (p. 9). Being challenged to read and expand the limits of their reading, Schoenbach et al. (1999) admitted that many students may never be prepared to independently read what they consider gatekeeper texts.
These are the various texts that permit or deny students access to educational, economic, civic, and cultural opportunities. Examples include the SAT test excerpts that assess student understanding; reading tests for entry-level jobs; college and job applications; textbooks and other reading material for postsecondary education and training; and even directions for applying for a student loan or home mortgage. (Schoenbach et al., 1999, p. 9)

Without a doubt, explicitly teaching grade-level appropriate reading strategies in the content areas is important at every grade level. Avoidance and circumvention will not serve students well. Effective teachers recognize this, deliberately positioning themselves in an ongoing process of learning to teach just as their students are reading to learn. “Good teaching attends to both content and process” (Topping & McManus, 2010, p. 4).

Learning to read does not end in the elementary grades (Tovani, 2004). Clearly, reading becomes more challenging for students during the middle and high school years. “To help all students succeed,” Ivey (2002) reported, “content area teachers can infuse into their curriculum several simple but powerful principles of developmental reading instruction” (p. 20). Teachers need to help students learn how to tackle difficult text (Tovani, 2004). Several literacy researchers agree that students are better served to master a few core skills than to be exposed to so many skills on a shallow level that they are not able to successfully master and internalize any of them (Allington, 2001; Dillon et al., 1994; Gallagher, 2004; Marksheffel, 1966). This is true for the teacher as well. Implementing a few literacy strategies with precision and care outweigh the over-implementation of numerous strategies that lack depth and repeated exposure.

Tovani (2004) admitted that there are no easy answers. One tool, tip, or strategy will not teach kids how to become strategic readers. Meaning arrives, Tovani (2004) explained, because we are purposefully engaged in thinking while we read. In tandem with strategic reading,
Gallagher (2003) denied that there exists a proverbial *golden ticket* to increasing reading motivation by noting that there is not a “single right motivational tool for building reading motivation” (p. 4).

There is not one perfect way, method, or model for teaching reading strategies within the content areas. Teachers should consider their curriculum objectives, the nature and needs of their students, and their own personal teaching styles (Billmeyer & Barton, 1998). Research has shown the pervasive view of science texts as instructionally challenging teaching and learning tools (Dillon et al., 1994; Educational Research Service, 2004; Fang & Wei, 2010; National Research Council, 1996; Thier & Daviss, 2002). Much of the work in the field focuses on ways of overcoming the poor organization of the texts by equipping students with text study aids, comprehension tools, and explicit strategies that improve cognitive reading skills (Dillon et al., 1994).

We need to train students in how to be strategic readers who are able to plan for, monitor, and evaluate their own reading process, and who reflect on the meaning of what they read in terms of their prior knowledge and experience. (Billmeyer & Barton, 1998, p. 45)

Science reading materials are challenging for middle school students due to the nature of their “expository style, terse and exact wording, and an abundance of technical vocabulary, symbols, and formulas” (Educational Research Service, 2004, p. 81). “The ultimate goal of strategy instruction is independence” (Billmeyer & Barton, 1998, p. 9). As a critical step toward developing independent and effective readers, the carefully choreographed use of literacy activities and text-processing strategies can improve content area reading comprehension (Dillon et al., 1994). The following sections explain some of the more popular and well-researched instructional strategies for use before, during, and after reading shown to improve reading comprehension in the content areas, specifically in middle school science.
Before-Reading Strategy: Observation of Text Style

Ample research demonstrates that reading comprehension increases when students are taught to identify specific text features (Schoenbach et al., 1999). The ability to organize the text content through graphic organizers or through previewing the text can directly impact readiness for understanding the content. Schoenbach et al. (1999) suggested explicit instruction of the following activities to increase students’ knowledge-building dimension of content area reading:

- Identify the ways particular texts are structured.
- Identify the particular kinds of language used in particular kinds of texts.
- Identify roots, prefixes, and suffixes of Latin and Greek derived words.
- Create word families associated with particular ideas or subject areas.
- Preview a text to build a schema for it; notice structural markers such as headings, subheadings, and illustrations.
- Notice that particular words or phrases signal that the text is heading in a particular direction. (p.37)

In order for students to become proficient in navigating the unique and complex textual structures of science reading, they must understand features of text structures in order to facilitate their own learning (Sejnost & Thiese, 2010).

Before-Reading Strategy: Activating Prior Knowledge

Middle school readers create new meaning by “synthesizing the material with background knowledge and personal experiences” (Educational Research Service, 2004, p. 12). When a teacher can activate and build upon prior knowledge, students can more successfully focus on why they are learning the new content. “In order for students to become proficient at reading to learn, they need to know something about the topics they will encounter in the text if
they are to make connections to the ideas and elaborate their prior understandings” (Schoenbach et al., 1999, p. 34).

Palumbo and Sanacore (2009) suggested the use of related genres and available technologies to activate, or sometimes strengthen, background knowledge in a subject area. By supplementing the content area reading with related resources such as picture books, maps, magazines, paintings, and historical fiction, students can “acquire familiarity with the conceptual background and teachers can more easily reinforce comprehension strategies with broadened and deepened experiences” (Palumbo & Sanacore, 2009, p. 276). Helping students pull from their background knowledge base extends and deepens their understanding of the new material. Juxtaposing existing knowledge and experiences with new information mimics the spiral curriculum concept, which is critical for meaningful learning (Palumbo & Sanacore, 2009).

**During-Reading Strategy: Decoding Vocabulary**

Research has shown that deficiencies in reading performance are directly related to deficiencies in vocabulary knowledge (Kelley, Lesaux, Kieffer, & Faller, 2010). To secure comprehension of science content, Carnine and Carnine (2004) encouraged careful selection, pre-teaching, and review of each chapter’s multisyllabic vocabulary words through daily exercises that include pre-testing, practice, and post-testing. The correct and fluent decoding of new vocabulary in content area reading passages is essential for effective reading comprehension (Bhattacharya, 2006). In fact, students’ inability to generate accurate written responses to comprehension questions is more likely related to the challenges they face in reading polysyllabic words in the content. Bhattacharya (2006) suggested explicit instruction for helping students comprehend content-obligatory words through teacher modeling, guided practice, and independent practice. This explicit vocabulary instruction includes engaging middle school students in silent and oral reading processes in order to “promote accurate and instantaneous
reading of scientific information through the application of syllabication” (Bhattacharya, 2006, p. 121). Regarding the importance of vocabulary skills in the context of overall reading comprehension, Rasinski (2003) stated that “although word recognition and fluency are not comprehension, which is the goal of reading, they are necessary for comprehension” (p. 176).

**During-Reading Strategy: Think-Aloud/Text Interaction**

Situated within the myriad of thinking strategies that effective teachers guide their students to use is the *think-aloud* strategy. To model the thinking processes involved as students make sense of confusing parts of the text, Barton et al. (2002) suggested that teachers select a short passage to read aloud to students. Discussing the thought interactions the reader should make with the text is a skill good readers use during reading (Tovani, 2004). Topping and McManus (2002) shared success in creating a community of readers and thinkers in a middle school science classroom to benefit content reading. “We thought aloud the strategies for reading and writing in science that have worked for us. We joined them in writing journals and jotted ideas that helped us reflect on the science concepts” (Topping & McManus, 2002, p. 30).

In order to improve students’ oral and written language skills in the content areas, teachers must create meaningful and frequent opportunities for students to speak and write about what they are learning and reading (Kelley et al., 2010).

**During-Reading Strategy: Self-Monitoring Strategies**

Researchers have found that good readers monitor their own comprehension as they read (Antonacci & O’Callaghan, 2011; Schoenbach et al., 1999; Sejnost & Thiese, 2010; Tovani, 2004). Known as self-monitoring, fix-up strategies, or comprehension-checking, proficient readers are equipped with a healthy list of interventions for checking their own understanding as they read (Topping & McManus, 2010). This during-reading strategy lives in the cognitive dimension of the reading apprenticeship approach (Schoenbach et al., 1999).
Breaking the text down into small segments, periodically paraphrasing or self-questioning, and talking through the text with marginal quotations are three key activities suggested by Schoenbach et al. (1999). Knowing how to read more strategically, reading different texts differently, and rereading sections or all of the text are also important self-monitoring strategies used by proficient readers and suggested by literacy researchers (Rasinski, 2003; Schoenbach et al., 1999; Tovani, 2004). Equipped with these strategies, students are more confident in tackling more challenging texts. Proficient readers read a text knowing they may not fully comprehend all of it immediately. Topping and McManus (2002) reported success in comprehension of difficult texts when they taught students how to slow down their reading and monitor their comprehension.

**After-Reading Strategy: Critical Reflection**

As Billmeyer and Barton (1998) noted, “reflection deepens understanding” (p. 46). With a short amount of time to cover the content material, it can be even more daunting to infuse time for reflection during or after a lesson. It is widely known that textbooks can create comprehension challenges for students. Therefore, the metacognition of textbook content plays a critical role in science classrooms (National Research Council, 2005).

In a qualitative case study that examined how successful teachers instructed their middle and high school students on reading and writing strategies, Langer (2001) found that incorporating the reflective element in the conclusion phase of a lesson helped students evaluate their own performance, develop acute reflection skills, and improve the repair strategies related to their reading, writing, and speaking tasks. The self-reflective element of instruction can take the form of small and large group discussion, evaluative rubrics, and journaling with critical thinking about the lesson.
Langer (2001) reported that when students engaged in critical reflection, they developed deep and substantive discussion skills with their classmates. The utilization of these metacognitive strategies helps fold the much-needed and critical literacy element into the content material. Just as reflective teachers “systematically monitor students’ reading performances and use the results to adjust their teaching” (Antonacci & O’Callaghan, 2011, p. 55), students can benefit from explicit instruction on being reflective about the quality of their own reading. This inquiry and reflection process helps students “confront their misconceptions and develop deeper scientific understandings” (National Research Council, 2005, p. 407).

**After-Reading Strategy: Peer Discussion**

Vygotsky (1978) viewed learning as a socially interactive process. More time is owed to students to verbally process what they are learning in school. “Students learn by interacting with others in the classroom, when they feel free to generate questions, and discuss their ideas freely with the teacher and one another” (Billmeyer & Barton, 1998, p. 4). Today’s students live in a largely networked and conversational world, and to deny that natural experience for them is to ignore the very tangible benefits it could have on meaningful learning. Effective approaches to content literacy encourage students to “use reading, writing, and discussing to socially construct knowledge, giving students more control over what and how they learn” (Ivey & Broaddus, 2001, p. 354). Two great influences over student success in content area literacy are the opportunities for student ownership over literacy and a focus on a meaning-centered curriculum.

Atwell (1998) argued that the most defining feature of her successful reading and writing workshop was the element of student ownership and voice in processing what they were reading and writing. Peer discussion in the content areas is critical. Listening in on these peer-mediated content area discussions is the fastest way for the teacher to monitor comprehension in order to steer effective instruction. Middle school students have an insatiable need for self-expression,
and having the ability to express and orally process the content leads to “greater personal investment in literacy activities” (Ivey & Broaddus, 2001, p. 354). Peer discussion is one effective strategy for teaching science. Research in science education at the middle and high school levels stresses the importance of class discussions for developing a language for talking about scientific ideas, for making students’ thinking explicit to the teacher and to the rest of the class, and for learning to develop a line of argumentation that uses what one has learned to solve problems and explain phenomena and observations. (National Research Council, 2000, p. 183)

The Challenge of Content Area Textbooks for Average Readers

Texts and textbooks, viewed as synonymous, are considered to be repositories of useful, prescribed information (Dillon et al., 1994). Research in science education has demonstrated that textbook-based instruction dominates most science classrooms (Dillon et al., 1994). Research notes the impact on students’ conceptual understanding of content based on the struggles encountered by textbook readability (Dillon et al., 1994).

Barton et al. (2002) highlighted the text style as one hindrance to overall textbook readability for middle and high school students. Olson and Mokhtari (2010) found that science reading demands “discipline-specific background knowledge. Students have difficulty understanding syntactic structures used to express complex scientific processes and concepts” (p. 56). Authors of science texts do not often follow the principles of writing that students learn to identify in language arts classes (Barton et al., 2002). Whereas the main idea and cue words, also called transition words, are more explicit and easily located in language arts reading passages, science texts are not so explicit. Science textbook authors write with a style that implies the hierarchy of conceptual relationships, thereby making it harder for students to
extrapolate main ideas and supporting details as they have been routinely taught (Barton et al., 2002).

Schoenbach et al. (1999) coined the phrase hitting the literacy ceiling in their book *Reading for Understanding*, in regard to students’ difficulty with reading and understanding subject area texts. The authors suggested that to the degree that students cannot independently access the knowledge and information embedded in the books and other printed materials that are part of a curriculum, teachers must offer alternative ways for them to acquire it. Schoenbach et al. (1999) conceded that students often make maladjustments in response to text reading difficulties by avoiding a reading task entirely and waiting for a teacher to review the pertinent concepts.

Students who have come to think of themselves as non-readers or poor readers develop various survival strategies. Some attempt invisibility, sliding silently down in their seats in hopes that they won’t be called on. Others act out, creating distractions when they fear their errors or inadequacies are about to be exposed. Still others adopt a stance that clearly says, “I don’t care about school at all.” The most dedicated among them—or perhaps simply those with the most stamina—struggle through assigned texts painfully. (Schoenbach et al., 1999, p. 5)

Billmeyer and Barton (1998) recognized that the difficulties students have with school reading assignments are caused by a variety of skill-related issues. Many students have trouble understanding an author’s ideas because they have not learned how to mentally organize those ideas as they read. Further, they have not had much experience with the topic and do not know how to make meaningful and personal connections to new ideas while reading (Billmeyer & Barton, 1998). Too often students will say that their school work is too boring when in reality they lack the skills needed to self-monitor their comprehension as they read.
Role of Professional Development in Sustainable Content Area Literacy

Because content area literacy is clearly a perennial educational issue, it might be valuable to also investigate the level of preparedness and training content area teachers receive in teaching subject-specific reading strategies. Expecting content area teachers to position themselves as expert reading teachers is not realistic (Tovani, 2004). With professional development that is supportive and straightforward, schools can better equip all teachers to complement their content area comprehension with explicit literacy skills instruction for the wide range of readers in their classrooms (Ivey, 2002).

When students have difficulty comprehending course textbooks, teachers are capable of responding with promising instructional strategies in content area reading skills. “Few middle and high school teachers feel they have the time or the expertise to teach students how to read” (Tovani, 2001, p. 13). Although middle and high school teachers have been trained in their content areas, Tovani (2001) also reported that most teachers do not feel comfortable enough to play the simultaneous role of content teacher and reading specialist. Schoenbach et al. (1999) acknowledged that teachers feel pressed to cover the curriculum, unprepared to assist students with reading, and eager to make sure students understand the content of a particular discipline. As a result, they end up avoiding explicit textbook reading assignments. One teacher confessed to Schoenbach et al. (1999), “I’m doing backflips in the classroom to get the content across without expecting them to read the textbook” (p. 4).

Pitcher et al. (2010) reported that the literacy demands for school and employment today are much greater than they were three decades ago. Suggesting implications for further research in their qualitative case study on the literacy needs of seven adolescent students, Pitcher et al. reported the need for qualified reading specialists in schools, increased professional development for content area teachers, and a strong suggestion for teachers not to avoid effective reading
instruction in the content areas. The call for administrative support for content area teachers’ training in literacy instruction has been echoed by literacy specialists for more than 50 years. Umans’ (1963) seminal text on content area literacy, *New Trends in Reading Instruction*, acknowledged the very challenging task of helping subject matter teachers “see the necessity of teaching skills directly related to the reading of a particular subject” (p. 7). Umans’s recognized the general consensus among most content area teachers that reading be taught in someone else’s class. Well-read administrators on the topic of content area literacy can have a positive impact on the acceptance of saturated literacy instruction within their schools. “It becomes the responsibility of the school principal and the reading consultant/specialist to construct in-service programs for the subject area teachers on the importance and value of reading instruction in all areas” (Umans, 1963, p.6).

The National Research Council (1996) recognized the need for professional development opportunities that reflect new approaches to the teaching of science, an understanding of how students learn science, and coursework to stay current with new science research. Tovani (2004) explained that in the absence of professional development, each teacher must decide for herself or himself whether it is worth giving up some content for the time it takes to design comprehension instruction that is useful to students. Valuing the thinking strategies required for successful comprehension does not require one versus the other. For best results, it should be a natural blend, teaching the content and the thinking strategies that accompany the understanding of that content.

**Summary**

Since the early 1900s, teachers have been studying the best ways for students to read and comprehend subject area reading material, such as course textbooks and related resources (Moore et al., 1983). Interest in the field of content area literacy weakened over the next several
decades but resurfaced in the 1970s with the publication of Herber’s (1978) *Teaching Reading in the Content Areas*. The first of its kind, this book helped re-energize the field of research in content area literacy, advancing it to the important research topic that it remains today.

Numerous research studies have reported that explicit lessons on reading instruction are vital to ensuring comprehension of content area material, regardless of the subject area or grade level (Moore et al., 1983; National Research Council, 1996; Thier & Daviss, 2002; Tovani, 2004). Teachers can no longer rely on the adopted course textbook as the sole source of content material presentation. Not all students can effectively decode and comprehend the textbook (Allington, 2002a; Fang & Wei, 2010; Kirk et al., 2001; National Research Council, 1996).
CHAPTER 3

METHODOLOGY

In the last 100 years, the landscape of education has changed dramatically. John Dewey’s (1910) *How We Think* validated the importance of language instruction and language skills usage in all subjects. Dewey considered language to present a twofold relationship with schooling, being not only a direct object of study but also existing as a social presence in every subject area. Dewey also called attention to the dangers of students being taught to function in two separate worlds: a world of out-of-school experiences and a world of lessons and textbooks. It was this very problem of disconnected teaching strategies and learning experiences that caused Dewey to focus his humanistic reform efforts on altering the course of American education. To make learning more meaningful and acquired skills more enduring, Dewey promoted a more student-centered, inquiry-based approach to learning.

Fortunately, education in America continued to evolve in this way over the next 60 years. Herber (1978) was the first to publish a book specifically dedicated to teaching reading skills in the content areas. Like Dewey, Herber recognized a natural presence of literacy skills in all subject area classes. Herber suggested that reading skills and subject content could and should be taught simultaneously. As students continue through the grades in school, the material becomes more sophisticated, just as the reading skills they learn become more sophisticated. Herber considered this a natural progression of learning that should occur in unison.
More than 30 years have passed since Herber’s work with reading research in the content areas began, and the topic is still on the cutting edge of what the leading educational researchers consider to be a best practice (Topping & McManus, 2010). Yet there is still more that can be learned. With current education reform and high-stakes state and national assessments demanding more advanced reading and writing skills in all content areas, especially in mathematics and science, it is crucial to advance the field of content area literacy research. It is along this vein that the need for this study evolved. This study adds to the knowledge base by examining specific practices used by effective middle school science teachers to advance students’ reading skills while delivering the content of the textbook and curriculum.

**Origin of the Study**

As a middle school English and literature teacher for over 18 years, I have often wondered what more I could do to advance my students’ reading comprehension skills in and beyond my content area. I figured I must not have been working hard enough, not exposing them to enough, or not delivering the skills in the best way my students learn. For too many years, I assumed my seventh grade students were able to transfer the reading and writing skills they learned in my language arts classroom to other content areas. Surprisingly, they cannot always successfully apply what they learn in one class to another. A preliminary review of the literature revealed to me that I share this problem with others. Sturtevant and Linek (2004) acknowledged that adolescents do, in fact, struggle when required to transfer skills learned in one class to a different class representing a different content area. Learning the skill in one class does not always assure application in another.

To learn more about content area literacy instruction, I began reading current research on the topic and speaking with colleagues about the literacy strategies they employ. The plethora of research in content area reading and writing reassured me that most teachers naturally embed
literacy instruction in the delivery of their content whether they are acutely aware of it or not. Literacy instruction and content material delivery cannot be separated. If the course requires a textbook, paper, and pencil, literacy skills are clearly being utilized. Some teachers are just more explicit about it than others. I set out to meet some of those teachers.

**Field Study**

After reading the literature on literacy in the content areas, I needed to know more. I was still longing to know what instructional strategies and materials were being used in conjunction with course textbooks to explicitly improve reading skills and consequently comprehension of the course material. I sought the content area teachers around me for that information. My curiosity about the literacy skills being taught in non-language arts classrooms was piqued when I began talking with some of my middle school colleagues about their instructional delivery methods that involve literacy.

In order to determine if I wanted to focus on content area literacy instruction for further study, I conducted a small-scale qualitative field study featuring one middle school teacher participant in the fall of 2010. Glesne (2006) suggested the use of a member of the target population in the field study to determine if more in-depth study would hold value. Because I was familiar with the teacher I wanted to interview and the subject area I wanted to study, the sampling in this field case study was purposive. Bogdan and Biklen (2007) defined purposive, or purposeful, sampling as the situation when the researcher actively seeks participants that fit into the formulation of his or her study.

Such was the case for my field study. Over a three-month period, I conducted two one-hour, on-site interviews and one 45-minute in-class observation with an effective science teacher in my building. In order to adequately document the content of the interviews, I audio-recorded each one for later transcription. To include artifacts and documents in my case study, I examined
the seventh grade adopted science textbook and two test review worksheets from the textbook resource guide for the unit on DNA replication.

During the interviews, I asked the participant about the reading strategies she felt her students needed in order to advance as well as the strategies she incorporated into her content lessons to improve her students’ reading comprehension. I also asked how prepared she felt for teaching literacy with her content, and I asked her to share her concerns about this being part of her professional duty in meeting students’ needs. After transcribing the interviews, I shared the transcribed information with the participant to increase the accuracy and representativeness of what she had shared with me. At that time, I asked for clarification for any interview questions or answers she gave that I found to be ambiguous or confusing.

To examine the documents, I reviewed the textbook chapter on DNA replication that she expressed a great majority of her students struggle with each year. I examined the non-fiction features of the adopted textbook, such as the presentation of new vocabulary, the graphics, the headings, subheadings, and placement of italicized words, and the comprehension worksheets that accompany that chapter of the textbook. To ensure accuracy of document analysis, I shared my findings with the teacher participant. I wanted to have confirmation from the science teacher that I had extrapolated the essential structural features of each document that aid in student comprehension.

During the observation, I took notes and audio-recorded while observing many verbal and nonverbal cues from the teacher. I observed her proximity to students, classroom layout, lesson pacing, degree of textbook content explanation, and various other teaching strategies such as the use of manipulatives, artifacts, and media to enhance the lesson material. I chose not to study student–teacher interaction, but focused only on the teacher’s varied delivery methods of content and the resources she used to teach the day’s lesson in juxtaposition with the textbook. I
took note of literacy strategies she employed such as vocabulary instruction, information recall from the previous day’s lesson, higher-order thinking skills, inferential thinking, guided reading instruction, and read-aloud modeling.

After gathering and coding the data, several themes were identified which revealed intense literacy instruction was embedded into this participant’s daily science lessons. She valued her role as the type of science teacher who makes the content more approachable with literacy instruction. She also noted that she found herself teaching more reading and writing skills in recent years than earlier in her 37-year teaching career. She attributed this equally to her students’ increasing literacy instruction needs and her increased personal comfort level with explicit reading skills instruction attained through corporation-level professional development opportunities.

As Glesne (2006) suggested, I took the opportunity afforded to me by conducting this field study to refine my observation and interview techniques. The field study also clarified my desire to study this topic more in-depth and prepared me for gathering the appropriate data. At the conclusion of this study, I felt more ready than ever to delve further into the area of content area literacy, specifically in middle school science.

Conducting this field study led me to wonder if this science teacher was unique or part of a new normal whereby content area teachers also see themselves as teachers of literacy. I also learned that the science teacher and I can collaborate on simultaneous instructional units that help the students advance their literacy skills in both of our content areas. For example, in the future I will teach research skills at the same time this science teacher is having her students research bio-genetics. This way, students can see the overlap in skills they need for both classes.
Role of Researcher

Denzin and Lincoln (2005) encouraged qualitative researchers to “stress the socially constructed nature of reality” (p. 10). They recognized the intimate relationship that exists not only between researcher and participants but also between researcher and what is being studied. In order to frame my lens as a qualitative researcher, I utilized this section to share my experiential knowledge of teaching middle school reading and writing for 18 years along with the origin of my passion for cracking the code on middle school students’ content area comprehension problems. I have long been interested in research related to content area literacy and the well-documented struggles faced by content area teachers in helping their students comprehend their respective course textbooks. It became the goal of my research to bridge the long-time gap that has existed between the aforementioned two.

In my role as a middle school language arts teacher, I am well aware of the literacy struggles my students face when they enter a non-language arts classroom. It seems they instantly forget to use the writing and reading skills I know they possess. Why is this? Do they turn off a switch related to all other content areas except for the subject taught within the walls of that particular classroom? Has the departmentalized middle school class structure encouraged them to separate learning in this way? Why do my English students struggle to compose a well-developed paragraph explaining how they solved an equation while sitting in algebra class? Why do my literature students have difficulty extrapolating the main idea of a passage from their history books or identifying the author’s purpose in a genetics article in science class? This dilemma led me to study content area literacy and the importance of teaching literacy skills in all classrooms at all age levels. Moore et al. (1999) reported that “many people do not realize reading development as a continuum” (p. 98). The development of literacy skills begins at birth and has no end, so it certainly should not take a hiatus during the formative middle school years.
For the purpose of this qualitative study, I served as a professional colleague with the next set of participants in a more formal way than in the aforementioned field study. As a teacher in a different corporation than my participants, I worked to establish professional rapport, allowing them to be more straightforward and willing to reveal the nuances of their teaching methods. As middle school teachers, my participants and I shared a common language, a teacher’s vocabulary, and an educational understanding of what is at stake—namely, student success. Each of us work to advance literacy acquisition in our respective content areas, and I made it clear to my participants that I wanted to become a better English and literature teacher as a result of this qualitative study. I was also aware that I needed to avoid bias and misinterpretation based on my personal lens as a middle school teacher, so studying teachers outside my own corporation helped me maintain a clean, valid perspective and presence as a researcher. To ensure this, I shared my field notes and subsequent findings with each participant to check accuracy, validity, and objectivity.

As suggested by Glesne (2006), I utilized multiple data collection methods in this qualitative study in order to strengthen the overall trustworthiness of my findings. I collected these data (field notes from interviews, observations, and documents) over the course of one academic grading period which was approximately nine weeks in length. When I met with each participant, I traveled to his or her classroom to experience the school environment and general classroom climate. Each interview and observation was conducted at a time that was convenient for him or her. The consent to participate form was explained and signed in person, once I had fully explained the purpose of this study. I met with each teacher in person four times: once to obtain written consent and conduct the initial interview and three times to make the observations of the teacher teaching the science content. Via e-mail, I shared each participant’s transcribed interview, coded data, and subsequent findings for confirmation and validation of accuracy.
Methodology and Data Collection

In order to strengthen the confidence and validity of my findings, I triangulated my data with the following methodologies: interviews, observations, and document selection. Creswell and Miller (2000) viewed data triangulation as an attempt to create a convergence from the different sources of information in order for themes and categories to emerge in a qualitative study. Since I wanted my data to be richer and my findings more believable, the use of three different methodologies enhanced this qualitative research study. Glesne (2006) considered the use of multiple data gathering techniques in a qualitative study to ensure richer data and more believable findings.

Participant Interviews

Through the semi-structured interview process with each participant, I discovered perceptions, attitudes, and experiences in teaching content area literacy as well as the level of preparedness and support each teacher believed he or she had in doing so. During the interview, I asked about the instructional strategies each teacher participant used to improve reading skills in science. Each interview session was audio-recorded, and I took analytic notes as needed during and immediately following the interviews. Glaser and Strauss (1967) viewed analytic note taking as the personal notes you write to yourself for immediate reflection and preservation of the experience. Denzin and Lincoln (2005) called these the field notes or field reflections. The success of this study and the validity of its findings, as with any well-designed research endeavor, relied on the rapport I was able to build with each participant. The interviews allowed me to build positive rapport with participants, strengthening the lines of communication throughout the duration of this study.

I asked each participant the perceptions he or she held of the textbook as the main source of course content and the resources and methods he or she used to supplement student
understanding of the textbook. I also asked each participant his or her level of training and confidence teaching content area literacy skills. To assist in coding and sorting data, I juxtaposed the analytic field notes I took with the interview transcripts of each participant. I was sure to listen to each interview session repeatedly in order to capture important nuances such as verbal pauses, tone, and related sounds.

Although the interviews were semi-structured by design, I did consider the use of different types of interviews as Bogdan and Biklen (2007) suggested. I opted to begin my interviews with a free-flowing conversation but concluded them with guiding questions and purposeful direction guided by our initial discussion. In order to elicit deeper conversational responses, I avoided asking questions that could be answered with the yes or no reply. Bogdan and Biklen recommended exploratory questioning in order to bring out details pertinent to the study.

**Observations of Participants**

To better develop an in-depth case study of each of the participating middle school science teachers, I visited the participants in their respective classrooms during three separate class periods. I observed the teaching methods employed and the resources used to help students read the course textbook and supplementary materials. For the purpose of this study, I did not observe or interact with students in the classroom. I simply observed teaching strategies and resources used by each science teacher during the lesson.

I took descriptive notes during the observations as well, sketching the layout of the room, noting the proximity of the teacher to students, and jotting down any questions that arose during the observations. As Glesne (2006) suggested, I took careful note of the physical setting, the events occurring simultaneously, as well as the gestures and teaching methods the teacher utilized to teach the course content. Since I studied the resources and strategies effective middle
school science teachers use to teach content literacy skills in conjunction with the textbook, I took note of the use, placement, and reference to the textbook throughout each observation.

Creswell and Miller (2000) reported that in a qualitative study, the description of the setting, the participants, and the themes must be documented in rich detail in order to establish credibility. This is known as thick description. More than simply reporting facts and general observations, the thick description of the setting and participants can give the readers of the study a sense of experiencing the observation themselves (Creswell & Miller, 2000). By creating this verisimilitude, I created a rich and realistic narrative account for the readers of this qualitative study. This added to the credibility of my research.

**Document Collection**

Finally, I collected documents used by the teacher participants to strengthen student comprehension of the content, such as study notes, test review outlines, graphic organizers, vocabulary guides, and so forth. The documents I collected were any type of worksheet or activity guide the teacher distributed for student use during my observation times. I noted the utilization of these documents during the lessons I observed in each classroom. I observed the ways in which the teacher referred to and included the documents in the delivery of the material. As I analyzed each document, I determined what skills each document addressed such as recall information, vocabulary development, summary of main idea, or other. It was also helpful to note at which stage in the lesson each particular document was used before, during, or after textbook reading. I also noted if the document was used in preview or review of the material. In this case, I remained aware that I may have needed to conduct further interviews to understand the usage of each document if that information was not evident during my three observations.
Sampling

It was my desire to invite six middle school science teachers to participate in my study from one middle school in Indiana, with a minimum of three participants as my goal. I used homogeneous, purposive sampling to formulate my participant group. Since I purposely selected effective middle school science teachers based on their use of before, during, and after reading strategies paired with each teacher’s highly-qualified status as deemed by the Indiana Department of Education, according to the operational definition of effective, this type of sample is homogeneous and purposive (Bogdan & Biklen, 2007). For the purpose of this study, I chose a middle school in one rural school corporation that served a similar demographic with regard to cultural background and socio-economic status of students and families as my own middle school. In this way potential errors, based on cultural differences, in my interpretations of findings were minimized.

There were two science teachers at each of the three grade levels at the middle school. I invited each of them to participate in this study. All six science teachers were highly qualified in their content areas. Although inclusive classrooms were not excluded from this study, I only included highly qualified science teachers in the prospective sample, not the special education teachers who co-teach in the inclusive classroom. This ensured that I included only highly qualified science education content area teachers in the study. It was my goal to study at least three of the six middle school science teachers, a goal realized in this study.

In order to study the teaching strategies of effective middle school science teachers, I shared the objectives of my study in an initial e-mail to the participants. I explained the purpose of this study and the operational definition of an effective science teacher as one who recognizes his or her role as a teacher of science literacy who employs before, during, and after reading strategies in the delivery of science content. I used the Indiana Department of Education’s
website to verify that the participant teachers were certified to teach middle school science in accordance with the state certification and licensure process for highly qualified teaching status under the stipulations mandated in the No Child Left Behind Act. Because the study focused on effective middle school science teachers in a particular school corporation in Indiana, I did not wish to narrow the sample any further (for example, by age, by gender, by years of teaching experience, or by specific grade level currently taught). I felt confident that selecting effective middle school science teachers in this fashion was as close to my target population as I could get.

Data Analysis

To adequately and thoroughly analyze the data from my three different sources of methodologies (interviews, observations, and data collection), I created what Denzin and Lincoln (2005) called *storying* and *restorying* through the coding process. To do this effectively and authentically, I began my data analysis immediately upon collection of any data. I repeatedly organized, sorted, and reflected on the data I collected in order to make the overall analysis of findings much more reliable and dependable.

Through personal memos to myself, rough initial coding, and intensive field notes, I was able to capture the experiences as they occurred. Glesne (2006) encouraged early data analysis to help the qualitative researcher shape the study as it progresses. In order to establish some control over the immense amount of data, Glesne suggested creating some semblance of order through the organization of notebooks, note cards, computer files, paper files, and relevant documents. For this study, I organized data in color-coded file folders and matching spiral notebooks labeled with each participant’s self-chosen pseudonym. The transcribed interviews were stored on separate word document files, and the hard copies were stored in each participant’s file folder along with the documents collected from each participant.
With so much information adding up as I progressed through the stages of my data collection, it was important that I kept my main research question in mind so that I did not get distracted. In order to establish boundaries for the completion of this research study, Glesne (2006) suggested posting the problem statement above my work area to remind me of the clear and precise task at hand. In my home office, I kept the problem statement and guiding research question posted on the wall above my desk. It was vital that I stay focused on the guiding research question in order to avoid distraction and wasted time on tangential material.

I used the data gathered from all three data sources to assemble themes that were alike in nature. These chunks of data were then sorted and piled into physical masses so that I could see the tangible collection of information. These information piles made clear to me the areas of my research questions that had been sufficiently addressed, unaddressed, or under-addressed. Just as when compiling my information stores for my literature review, it was important that I maintained hard copies of each source. The same held true for coding and information sorting; I was able to analyze data more accurately and confidently by creating an organizational framework that I could see, touch, and sort with my hands. The coding process also revealed data that spanned multiple themes. Those common themes served to deepen the understanding of my specific findings (Denzin & Lincoln, 2005).

Once I collected and sorted all the data, I formulated a list of coding themes and subthemes. In an attempt to ensure the quality of my coding and analyses, I sent a culminating e-mail to each of my study participants, to share my information with them. This was an important step in ensuring the validity and authenticity of my findings. Bogden and Biklen (2007) cautioned that the researcher take careful steps to capture the judgment and perceptions of the participants and not the judgments and perceptions of himself or herself. Known as member checking, Creswell and Miller (2000) suggested that validity can be reinforced by taking the
interpretations back to the participants in the qualitative study to assure credibility and to obtain confirmation of information. It was important that I allowed my participants the opportunity to react to the narrative account of my findings. If my narrative account had been disconfirmed or in need of correction, I would have revisited my field notes and interview data used to formulate my codes and sorting piles to determine the nature of the discrepancy. After adjustments were made, I then would have asked the same participant to review my revised narrative account. Upon receipt of that e-mail and a careful review of the attachment, each participant found his or her particular section of my narrative to be accurate and representative of the information he or she shared with me during the interviews, observations, and document analysis.

Summary

It was my goal as a qualitative researcher to discover what is and to tell the narrative story of the teacher participants. In my qualitative research study, I discovered what strategies and resources effective middle school science teachers use to improve content area reading skills. Through a three-pronged approach to data collection through interviews, observations, and document analysis, I was able to witness what was occurring in three effective middle school science teachers’ classrooms to incorporate science textbook content with literacy skills. Sharing the findings of this qualitative study with other educators has added to the existing knowledge base that literacy is an ever-developing process and that scientific literacy is critical in preparing students to be proficient readers in the 21st century.
CHAPTER 4

RESULTS OF THE STUDY

The National Research Council (2005) posited that “science is about questioning the obvious” (p. 410). This is how we discover, learn, and grow. For this reason alone, I studied that which may already seem obvious to some, in hopes of shedding a brighter light on the topic for others. Through a qualitative research study on the resources and instructional strategies effective middle school science teachers use in conjunction with their adopted textbook, I revealed the stories of three teachers who use literacy skills to help their students understand the subject matter in the science textbook.

During a time in our nation when it is more important than ever for our students to not only read critically but also read challenging material comprehensively and reflectively, teachers stand at the helm of steering their students in the right direction toward their own metacognition and literacy self-awareness. In the science classroom, this type of thinking about learning is paramount. The science textbook is a complex resource, making it difficult for many students to comprehend (National Research Council, 2005).

Instruments

Conducting this qualitative study allowed me to witness effective science teaching methods that embraced literacy skills instruction as a valuable part of science inquiry and discovery. The population for this study included three middle school science teachers who openly embrace literacy skills instruction in conjunction with their textbook content delivery
methods. I interviewed them, observed them on three separate occasions, and collected
documents each teacher uses to supplement the textbook content. The observations were
conducted on a convenience basis. The topics teachers were covering were not used as a basis
for selection of observation times.

Three teachers welcomed me into their classrooms for this purpose. Telling their stories
can lead to meaningful discussion on the importance of content area literacy. I spent time with
each of them to question the obvious.

**Organization of Data Analysis**

The following is a narration of the three teacher participants involved in this study. Each
participant’s pseudonym was self-selected. It is my desire for the reader to experience it as
closely to the way I experienced it but in written form. Each teacher consented to an
approximately one-hour interview. During each interview, I audio-recorded the question-and-
answer discourse between the two of us. I asked questions that stemmed from three general
categories:

1. students’ difficulties in reading and comprehending the textbook/curriculum material,
2. strategies and resources used to improve comprehension of the textbook/curriculum
   content, and
3. the professional development offered to train and support teachers in understanding
   content area literacy.

Once transcribed, their responses were sorted and organized to allow the recurrent themes
to surface. I conducted this same coding process for the observations and the documents
collected from each teacher.

When I asked the teacher participants to explain the difficulties their students have in
comprehending the textbook content, two strong themes emerged in this category. The first
theme was evident in the literature review in Chapter 2 and then further supported by each participant. The participants commented on the technical and challenging readability of the textbook reading passages. The next theme was prevalent among the science teachers I studied due to changes in curricular demands at the elementary level. They expressed that their students’ limited background knowledge was in the sciences due to lack of science instruction in the elementary grades.

Several themes were evident in the literacy strategies and instructional resources used by the teacher participants to help their students understand the textbook reading passages. The themes identified in the literacy strategies employed were the use of classroom discussion, vocabulary instruction, differentiation, and leveled instructional resources. The themes identified in the instructional resources used to complement the textbook included the use of technology, outlines of key concepts, text features, and the physical set-up of the classroom.

Three themes were identified in the professional development teachers receive for training and ongoing support for content area literacy. The first theme revealed in this category was the perception science teachers held of themselves as teachers of reading responsible for helping their students decode and comprehend the text. The next theme revealed by teachers involved in this study was the need for further professional development in content area literacy for themselves and their colleagues. The final theme that emerged from the data was the teachers’ lack of time to plan and implement content area literacy strategies.

In order to clearly and accurately reveal the coded themes that emerged during data analysis and allow the reader to know each teacher as fully as possible, this chapter unfolds each teacher’s story separately. The coded themes are elaborated further in Chapter 5.
Meeting Miss Marie

Miss Marie had been teaching general and inclusive science for 12 years in the same school corporation that she attended as a student. At the time she was a middle school student, she attended the original building located in the downtown area of this rural community. The new building opened in 1995. After graduating from a local university, she returned to this community to live and teach. She is proud to tell her students she grew up in this rural community. Her school pride is evident, and she used that to motivate her students to do well in her science classes. She attended her students’ extra-curricular events, and they knew she stayed well-connected to how they are doing in and out of school. She used this to her advantage in building rapport with new sixth graders at the beginning of each school year.

When asked to reflect on her favorite aspect of being a teacher, she quickly mentioned reading. She boasted that she had seen the pay-off from pushing her students to love reading. She enjoyed seeing kids “light up when they fall in love with reading or a good book.” She brought the same passion for reading into her science classroom. “I strongly believe reading is the basis of everything.” Aware that many of her students struggle with reading, she said she prepares her science lessons with that in mind. “I have seen a difference in the way they interpret what they are learning in science after I’ve taught a lesson that’s heavy in literacy skills. Our discussion is just so much richer.” She explained that the students use the vocabulary words more confidently and frequently, and they have a stronger ability to infer and extrapolate information from the book. She worked hard to make her textbook content accessible and meaningful to her students. She did not want their reading struggles to get in the way of their science learning.

Overall, Miss Marie saw herself as a passionate reader who loves to learn new things, and she wanted that to come through in her teaching style. She characterized herself as a reading
teacher first, simply because it is a love of hers that she wants to pass along to her students. She explained, “I want my kids to be able to appreciate the power of reading and reading for understanding and the knowledge that you can gain from that.” She believes that a teacher who loves learning and makes it obvious will pass that quality on to her students.

Inside Miss Marie’s Classroom

The way Miss Marie’s sixth grade science classroom was physically arranged and decorated spoke volumes for the emphasis she places on literacy skills. From word walls, to a display of recently completed science projects, to the arrangement of student desks, Miss Marie wanted her classroom to send the message that learning science is exciting. Each wall of her classroom was decorated with motivational sayings about doing well in school, facts about science, and quotes from well-known scientists. She said, “I leave these quotes up all year long, and I refer to them as they apply in various lessons. That’s kind of my thing.” After looking up at the array of quotes for a few seconds, she laughed as she said, “I’m the one with the quotes all over the classroom.”

The main word wall display was located on the inside wall of her classroom, and it occupied an entire blackboard surface area. A new word was added to the wall each week, and students were expected to write something about the weekly word in their vocabulary folders as class began each day. Miss Marie said her students were accustomed to this routine, and this procedure was how each class period started. The words were printed in black ink on neon colors that corresponded with different units of study in her science curriculum. She commented, “I don’t use chalk on that board anyway. It’s my word wall that we build onto all year long. I like the way the neon word cards look on the black chalkboard background.”

At first glance, Miss Marie’s sixth grade classroom did not resemble a traditional science classroom. Students sat at individual desks, not at stools in front of black lab tables. She noted,
If we are doing a real lab, I take them down the hall to room 122. It’s a typical science lab with the faucets and gas valves at the lab stations, the big black work tables, and no carpet for safety reasons.

The student desks in Miss Marie’s room were arranged in two concentric horseshoe shapes that opened up to the front of the room. “I want them to interact with each other, so I put the desks like this so they can see each other and learn together during this unit.” Her desk arrangement changed frequently for the type of instruction or student groupings that she utilized during lessons. She explained that during standardized testing periods, her student desks were aligned in unconnected rows.

Joining Miss Marie’s room to the other sixth grade science teacher’s classroom was a lab prep and supply room. Her classroom had one regular window and one bay window that she called her “little greenhouse.” She explained that the bay windows were only installed in the rooms designated for science instruction, yet not in the official laboratory science rooms. Student-created picture books were drying in the sunlight on shelves inside the bay window. Adjacent to her teacher desk positioned in the front corner of the room near the greenhouse window, she had a science lab table borrowed from another classroom. “This table is higher, and the students can see when I do a demonstration.” Miss Marie says she used student work to decorate her room. “I feel like that’s important to them. I know it might seem a little elementary, but they need that comfort zone in middle school. They’re new here.” On the back wall, above the countertop and below the upper cabinets, she had posted a small drawing from each student. The drawings stayed up all year, and she referred to them when a lesson related to one of the drawings. Large letters in the center of the drawings spelled out the words What is Science? “See those pictures on that wall? They did that on day one. When they walked in, they had to draw something, anything that related to science.” Miss Marie explained that over
the course of the school year, every drawing on that wall related to something they were learning, and she let them know that. Another wall featured foldable arthropods. She noted that the students took them seriously, and they could not look cartoonish.

In Miss Marie’s 12 years of teaching middle school science, she had acquired a great number of resources that she used to supplement her teaching. Miss Marie explained,

You can tell by looking around that I’m a collector of odds and ends. My closets are busting at the seams, and I can reuse just about anything and put that into one of my science lessons. I collect bubble wrap for these book projects, newspapers, fabric, buttons, ribbons, glue guns, sequins, cardboard, you name it. It all comes in handy at some point when I need a visual to explain a lesson concept or the students are constructing something.

The back wall of Miss Marie’s classroom was lined with a section of floor-to-ceiling cabinets with a section in the middle left open for countertop surface. Her cabinets were full of supplies and resources she used for different units to keep science interesting for her students.

Anytime I find a book, whether it’s a picture book or a reference book that relates to anything I teach, I grab it and bring it to my classroom. I keep all my books and artifacts somewhat organized by unit topics in plastic tubs in those closets on the back wall.

Inside Miss Marie’s sixth grade science classroom, visitors notice her emphasis on making learning inviting and creative. From her displays of student work, to science information covering the walls, to motivational quotes posted near the ceiling on all four walls, Miss Marie hoped her students were getting the message. Miss Marie believed strongly in using every bit of physical space in her classroom to motivate students to want to read, learn, and discover science.
Students’ Reading Difficulties

Miss Marie had concerns for the reading difficulties her students face, especially in her content area. She said her students were not as comfortable with non-fiction, and they struggled to comprehend the concepts presented in their science books. She attributed this struggle to a lack of time spent on science instruction in elementary school. She explained,

Our school board made a decision at the beginning of this year to eliminate separate science and social studies time from the school day in the elementary schools. In years prior, it was just suggested that those subject area time blocks be curtailed. The ruling at the summer board meeting made it official. The only time they [the elementary teachers] are using the science/social studies textbooks is if it’s part of their reading time. They’re supposed to be spending the bulk of their instructional time on math and reading to get our scores up. I think it’s kind of sad, really. Kids don’t want to just read about science. So when they come to me, they are missing that background knowledge and the experience of reading higher levels of non-fiction, not to mention the labs and science inquiry experiences they’ve missed out on.”

Miss Marie explained that she had students who knew very little about basic science concepts. She felt obligated to add much to the textbook content so her students were not intimidated by the concepts and the higher level of reading in the textbook. She explained that when they had not had much experience reading this kind of non-fiction, it could be quite intimidating when they came to middle school and had daily science instruction.

She had this to say about the lack of science exposure in elementary school: “When students come to sixth grade, they are already in the hole in the sciences. This is the first time they’ve had science instruction for 50 minutes a day. It is daunting material anyway.” She
lamented that it was equal to learning a new language for her students, and if a teacher breezed right through the material, it was unfair to the kids.

Students in Miss Marie’s classroom were completing their picture book projects, and she reminded them that they could learn more from what they could teach others. Miss Marie explained that the picture book project required students to select a science concept in their current unit on conservation and tell a story that explained the key facts in easier terms using pictures and simplified narrative text. The books could be written in fiction or non-fiction, but the scientific concepts had to remain unaltered. Upon completion, students shared their books with their classmates, and the books were displayed in the school library.

She encouraged her students to consider their audience as they wrote their texts, because the conservation and ecology concepts had to be showcased at an age-appropriate level their readers could understand. If the book was written for pre-school children, the text size and difficulty had to match their abilities. The same went for primary and intermediate-level elementary audiences. Miss Marie had published books on display on her chalk ledges for each of these levels, so her students could gear their texts accordingly.

She explained to me that this hands-on science activity helped bridge the gap between merely reading about science and discovering science. Miss Marie shared with her students her plans to send these picture books to the elementary school for their target audiences to enjoy for a short period of time. She explained that her students were excited to share their books with younger students, and that kept them focused on producing quality books. She also explained that this topic of conservation was important to them, and this project revealed that. If they missed out on this kind of science project experience in elementary school, they were quickly making up for lost time in sixth grade.
In Miss Marie’s classroom, vocabulary seemed to be a major reason the textbook reading was so challenging for her students. “Most of our textbooks are written above the reading level of our students. I haven’t done the check on this one, but every other one we’ve looked at, the readability level is above what our students can handle.” She noted that her sixth graders just did not have much experience doing science, so the material in the textbook could easily intimidate them.

“Some students are naturally drawn to certain areas in science, like physics, earth science, or whatever,” noted Miss Marie. “I know they lack the background knowledge for a lot of the textbook material. The more difficult chapters for them are the ones with the new concepts, stuff they’ve never really experienced before.” She let the students know this too, even when the chapters were challenging for her.

So that’s when I tell them I’ve had a bazillion science classes, and I feel like I need to read through this section a couple of times. That’s an important strategy to use with them. They need to hear that from me.

Because she knew which textbook sections were most challenging, Miss Marie planned ahead. Observers can see the countless materials and supplies she collects that help her students grasp the more challenging concepts. She used them to supplement specific lessons throughout the year. These items, such as leveled readers, maps, diagrams, 3-D objects, models, video clips, and related artifacts, were strategically placed on shelves, board ledges, and tabletops throughout her room to entice students to learn more about the concepts. These learning resources go back in the closet to make room for new ones when the unit is concluded.

**Resources and Instructional Strategies**

Knowing her students’ difficulties in comprehending the science material presented in the textbook, Miss Marie employed several strategies to improve their comprehension. She used the
discussion strategy as a way to lessen her students’ apprehension about the science content. “I’m not afraid to tell them that there are parts of some chapters in their book that are hard for me to understand. I tell them not to worry if they don’t get it the first time.” She added that if the textbook is the main source of reading for a given unit, she will read it with her students and discuss it with them.

A lot of times, there may be several paragraphs in a row that are just written in such a confusing manner, that I’ll read it to them and then tell ‘em “Okay, this is what all that means.” They love that. You can see the light bulbs turning on.

Miss Marie recognized that her students come to her at all different reading levels, especially in her inclusion class.

When I have a kid reading at second grade level, discussion is the best way I can differentiate for them. If I don’t, some chapters might sound like a Dr. Seuss book to them. It will just look and read like nonsense to them, and they’ll give up. I can’t have that.

Retelling is a discussion strategy Miss Marie utilized once students had read sections in the book. “If they can explain it to me, I know they’re getting it. It’s good for them to summarize or give me an example of the concept in real-life terms.”

Miss Marie’s science class buzzed with conversation about the content as she roamed the room monitoring the student-led chats. Observers can see that she was not the conductor of the discussions. There was a more student-centered approach present during this lesson, since students were working in groups to complete their picture books. If conversation strayed from science content, Miss Marie redirected the group toward discussion of the project itself.

Miss Marie started every science class with vocabulary instruction. She said it was a routine they adapted to quickly.
This is my bell-ringer activity. The vocabulary word is what they work on at the beginning of the period. They have vocabulary notebooks to record this stuff in. I encourage students to use that word in our discussion that day.

The word wall in her classroom took up an entire chalkboard. The words changed weekly. The posted words represented what had been covered so far during the semester, and on the right side of a blue tape line that divided the board, the words for the current unit were posted. These words appear on the test, and she expects her students to use them when they talk science in her classroom.

Miss Marie used handouts to help her students summarize, outline, and understand the key concepts in each chapter. She distributed an outline on animal populations. On each level of the outline, terms were defined and underlined. The outline ended with a discussion question that asked the students to explain a biosphere and describe what is included in it. She also gave students a paired reading that accompanied the chapter content. Miss Marie found this short narrative in a related book and thought it would help her students comprehend what they were learning in the textbook. The reading passage was about space animals (the animals scientists have taken into space with them for experimental purposes). After reading the passage, students were instructed to answer five multiple choice questions about what they read. The questions ranged from simple facts recall, to a vocabulary analogy, to selecting the author’s purpose for writing the passage. Even though her students were working on their picture book projects, she wanted them to complete the related worksheets in the meantime. Early finishers worked on these lessons, or they could complete them at home. Either way, Miss Marie used these handouts to assess their learning for the concepts they represented. She explained, “These picture books take a long time to design, but my students know they are responsible for related work in the meantime also. It’s all about task management.”
In Miss Marie’s inclusive classroom, the co-teacher was a shared brain instead of an extra set of hands.

I try to use all the same teaching strategies and resources for the inclusion class that I use in my regular [sic] science classes. When I realize some stuff is going over their head, I make the differentiation then and expose them to the same content in a slightly different way. I try not to dumb-down the way I talk to them, although that’s an easy thing to do.

She still used words they saw in the lessons like identify and interpret. She also found herself encouraging even more participation in her inclusion class than in her general classes. “They can get their hands up if I’m saying something they don’t understand. I need to hear what they are thinking all the time.” The types of assessments she used with the students were modified as well. She incorporated most of her differentiated teaching strategies when she was working on project-based learning.

Technology had a huge presence in this middle school. For this unit, Miss Marie used the portable laptop cart. Students signed the laptops out if they needed to research facts for their picture books or print text for their stories. Miss Marie explained the technology resources available in this building.

Every teacher has an interactive whiteboard, and every textbook has an online version that our students can access at home or at school. Assignments can be submitted online, and diagnostic skills can be catered to any learning needs through online tutorials for individual students. Online assessments are also available once the teacher has created them through the subject area’s test taker module. Rolling technology carts have a classroom set of wireless laptops, making it easy for our students to word-process, do research, and print projects remotely. Next year, the entire high school student body will
be issued iPads, and plans are in the works for the middle school to receive the same technology.

Miss Marie felt lucky to teach in a building with such advanced technology, yet she admitted that she did not rely on it too heavily. “The technology is great, but I still want my students to hold the book in their hands, carry it with them, and know how to find information without using technology every time.” Commenting on the digital divide that still existed for many of her students, she said,

I know that not all my students have access to technology at home, but they all have hard copies of their textbooks. If they need or want to go to the public library to access their online textbooks, that’s great. But I don’t expect that.

Along with the textbook each student was assigned in science, there was also a student workbook. Miss Marie noted that it was often helpful to use one or two of the workbook pages before reading in the textbook so students had a chance to think on paper about what they were about to learn. When she scored these workbook pages, she also determined how much her students comprehended about the concepts. She used that, along with their daily science discussions, to guide the rest of her teaching strategies. She explained,

There are workbook pages for them to make predications and record initial observations, and then we revisit those after reading in the textbook. At that point, the students are ready to make corrections to their original ways of thinking. It’s kind of an important reflection activity to do.

Miss Marie also relied on handouts, chapter notes, and concept booklets related to the chapters to help her students process what they were reading and learning in science.
I have a whole cabinet full of stuff I pull out for whatever unit we are studying. Those resources really help the kids, because they each present the information in slightly different ways. You just never know what’s going to stick.

Miss Marie supported this by saying that skills sheets can do more than prompt students to supply basic recall information. Vocabulary comprehension was the most common skill reviewed and practiced on the workbook pages or related handouts from a simple chapter outline to the unit test. These skills sheets also taught her students how to take organized notes. Miss Marie explained that outlining extrapolates the important information in the chapter and helped students formulate a schematic structure for comprehending the material.

There were also helpful comprehension aids embedded in the chapter sections of the textbook. Miss Marie enjoyed using the real-life connection pages embedded in each chapter. She utilized these additional stories as mini-narratives to show the students how science directly related to their immediate surroundings.

It will be kind of a supplementary thing right there in the chapter that applies to the world today. It’s generally a two-page spread about an oil spill that took place somewhere if we’re studying conservation. These are current events with pictures, and that really adds the details and the authenticity that are missing in the dry passages.

**Professional Development in Content Area Literacy**

Miss Marie believed reading was the basis of all learning. She commented about the importance of professional development in content area literacy for all teachers. “If a child cannot read or struggles with reading, then you’re not going to be able to get through a science textbook with them, that’s for sure.” When asked about the general consensus in her building about literacy training in the content areas, she praised middle school teachers for being receptive to that type of training.
If anyone above elementary level is going to view all teachers as teachers of reading, it’s going to be the middle school teachers. High school teachers assume students should have mastered the reading skills needed for their high school textbooks by now. They’re also looking toward careers and college readiness.

Miss Marie did not remember a time when she did not love reading. That fondness and appreciation drove her to take as many literacy classes as possible throughout her undergraduate and graduate coursework.

The greatest way I’ve improved as a reading teacher is to read with my students. I know that’s more personal development than professional development, but I do believe professional development has to be personal or the buy-in will not work.

She credited the enhancement class she taught each day as a major opportunity for sharing her love of reading with her students. Each teacher in the building taught an enhancement class that focused on reading skills with the students. Students were grouped according to their reading needs.

During this enhancement class time, we each have a group of kids we just read with. I get to read novels with them, and it might just be my favorite part of the day. It has to be for the kids too, because they don’t have to worry about routine testing over what they’re reading in this class.

When asked to comment on the type of professional development opportunities she had recently received as ongoing support for content area literacy, she lamented that she did not see much of that type of professional development. She did say she would embrace it if given the opportunity for more literacy training.

I know things are changing with the way we are supposed to approach instruction. I really hope it leans more toward the content area literacy stuff than the teach-to-the-test
business. I think the new Common Core Standards require literacy instruction in all content areas, and that’s great. Our students need to improve their language and reading skills in all subjects. I am not going to overlook the things that really matter.

Although Miss Marie certainly took charge of her own professional renewal and development, she added that a school-wide professional development opportunity focused on science literacy and literacy in other content areas would be beneficial.

I think it’s a unique time to be a teacher. There are pressures from all over. For full buy-in, it would have to be handled very delicately. Instead of treating it like this is one more thing we have to do, there has to be a way to present it to teachers so they understand it’s what we’re already doing. We just need to get better at it and talk about literacy in every class more with our students.

Miss Marie admitted that many science and math teachers found content area literacy training a little uncomfortable at first. “The people who teach these subjects are very skills focused and driven to cover their content. They think in technical terms, and they’re very protective of their subject matter.” She suggested that if presented in a non-threatening way, the teacher buy-in would be greater.

In Miss Marie’s classroom, her confidence in employing literacy skills instruction was obvious. Time, however, is not on her side.

I’m getting kids who are starving for science yet overwhelmed by it at the same time. They haven’t had much of it in elementary school. As a sixth grade teacher, I’ve got a lot of ground to make up for, I’ve got my own standards to meet, and I’ve got to take time for differentiated instruction. The secret to fixing all that is more time. I need more time with them.
She confessed to the amount of after-school time she spent on improving her techniques. She spent time in and out of school on her professional development interests. She knew that she and many teachers in her building feel pressed for time to cover all the material in their textbooks and curricula, let alone design more literacy-based ways to deliver that instruction. “I am just so crunched for time. We all are.”

She attributed this lack of time to changes that had happened systemically from the state department all the way down to her building level.

Even up to like two or three years ago, I felt like I had a great deal of freedom to teach in different ways. Now I do feel pressured to get more covered, and I feel pressured to stick pretty close to the adopted textbook. I don’t honestly feel like I’m doing as good a job teaching as I have in years prior. I don’t know. Maybe I am. I just wish I had the freedom to spend more time on the projects like they’re working on now. That’s the stuff they remember.

**Meeting Mr. Ball**

Mr. Ball was in his first year of teaching in this middle school. Prior to this school year, he taught high school math for one year in a nearby school corporation. Having taught for only two years, he admitted he was still finding his comfort zone with the curriculum and the younger age group. Living one county away, Mr. Ball drove about 40 minutes to work each day. He used the drive time on the way to school to mentally prepare for the day and the drive time on his way home to reflect. He credited his training at the local university for teaching him to become a reflective practitioner. His extended drive time afforded him that opportunity, and he conceded that most new teachers were too busy “finding their way” in their new profession to reflect on their practice.
Mr. Ball taught sixth grade general, inclusive, and high-ability math and science classes. He was currently finishing an internship for his administrator’s license, and he spent his planning time each day apprenticing with the building principal. For part of his internship requirements, he attended many after-school sporting and academic events to monitor student conduct. He confessed that his visibility among the students during and after school hours had helped him become connected with the students, their families, and the community this school corporation served. He felt accepted and respected in this community.

During my first meeting with Mr. Ball, he revealed that he did not feel confident that he would be a good participant for a study focused on content area reading skills. Although he qualified as an effective teacher according to the operational definition used in this study, he admitted that he did not feel like a teacher who uses a lot of literacy strategies in his science lessons. Mr. Ball agreed to continue as a participant in this study. As it turned out, he was largely unaware of the many literacy strategies he employs in his daily science lessons.

**Inside Mr. Ball’s Classroom**

Mr. Ball strategically aligned his student desks in pairs at an angle in order for the students to have equal vantage points of the interactive whiteboard and the traditional whiteboard. He pointed out that in order to eliminate dust particles that could damage the technology installed in the classrooms, the whiteboards recently replaced the traditional chalkboards. Dry-erase markers were used on the whiteboards. If there were blackboards still mounted in this school, they were either used as bulletin boards or for their magnetic surfaces to display announcements or student work. Floor-to-ceiling cabinets aligned the back wall with partial countertop areas that were used to display student projects and Mr. Ball’s instructional resources. As a second-year teacher, Mr. Ball had not amassed a great deal of teacher clutter. He was also extremely careful about the look of unorganized stacks of books and papers, so there
was no such disorder anywhere in this crisp and tidy classroom. His walls were mostly bare except for an emergency protocol procedures chart, classroom rules, and two posters: the scientific method and math conversions.

The exterior wall had two windows: one was the greenhouse window and the other was a regular classroom window. In the space between the windows, Mr. Ball used a 9' x 4' cork bulletin board to post file folder pockets used to hold make-up work for absent students, extra copies of the handouts, and extra graph paper used in his science and math classes. Since his room had carpet and no real space for science labs, he was able to sign-out the room down the hall that had the necessary fixtures needed for most labs and met state safety guidelines for conducting science experiments.

Near his desk, he displayed a framed picture of himself on his middle school track team in seventh grade, along with one of his middle school report cards. He said he shared these with his students when he introduced himself on the first day of school. Two file cabinets were situated behind his desk, and he controlled the interactive whiteboard from the laptop on his desk. Behind his desk was the door to his science prep and supply room, and that room connected to Miss Marie’s classroom.

**Students’ Reading Difficulties**

As a sixth grade teacher, Mr. Ball said he works hard to make the textbook content accessible for his students. He believed his students struggle with the amount of reading they encounter as new middle school students. He searches for ways to make their reading tasks less of a chore. He stated,

> In my science classes, I really do think that’s half the battle [reading]. We have to take time to read this textbook together a little bit each day, since they’re not teaching science in elementary except for occasional 20-minute blocks. It isn’t consistent.
Mr. Ball elaborated on an example of his students’ limited background experiences in science stemming from decreased time spent on science instruction in the elementary years.

Chapter 4 in our sixth grade textbook is all about the planets, and believe it or not, some of my students didn’t know anything existed outside Earth. They don’t know about the universe like they used to. They aren’t making models of the planets and their orbital paths in elementary school like they once did. It isn’t the teachers’ fault. They’re doing what they’re told, and there just isn’t enough time.

Mr. Ball’s students had recently completed biome and habitat presentation boards. Creating these three-dimensional displays gave his students a chance to get comfortable with the science content in an individualized, project-based learning manner. He kept these presentation boards on display in his science classroom to increase the word-rich environment for that unit of study.

Mr. Ball commented on how frustrating it is for his sixth grade students to read aloud in class. “Listening to them read aloud, it makes sense to me why they can’t understand it [the textbook passages]. They do not read aloud like they know what a sentence is. Everything sounds like a run-on sentence.” He noted that this could be attributed to read-aloud anxiety, since they were reading aloud in front of their peers. Still, Mr. Ball said that even the volunteer readers in his class did not read with much fluency and ease.

When asked to comment on whether his science or math content created more of a reading challenge for his students, he did not hesitate to say science.

In math one day, we might just work with angles on the board, no reading in that. In science, we are reading every day. It isn’t always from the textbook; it could be from a scientific report or from an article on a scientific breakthrough, but we’re constantly reading and that kind of reading is very technical.
Vocabulary terms also created a definite challenge for Mr. Ball’s sixth grade science students. “There’s no way they could figure some of this content out on their own: ecological succession, climax community, eutrophication. I had a girl last week ask me what the word determine meant in a test question.”

He noted that sometimes the sidebar information on a textbook page was helpful, like the word origins, pronunciation guides, etc., but the diacritical marks in the pronunciation key were even new to many of his students. “When my students look at one of these new words, it scares the heck out of ‘em, and they just shut down,” Mr. Ball added.

Mr. Ball observed that his students had other reading struggles too, aside from reading passages in the textbook. “They have to read diagrams, graphs, maps, and charts too. They don’t just struggle with reading the paragraphs in their science book. They have to do other types of reading too; it’s challenging. It’s new to them.”

**Resources and Instructional Strategies**

In Mr. Ball’s classes, he spent a lot of time talking with his students about science, listening to their theories, redirecting their misinformation, and guiding them to discover new ideas.

We talk about what we learned the day before, so I know they are ready to learn today’s lesson. This is a time when they ask the best questions. They’ve had time to process yesterday’s content, and now they have real ideas and wonderings. They need time to talk. I have to make time for that, because that’s how I determine what they’re grasping.

He noted that according to the ability level of the class, the discussion might go deeper or remain more at a surface, recall level.
The physical arrangement of Mr. Ball’s desks demonstrated his value for science talk. His student desks were arranged in couplets. He said this enabled his students to share what they were thinking, and he could easily partner them up for specific tasks. “I think if I arranged the desk in quads, they’d get too talkative and that would be distracting. In pairs, they can help keep each other on track.” Mr. Ball used the desk arrangement as an instructional strategy, and he assigned seats according to their ability. He changed their seats frequently, so they were always working with someone new.

Discussion played a pivotal role in Mr. Ball’s instructional strategy as well. Discussion in Mr. Ball’s classroom occurred in many ways: teacher-led, student-led, small groups, pairs, or even as a competitive game. Students were eager for him to begin the basketball review game in which they answered questions aloud and got to shoot a paper wad into the trash basket to score points for their teams. Students spent the greater part of the class period engaged in discussion-style test review under the guise of a game. Mr. Ball boasted that the students did not really consider this learning. “They think this is a free day. We’re shooting paper wads into the trash can. Who does that?”

In Mr. Ball’s science classes, he spent a lot of time on vocabulary instruction to help his students comprehend the textbook reading. He knew he must work time into the pre-reading stages of a unit for his sixth graders to learn the new vocabulary embedded in a chapter. “It helps them if they’re familiar with it before they read it. So, I pull out the words, and we take ‘em apart to try to figure out what they mean.” He encouraged his students to take the words apart to find smaller words that they did know. “We look at the word in context, then we break the word down to look for word parts that we already know.” Mr. Ball knew this word attack skill was one that could help his students in all subject areas.
Using the dictionary to define new vocabulary was a last resort for Mr. Ball’s students. He did not think it helped them much to simply look the word up in the dictionary. “I want them to see if they can figure it out the way it’s used in the sentence first. The dictionary won’t help them at all if they can’t figure out how it’s being used in context.” Spoken like a language teacher, Mr. Ball did not want words to intimidate his students.

His students saw the vocabulary words again and again throughout the unit. He posted the words on the whiteboard, and the students saw them in bold print in the textbook reading. “If the students are using the online textbook, they can click on the word and hear it read to them and get all sorts of examples, synonyms, pictures, etc. to help them learn that word.”

Mr. Ball gave his students a teacher-made test review outline of a chapter in the textbook and a practice lesson on biomes and ecosystems from the textbook materials binder. Both documents dedicated considerable space for the vocabulary terms students should know for the test. The teacher-made review sheet has 15 content-specific vocabulary terms. The review questions at the bottom used those same vocabulary terms, so students must understand what the vocabulary means in context. The practice lesson from the workbook asked students to use the nine terms listed at the top to fill in the sentences below to complete the statement. The second section on the workbook practice lesson was short answer. Students were asked to respond to each question in paragraph form. Several of the vocabulary terms listed at the top of the page were used in the short answer questions.

Mr. Ball talked his students through each part of the outline and accompanying comprehension sheets. They asked questions or volunteered answers for the sections he wanted them to do right away. After completing some of the answers together, he felt his students would be able to finish the assignment on their own. “It makes a big difference if I do one or
two of the problems with them in each section. It relieves their anxiety, and they know they can’t tell me they didn’t understand what to do.”

When asked how he presented the textbook material differently to different classes, according to ability, Mr. Ball said it was an issue requiring more time and discussion. He explained that he must spend more time on the challenging, less-familiar units with the students in his inclusive classroom, and they discuss most of it together before doing any work in pairs or independently. He explained,

With my lower ability class, I might have to spend a whole class period going over things slowly, like what this word means and a real-life example of that science concept, etc. But the next hour is my high ability class. We can read it, discuss it, and they’re fine with it.

He explained how he differentiated within the class as well.

Some students work better on their own, while others are more productive in pairs. Then, I include some type of choice menu with bigger projects, so students can pick what fits their interests the best. Of course, the students with identified learning needs get more verbal explanation from me, more time to complete work, and an adapted grading scale. But that’s the behind-the-scenes stuff. You can’t observe that as an outsider, and that’s good.

Mr. Ball utilized his paired student desks to place a stronger student with a weaker student by design. The strong students and weak students changed from unit to unit. He had some students who were naturally drawn to some aspects of the science content, making that particular concept easier for them to learn. “So, my strong students aren’t necessarily strong in everything, and likewise for the weak ones. We’re changing seats a lot.”
Mr. Ball had harnessed technology as a viable instructional resource to supplement the textbook in his classroom. Since the textbook pages could be projected onto the interactive whiteboard via the online textbook adoption package, the students could view the textbook page in real time as they were reading along. Mr. Ball highlighted and clicked on text features that might be challenging for students in order to take advantage of further materials that could explain the concepts. His students could do this at home too, if they had Internet access. If not, they could visit the public library or the school’s lab before or after school hours.

Mr. Ball explained that the technology package available for the teacher’s edition of the science textbook allowed him to show his students worksheet links and virtual labs. During class, he demonstrated what he called “a cool feature” where the students could spin a planet. He addressed the class, “You can slow down a planet by doing this, and you’ll see how much gravity you can push into that, along with changes in the pressures and gasses.” After this demonstration, he directed his students to read the accompanying section in the textbook. With their interests piqued, his students appeared eager to move to the next task. The chatter in the room during the transition between the virtual lab demonstration and the textbook chapter was content related, peppered with what if statements from a few students and their hypotheses in response to those statements. Recognizing the importance of this student-led inquiry, Mr. Ball allowed the chatter to continue for awhile, commenting on questions posed to him by various students.

In order to incorporate real-world connections to his physics unit on energy and power, Mr. Ball showed the students a virtual lab that was linked to his teaching manual for the science textbook.
We learned about kinetic and potential energy by watching this skate park video. My students had no idea they were learning information we were getting ready to read about in the textbook. They just thought they were learning facts about a skate park.

Mr. Ball commented that this strategy really helped embed background knowledge before they read a challenging section in the book. As they read, he mentioned segments from that skate park video to remind students that they had seen these science principles in full effect. This way, everyone in the class could pull from that prior knowledge that they would not have had without that technology feature to complement the content.

Mr. Ball demonstrated the value of text features in the online version of his classroom textbook. Students had access to this feature by logging in and clicking on any areas that they needed explained further. In the hard copy of the textbook, a new concept might be bolded or highlighted with additional information in the form of tables, pictures, or maps within the pages of the chapter. New terms were often defined in parentheses, at the bottom of the page, or alongside the paragraphs. The online version had the ability to take the vocabulary assistance one step further by pronouncing the word aloud for the students. Mr. Ball admitted that this could be an especially helpful form of differentiation for students who already struggled with grade-level reading. Headphones used in the computer lab or in tandem with the travelling laptop cart allowed students to work through the reading at their own pace as they took advantage of the many text features that complemented comprehension of content.

A hallmark of Mr. Ball’s instruction was ability to use technology in the classroom. He noted that the school’s technology liaison offered monthly in-service tutorials to help teachers become accustomed to the new technologies in their building. Technology had always been a passion of his. While he incorporated technology into his lessons more than most teachers in the
building, he said he used that to his advantage as an apprenticing administrator to help his colleagues with their technology needs.

When asked if the infusion of literacy skills instruction in his science lessons made it easier to teach science or more burdensome, he said he considers literacy to be a natural bridge between what students needed to know and how they came to know it. “If they are learning how to read the science book more critically, and if we are discussing what we are thinking as we read it, their ability to decode the challenging information is much easier.” He believed the disciplines were a likely match that could help strengthen one another.

**Professional Development in Content Area Literacy**

Mr. Ball said he did not see how teaching reading in any content area could be avoided if student comprehension was the goal, yet he did not believe that all science teachers would agree with him.

I believe reading comprehension is half the battle, so it’s my job to make sure they [his students] understand what they’re reading. Am I doing it right? Maybe not. But as a new teacher, I’m willing to keep trying to help improve reading skills in science.

Mr. Ball said this topic had already been addressed in his weekly professional development talks during grade level meetings. He and his team of teachers sat down together on Wednesdays to discuss how their curriculum map aligned with what they needed to be teaching.

We’re making changes to bridge the first map we made that meets Indiana Academic Standards and the new one that will meet Common Core Standards. They’re pretty similar, but we have to add in the greater focus on technology, literacy, along with career and college readiness.
When asked what type of professional development was needed in his content area at this time to address students’ struggles with content area reading skills, he suggested that the language arts teachers in the building could share literacy strategies with other teachers.

I know that as science teachers, we really need to spend time just focusing on the reading challenges in our subject area. Maybe we all need to discuss what we already do to address our students’ reading difficulties, and we could hear suggestions from the language arts teachers. We do need more time to talk together on the topic of reading skills improvement outside of reading classes.

Mr. Ball was confident that there is a lot that can be learned from the teachers in his building, if given the time to work together as a faculty to that resolve.

Reflecting on his college courses that contributed to content area literacy training, he remembered receiving more literacy skills training in his math classes. “We spent a lot of time in our math courses discussing the different ways students read a math problem, not just story problems, but number problems.” When asked to give an example, he used a math problem written on his whiteboard to explain.

On that board, I have written the question, *What is 20% of 80?* The kids have to answer that when they come into class as their bell work. Okay, so I have to teach them that the word of means to multiply.

Mr. Ball made several references to time being the main roadblock to the presence of literacy strategies in conjunction with textbook material in content area classes.

You have to cover so much content, and you have to be on a strict schedule to get it all covered. You want to make sure they understand what they’re reading, though, or it doesn’t matter how much you cover.
Even though he saw the way literacy strategies helped his students, he admitted that he, too, felt pressured to move on for the sake of time. He also said he did not have much available plan time to learn new strategies.

I know there is more I could do, and I’m only in my second year of teaching. I’m still in that deer-in-the-headlights stage. I know I need to keep the same pace as the other science teacher, so yeah, time. It’s the time issue.

**Meeting Miss Everdeen**

Miss Everdeen was enjoying her 24th year of teaching, and all 24 years had been spent teaching sixth and eighth grade science in this school corporation. Her current assignment was eighth grade general, inclusive, and high ability science. The current eighth grade class was the largest they had seen in several years, and her class sizes ranged from 30-37 students.

Miss Everdeen lived in this community, and her adult children had attended this school. When she started teaching, she taught sixth grade in the old building located in the downtown area. She moved to this building when it opened 17 years ago. At that time, she began teaching eighth grade. She remembered the architecture and nostalgia of the old brick middle school building fondly, but she liked the layout, greater campus space, and proximity to the high school the new building provides. Although she had been offered teaching positions at the high school and in neighboring districts, she enjoyed teaching the middle school students in this district and wanted to stay here. “It’s a neat age. There is always something new with these kids. This job doesn’t get old. These are good kids. They aren’t all trouble-free, but they’ll work hard for you if you get to know them.”

With a background in elementary education, Miss Everdeen said she had always considered herself a reading teacher first.
I’ve just always been one to check their reading comprehension as we’re going through the chapter, and I have always expected them to write their answers in complete sentence format and pick out the main idea of a paragraph. I think if they can do that, they understand the material.

Miss Everdeen explained that she felt like a reading teacher almost as much as she felt like a science teacher. “In completing my Master’s degree, I took classes especially for that. I saw what science instruction was becoming. Students need literacy skills training in all classes, since the books in all classes are different.” When asked to elaborate on what she meant by “what science instruction was becoming,” she explained that she noticed a long time ago that students were struggling with comprehending science content, and all teachers needed to share in the responsibility for teaching students to understand what they were reading.

**Inside Miss Everdeen’s Classroom**

Miss Everdeen’s classroom resembled a traditional science classroom. It had the tile flooring, the traditional black science tables where students sat for instruction, and the lab stations equipped with the gas valves and water sinks. The lab stations were located along two walls of her classroom, the back and the inside wall. For overflow purposes with larger classes, about six students were seated on taller stools at these lab stations. During testing times, she spread the students out among the science tables and the five lab stations.

The walls in Miss Everdeen’s eighth grade science classroom were colorfully decorated with student work and motivational posters. Miss Everdeen mentioned how much the students take pride in seeing their work posted in the room. She explained that even the kids in the eighth grade love to have their work put up. If they got an A on a test, she wrote their names on paper stars that got mounted on the ceiling tiles.
She even utilized her wall space to remedy the chronic problem of students not turning their work in on time. If they had 10 consecutive assignments turned in, she put their name on a light bulb. She chuckled as she said, “I tell ‘em that’s because they’re bright!” The light bulbs are taped on the cabinet doors that line the back of the classroom. “Stars and light bulbs are all over the place in this room celebrating student success. They are excited about that.”

Buckets decorated with camouflage tape were lined up on one of the countertops near the plastic baskets used for turning in assignments. Miss Everdeen used these as incentives too. Students who earned light bulbs also got to put their names in the bucket. “I just have a box of cheap stuff I collect. They just think it’s great that they get to pick a prize. I’m just trying to get them to do their assignments.”

Miss Everdeen’s student desks were arranged in clusters of five to six desks each. “I keep them [the desks] like this because it’s helpful when we do activities. If we do a lab that requires even more space, we can go to the large science lab down the hall.” With class sizes of anywhere from 30-37 students, the clustered desk formations helped maximize the space in her room.

One bulletin board in her room served to announce school events and reminders. Another was the weekly assignment board where she outlined the lessons that were covered for the week, along with student learning objectives. There was not a bay window in this science classroom, like in the two sixth grade science classrooms. The bulletin board space in between the two classroom windows was for student work and photographs. “This is the end of their middle school time, so they like to see pictures of themselves on this board from different school events. Many of these pictures are also on our school website.” Motivational posters and charts about science concepts and phenomena fill most of the remaining wall space. Miss Everdeen’s
classroom was colorful, and the décor in the room suggested positive thoughts about learning science.

The amount and variety of reading material on display in Miss Everdeen’s classroom made it seem like somewhat of a science library. Her students enjoyed access to all of it. Books of all sorts lined bookshelves on two sides of the classroom. She explained that some of the books were from the textbook adoption materials, like workbooks and resource guides. Dictionaries and science reference books were stacked neatly providing easy access for student use. Other books and magazines were from her personal collection of science-related content that she had collected throughout her nearly two and a half decades of teaching science.

Miss Everdeen’s desk was positioned in the back corner of the room, along with a desk for her co-teacher who assisted during the inclusive class period. Miss Everdeen taught primarily from the front of the room, seated at a large science lab desk with the traditional black surface. If she needed to use the interactive whiteboard for a lesson, she had her class meet in the larger science lab at the end of the eighth grade hall. “I am one of the few teachers who kept a blackboard in her room. I prefer using a chalkboard over the dry-erase whiteboard. So, since I don’t have that technology in here, I get to keep my chalkboard, for now.”

**Students’ Reading Difficulties**

When asked to explain her students’ reading difficulties in science, she began by expressing sympathy for the burden placed on sixth grade science teachers to make up for time and instruction lost during the elementary years.

With it [science] not being taught in the elementary, that’s probably the greatest problem our students face in comprehending the science content in middle school. They’re not used to reading that kind of textbook, let alone the concepts in it.
Miss Everdeen said she felt sorry for Miss Marie in sixth grade, because the science and social studies standards had to be incorporated into the reading time at the elementary level in their corporation. “It just makes it that much harder to comprehend when you don’t have the experience learning the content in the previous years. Plus, these new books are just much harder to read.”

When Miss Everdeen considered the reasons the textbook reading was challenging for her students, she quickly mentioned comprehension. They can read it, but they can’t understand what they’ve just read. Our science books are very hard, very difficult. I learned some of this content in college. They’ve [the state grade level standards] really stepped it up as far as what they expect, so comprehension is number one.

Another concern with textbook reading difficulty Miss Everdeen expressed was the level of abstract thinking required in order to understand the material. “To think of an atom and protons and neutrons, and you can’t see it like you can an animal or a plant. It’s easy if you’re already familiar with it, but they’re not.” She stated that the most difficult chapter in the eighth grade textbook was the chapter on chemistry. “They’re not even going to have it in the seventh grade, because it isn’t even in the seventh grade book. The seventh grade science teachers are just going to have to teach it on their own. This is crazy.”

Miss Everdeen used every inch of space in her room to improve science reading comprehension for her students. Her counter surfaces were lined with student projects and displays. Wall posters outlined key concepts in various science topics. Even the clustered desk arrangement was planned for easy discussion and sharing sessions among students. When Miss Everdeen posed a question about the material, she encouraged students to discuss it first at their table groups. Once they had spent about a minute discussing, she invited one student per table to
speak for the group. She noted how interesting it was when other tables took issue with another table’s response, because this caused table members who had not spoken up yet to defend the answer on behalf of the group. “It’s very democratic. We spend a long time on discussions like these, and the only rule is that they cannot argue or ridicule another group’s answer and they have to support their table mates.” The table clusters were also useful when students study together in small groups. She said her students learned to divide tasks among them and bring their findings back to the group.

Miss Everdeen prided herself on being aware of her students’ individual learning needs. She planned her lessons and arranged her room to maximize the learning for her students. She said she understood the science comprehension deficit they brought with them to middle school. Miss Everdeen challenged herself to prepare the eighth grade students for the literacy skills she knew they would use in high school science.

**Resources and Instructional Strategies**

Miss Everdeen employed different levels of discussion according to the abilities of her students. She said each class was different, so she taught them accordingly.

In my inclusion class, we do more partnerships. I need to say, “Did you ask your partner” or ‘Have your partner explain this to you” and I’ll listen to how they explain it to each other. I don’t feel confident giving the test over a unit to any of my classes until I’ve heard them discussing what they’ve learned.

In her high ability classes, she admitted that the discussions go a bit deeper because they tended to be able to pull in more background knowledge. When her students could tell her the main idea of what they were reading, Miss Everdeen was confident in their growth and understanding of that chapter. “If they can say it back to me in their own words, I know they’re getting it. We do almost all our review sessions aloud in class. It just helps everyone along.”
There were moments in Miss Everdeen’s classroom discussions when students bounced thoughts and theories back and forth amongst one another as she watched this important discourse develop. She reined them back in when they needed to move on. She felt her students were comfortable asking thought-provoking questions over the content as well as clarification on any ambiguous facts in the material.

To help her students focus on vocabulary terms, Miss Everdeen allowed her students to highlight and take notes in the textbook.

As a grade level, we agreed at the beginning of the year to let the students highlight in the text. The books are new, too. Someone will use that book next year, and the important sections and terms will already be marked for them.

Because the chemistry unit was so challenging, she allowed them to highlight under her guidance in that section of the textbook first. “It really keeps them into it, since this particular chapter in the book is so difficult.”

The workbooks she used in tandem with the books reinforce the vocabulary instruction she provided in her classroom. The same terms defined in the chapter were covered in matching or fill-in format on the workbook pages. Miss Everdeen encouraged her students to use those content-specific terms when they summarized or reflected on the chapter.

While conducting an oral review study session for an upcoming test, Miss Everdeen referenced the wall displays in the classroom that featured those new vocabulary terms. She explained that utilizing the word-rich classroom environment during lessons reminded students of the importance of those content-specific terms. She said she taught her students to “read the room” when studying for a test.

Miss Everdeen distributed a practice lesson on air quality from the workbook. Students were instructed to circle the term in parentheses that correctly completed each sentence. She also
distributed a test over the chapter in the textbook on Earth’s atmosphere. Students had to respond to true/false statements, choose the correct vocabulary term for several multiple-choice questions, and complete several statements about the atmosphere by writing the answer in the blank. For this section, no word bank was provided; students had to demonstrate their retention of the material by filling in the blank. The last page tested students to explain why certain science concepts were important and describe how events in Earth’s atmosphere occur. Again, students were expected to demonstrate an understanding of the vocabulary terms throughout all sections of the test.

Miss Everdeen explained that it was much easier to let students in her high ability science class complete tasks on their own. They’ll see me if they need help or don’t understand what to do, whereas my lower ability [inclusive] class won’t. I have to pull it out of them. They may not even know enough about a particular concept to know that they don’t know it. It’s like they’re so used to accepting that there’s stuff they don’t get. I don’t like that. I need them to inquire more, think more, talk more about what they’re learning.

Miss Everdeen commented about the value of the written outlines in helping students improve their reading skills.

It [the outline] helps them visually see the main idea and related subheadings. I know that by the end of the year, my students can create their own outlines for a chapter. We do written outlines and then discuss them. That helps my students mentally organize what they’ve read in their books.

One text feature Miss Everdeen used in her science classroom was the lab resource book that accompanied the text. With the online version, students could click on the link. With the hard copy textbook, the lab book was a separate manual that coincided with the text. She
admitted that she did not use the online version in class as often as she probably should. She knew there was so much reinforcement that helps students understand the material in the online version. She thought her students would be comfortable with either the hard copy textbook or the online textbook. “They’re young. They can adapt to anything quickly.” She utilized the online links when she knew they needed extra help with certain concepts.

My students can look up the diagram of a tornado from the textbook link. From there, they can make an informative brochure about tornado systems. With our weather unit, they can watch a video on hurricanes. This helps them understand what they’re reading about in the chapter.

Miss Everdeen said the technology resources in her school were plentiful and current. She knew her students were lucky to have such resources at their fingertips. For those students who had compatible technology at home, the learning could continue.

**Professional Development in Content Area Literacy**

Without hesitating, Miss Everdeen answered the question regarding the need for professional development in content area literacy skills. “I know it would be helpful if we had more professional development in literacy. All of us. We’re all at different stages of how we use it already, so coming together on its impact would be great.” She believes an entire faculty gathering at least once per year focused on literacy strategies that could be used in all classes would be helpful.

Miss Everdeen blamed lack of time as the number one factor that stymies the implementation of literacy skills instruction in content area classes. “Most teachers I know would feel okay with addressing literacy standards if they had time to make it fit in. Time is the major factor.” She explained that time is needed on several levels: time to be trained on content area literacy, time to work it in with already existing lessons, and time to try it out with the
students. “This isn’t something you can just haphazardly throw into a lesson. You need to do it right, or the teachers won’t keep using it. The students won’t benefit either, and helping the students learn better is the goal.”

While discussing the need for ongoing professional development in content area literacy, Miss Everdeen added that so much pressure for mastery is placed on the shoulders of the math and English teachers. She also knew that the state publishes guidelines stipulating that all teachers meet literacy standards in their content areas. She believed this highlights the importance of content area literacy instruction. Miss Everdeen strongly felt the science classroom is a natural setting for using speaking, reading, writing, and discussion skills to communicate, interpret, and question scientific concepts. Because she understood the importance for all students to become scientifically literate, she hopes her colleagues embrace professional development in content area literacy.

Summary

As noted earlier, this qualitative research study investigated the strategies and instructional resources middle school science teachers use to improve reading skills. Through each teacher’s story, the responses of three main categories of the research questions were revealed.

1. What do three middle school science teachers’ perceive to be their students’ reading difficulties in science?

2. What are the strategies and resources used to improve reading comprehension of science textbook content?

3. What professional development and ongoing support is needed to implement literacy strategies in content area classrooms?
In my capacity as principal investigator, I used my lens to capture what is occurring in effective middle school science teachers’ classrooms to blend content instruction with literacy skills instruction. After sorting and organizing the data compiled from interviewing, observing, and collecting documents, I coded the emergent themes that existed as common threads in the data analysis. Themes emerged in each of my research question categories. The emergence of these themes helped me frame the narrative in order to tell each teacher’s story as clearly and accurately as possible. The next chapter will present the findings, conclusions, and implications for further research in hopes that the current knowledge base on content area literacy will continue to develop. It is in the coming chapter that I will culminate the results of this study in recognition that scientific literacy is a harbinger of proficient readers who are prepared and competent for an ever-changing, highly-advanced society.
CHAPTER 5

FINDINGS, CONCLUSIONS, AND IMPLICATIONS

In an information-rich, ever-changing world, it is more critical than ever before that our students become proficient readers in all content areas. Scientific literacy is paramount for success in the 21st century. A sound understanding of science enables people to experience the richness and discovery of the natural world around them and beyond. In the middle school classroom, one pivotal element inhibits this capacity: a student’s inability to comprehend the reading material in the science textbook and/or related curriculum resources. This qualitative study explored the strategies and instructional resources effective middle school science teachers use to improve content area reading skills. Discussion of the findings of this study, conclusions about what the findings revealed, implications for practice, and future research suggestions for furthering the knowledge base in content area science literacy are discussed in this chapter.

A review of the literature on science literacy demonstrates its rightful place in the forefront of the educational reform discussion. The National Science Education Standards define science literacy as “the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (National Research Council, 1996, p. 22). A solid knowledge base in science requires effective teaching and learning in the science classroom, and that knowledge base relies heavily on strong language skills. “Science and language are inextricably linked in the pursuit,
determination, and communication of meaning in the context of the physical world” (Thier & Daviss, 2002, p. 8).

The teachers who participated in this study concur that the science textbook content is challenging material to read for their middle school students. Allington (2002b) warned that students cannot learn from books they are unable to read, regardless of the content area. The commentary on the struggles adolescents, in particular, have in comprehending their grade level textbooks is not new. Students simply lack the critical reading skills required to comprehend their assigned textbooks within content area classrooms (Antonacci & O’Callaghan, 2011). With as much emphasis placed on beginning readers by national reform efforts, no such attempt has been made to promote critical reading skills among middle and high school students nationwide (Antonacci & O’Callaghan, 2011). State-by-state, curriculum standards outline benchmarks and mastery goals across the content areas. Help is on the way.

The state of Indiana is currently in transit from the Indiana Academic Standards and Frameworks to the Common Core Standards Curriculum established by the Common Core State Standards Initiative. The Common Core Standards include a greater emphasis on literacy in every subject area at every grade level, along with more specific technology standards and also college and career readiness standards in each subject area. The mission statement of the Common Core State Standards heralds that the standards are “more robust and relevant to the real world” (Common Core State Standards Initiative, 2009, para. 1). The standards go into full effect in Indiana at the start of the 2014-2015 school year.

Knowing this, it might seem obvious to simply connect science instruction with language arts skills to blend a dynamic delivery of effective instruction that begets meaningful learning. While it certainly is obvious, it is not so simple. Content area teachers are highly trained in the genre of their respective disciplines and often feel threatened by the suggestion that they also
spend time helping their students learn to read their content more proficiently (National Research Council, 1996; Tovani, 2004). The literature suggests the importance of ongoing support through professional development focused on content area literacy. “Professional development for teachers should be analogous to professional development for other professionals. Becoming an effective science teacher is a continuous process that stretches from preservice experiences in undergraduate years to the end of a professional career” (National Research Council, 1996, p. 55).

The purpose of this study was to shed light on what is occurring in three middle school science classrooms to address the literacy needs of the students. This is essential and timely considering the literacy demands on the 21st century learner. The recognition of such is reflected in every curricular area of the Common Core State Standards Initiative.

Three middle school teacher participants were interviewed and observed for the purposes of this study. Because of the small population size, a more intimate vignette of each participant’s science teaching practices is possible. It is recommended that the stories of the three teachers be considered a brief snapshot in time of what they perceive and believe about science literacy within their classrooms.

Findings

Themes Identified in Teachers’ Perceptions of Their Students’ Reading Difficulties

A significant theme emerged as the result of asking each participant why they believe middle school students have trouble comprehending the science textbook. The teachers reported two reasons for their students’ reading struggles: the challenging and technical nature of the reading material in the science textbook coupled with a lack of background knowledge in the subject area. The lack of background knowledge stems mainly from minimal science instruction during the elementary years.
As described in Chapter 2, a number of studies indicate the problems posed by textbooks that are too challenging for their intended audience. “Content area teachers consistently complain about the literary type of passages students encounter during basal reading instruction. The most common recommendation to this end was to provide students trade books, periodicals, and other supplemental materials during subject matter instruction” (Moore et al., 1983, p. 433). The teachers involved in this study were aware of that problem. The strategies and instructional resources they include in tandem with the textbook to improve their students’ reading skills demonstrate how they view literacy skills instruction in their science classrooms.

**Themes Identified in the Literacy Strategies and Instructional Resources Teachers Use**

Another identified theme of this study was the large number of literacy strategies and instructional resources used by the participants. Although they each focused heavily on reading the textbook material with their students, they also commented on the related literacy strategies that lie within their individual comfort levels derived from professional development training and graduate coursework. From my data collection, the analyses revealed multiple strategies that were implemented depending on teacher preference, student readiness, and subject matter.

As revealed in Chapter 2, effective teachers employ before, during, and after reading strategies to help connect student thinking to the reading material. Billmeyer and Barton (1998) outlined these three segments of reading skills instruction as strategic and necessary for explicitly guiding student comprehension through a reading task. The research suggests that teachers utilize pre-reading activities, metacognitive strategies during reading, and a review of the new knowledge once the content has been read (Billmeyer & Barton, 1998). Several of those literacy strategies and instructional resources were ubiquitous among my participants, emerging as common themes in my data, including the following: the use of discussion as a strategy, guided vocabulary instruction, differentiated instruction for varying learner abilities, and leveled
instructional resources to complement the textbook material. Table 1 shows the literacy strategies used by the participants to complement the reading material in the science textbook.

Table 1

*Table 1

Literacy Strategies Used By Participants*

<table>
<thead>
<tr>
<th>Participant</th>
<th>Before</th>
<th>During</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miss Marie</td>
<td>-Discussion of content</td>
<td>-Discussion</td>
<td>-Use vocabulary to scaffold (Word Wall)</td>
</tr>
<tr>
<td></td>
<td>-Discussion of new vocabulary using</td>
<td>-Real-life Connections sections in each</td>
<td>-Display of student work in the room</td>
</tr>
<tr>
<td></td>
<td>vocabulary (Word Wall)</td>
<td>chapter</td>
<td>-Retelling</td>
</tr>
<tr>
<td></td>
<td>-Workbook pages</td>
<td>-Leveled reading materials</td>
<td>-Handouts/Outlines</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Chapter notes/Skills sheets</td>
<td>-Summary discussions</td>
</tr>
<tr>
<td>Mr. Ball</td>
<td>-Discussion of content</td>
<td>-Discussion</td>
<td>-Review game</td>
</tr>
<tr>
<td></td>
<td>-Discussion of new vocabulary (Word Wall)</td>
<td>-Use of text features</td>
<td>-Display of student work/projects in the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Video simulations (Online text features)</td>
<td>room</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Review sheets/Study guides</td>
<td>-Workbook pages</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Test review outlines/Study guides</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Virtual labs (Online text features)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Summary discussions</td>
</tr>
<tr>
<td>Miss Everdeen</td>
<td>-Discussion of content</td>
<td>-Discussion</td>
<td>-Display of student work in the room</td>
</tr>
<tr>
<td></td>
<td>-Discussion of new vocabulary (Word Wall)</td>
<td>-Partner and small group activities</td>
<td>-Test review outlines/Study guides</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Use of text features</td>
<td>-Workbook pages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Display and use of resource books/materials</td>
<td>-Online labs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Student-created outlines</td>
<td>-Summary discussions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Review sheets/Study guides</td>
<td></td>
</tr>
</tbody>
</table>

Not meant to be an inclusive representation of the literacy strategies the participants employ, this table reveals the literacy strategies revealed to me during the interviews and
observations. Because I did not expect the science teacher participants to use the same verbiage found in content area literacy strategies research, parenthetical references note the typically-accepted terminology found in the literature.

The instructional resources included the use of technology as a resource, handouts and study guides, text features embedded in the chapters and in the online textbook version, and the physical arrangement of the science classroom. The physical arrangement and creative use of wall space to impact learning in the science classroom was one unexpected and positive finding of this study. The teachers recognized such factors as desk arrangement, deliberate placement of resource materials for student access, and the use of wall space to display student work and science information as one of their key strategies for effectively teaching science. When asked why the physical set-up and use of wall space is perceived to be so conducive to learning, each participant commented that they consider it a motivational strategy for sparking their students’ interests in scientific concepts and capturing their attention during class.

**Themes Identified in Professional Development for Content Area Literacy**

As noted in Chapter 4, this study found that the teacher participants viewed themselves as reading teachers as well as science teachers. The research is encouraging for those content area teachers who see themselves in this way. “It’s an unusual teacher who comes into secondary education wanting to teach students how to learn. Yet, if we’re going to be good teachers, that’s really essential” (D’Arcangelo, 2002, p. 13). One teacher explained that she really could not see herself separating the two disciplines due to her elementary education background and her trepidation that her students did not receive concentrated science instruction and experiences in elementary school.

One predictable finding in this study was the expressed need for professional development in content area literacy strategies. All three participants identified this as a need,
although they each revealed that the levels of teacher acceptance and buy-in of such professional development might vary. As explained in Chapter 4, Mr. Ball noted that he met with teachers weekly to address curriculum mapping, and content area literacy was a common topic of discussion. Miss Marie admitted that middle school teachers would be more accepting than high school teachers of such professional development opportunities. Miss Everdeen explained that the English and math teachers cannot be expected to address the literacy standards alone.

The review of literature from Chapter 2 revealed the overall importance of professional development as well. Research reveals the pivotal role professional development plays in supporting teachers’ implementation of literacy development in their content areas (Carnine & Carnine, 2004; Sturtevant, 1996). Professional development in content area literacy is strengthened by effective administrative leadership that monitors and supports the pedagogy for science and reading instruction (Carnine & Carnine, 2004). The participants in this study expressed a need for this type of systemic support and noted that the conversation of content area literacy would be best conducted by school administrators in order to underline its value.

This study also revealed that teachers feel overwhelmed by a lack of time to implement literacy strategies. Pressures to cover the content in the designated grading periods according to their carefully-planned curriculum map make teachers acutely aware and cautious of yet another demand on their time. This finding is supported by the research. Moore et al. (1983) recognized implementation as the main issue in improving students’ reading skills through content area literacy instruction. Moore et al. (1983) considered it quite a chore due to the amount of time required to implement strategies. “Teachers must spend a great deal of time planning activities and then managing them” (Moore et al., 1983, p. 433). Time will always be an issue. Including more reading strategies in content areas demands an enormous amount of time and energy on the part of an entire school faculty. It will take time away from other topics that staff development
meetings must also address. D’Arcangelo (2002) stated that nothing is more significant than preparing students for the multiple literacies they need in order to think and learn proficiently in their lives. The teachers involved in this study expressed the demands they have on their time as one of their strongest concerns regarding the implementation of literacy strategies in science. This did not make them less willing, however. It just made them aware that some colleagues who have not yet embraced the value and urgency of content area literacy will have a long road ahead.

**Conclusions**

This study sought to explain the strategies and instructional resources used by effective middle school science teachers to improve their students’ reading skills. My objective was to tell the stories of the teacher participants as they revealed their professional perceptions about content area literacy to me during interviews and observations. I also used documents, such as study guide handouts and chapter outlines, collected from each teacher participant to help story the reality of the literacy strategies and instructional resources they use to improve their students’ reading skills in science.

Before investigating the aforementioned strategies and resources, I wanted to discover each teacher’s reaction to William S. Gray’s popular slogan coined in the early 1900s, “Every teacher is a teacher of reading” (Moore et al., 1983, p. 424). More than 100 years have passed since Gray coined that phrase, and I feared that the acceptance of it as fact is not pervasive among all content area teachers. Fortunately, it was a strongly held belief by the three teacher participants. Gray’s statement framed the structure of my interviews with each teacher, and I began with that research question. When I asked the teacher participants if they view themselves as teachers of reading, they did not hesitate to say yes.
The next set of research questions focused on the reading difficulties middle school students face. It is known and widely held in the research that adolescents may have accomplished the task of learning how to read, but are barely on the cusp of learning how they learn. Their literacy learning needs do not end on elementary school graduation day, nor does the responsibility of adolescent literacy instruction fall on the backs of the language arts teachers. Every content area requires some type of technical reading unique to that content area, and with that specialized type of reading material should come specialized types of instructional strategies that will increase comprehension. “Learning to read doesn’t end in the elementary grades. Reading becomes more complex as students move into middle and high schools, and teachers need to help students understand difficult text” (Tovani, 2004, p. 5).

When I asked each teacher participant to explain why middle school science students struggle with reading and comprehension, they blamed the lack of background knowledge during the elementary years that would have prepared them for the reading they encounter in middle school science classrooms. One teacher observed that students are coming to the middle school each year knowing less and less about scientific concepts.

The teachers also expressed concerns for the challenging and technical reading material in the science textbooks. This theme was consistent with research compiled by Olson and Mokhtari (2010). “Science texts often pose special challenges for inexperienced and struggling readers, particularly when those students are transitioning from the elementary to middle grades” (Olson & Mokhtari, 2010, p. 56). The authors explained that it takes time and practice for students to understand how material in middle school science content is organized in the textbook. Even average ability readers would have difficulty interpreting “the syntactic structures used to express complex scientific processes and concepts” (Olson & Mokhtari, 2010, p. 56).
As a language arts teacher, the findings in this category of my research questions alarmed me. Although I have long understood how my students grapple with the technical content, specialized terms, and scientific concepts that exist in their science textbooks, I was saddened to learn that science and social studies instruction has been minimalized if not extinguished in the elementary grades. Having taught fourth grade for a period of time, I remember the science labs and inquiry sessions as truly teachable moments injected with joy and discovery from the students. For the sake of the elementary-aged budding scientists and voracious explorers of the natural world along with the elementary teachers who love to inspire them, I can only hope this trend does not become policy.

Not once during my data collection did the teachers suggest watering down the curriculum in order to make up for lack of background knowledge in learning scientific concepts. Not once did they suggest avoiding the current science textbook materials due to the difficulties their students have reading them. This finding was quite impressive, and from it I was able to conclude that the teachers were ready for the challenge and eager to find ways to supplement the textbook and guide their students through the rigor. They were not suggesting that their students just could not handle it. They recognized the challenge and felt it was their responsibility to making textbook reading accessible to their students.

The next set of research questions focused on the main purpose of the study: the resources and instructional strategies effective middle school science teachers use to improve content area reading skills. Tovani (2004) defined a literacy strategy as an intentional plan that is flexible and can be adapted to meet a student’s literacy needs. I conclude that the following literacy strategies are used by all three teachers: discussion of content material, vocabulary instruction to enhance comprehension, and differentiation based on students’ learning needs. These three strategies are used before, during, and after reading the material from the textbook in
order to prompt, guide, and assess student learning. In Chapter 1, I defined an effective teacher as one who has achieved highly qualified status as stipulated by the Indiana Department of Education and one who utilizes before, during, and after literacy strategies to improve student comprehension. From my interviews, observation, and data collection, I made the conclusion that the effective middle school science teachers I involved in this study are open to using these strategies and more as they continue to learn about content area literacy. They recognize the urgency of a rigorous curriculum, and they are using their role to its fullest potential in preparing their students to master the standards set forth in the Common Core Standards Initiative.

Aside from the content area literacy strategies the teachers use in their middle school science classrooms, I was additionally interested in the type and amount of professional development training and support they receive for ongoing content area literacy strategies. When I asked the participants to explain the professional development training they have had in content area literacy instruction, they reflected on their undergraduate and graduate courses. They spoke of varied experiences from one teacher having numerous literacy courses to another with very few. Currently, however, they are taking responsibility for their own professional development. The research supports this kind of proactive thinking. The National Research Council (1996) clarifies that teachers of science are professionals responsible for their own professional development and for the maintenance of the teaching profession” (p. 55). Although it is laudable to take professional development in your own hands, the inculcation of content area literacy strategies cannot be placed in the teachers’ hands alone. “Teachers are central to education, but they must not be placed in a position of being solely responsible for this type of reform” (National Research Council, 1996, p. 27).

The last set of research questions focused on how content area teachers would respond to professional development opportunities in content area literacy. Although lack of confidence in
teaching reading strategies and reluctance to make changes in an already established science curriculum were identified concerns that stymie the use of content area literacy strategies, they were not the themes that stood out as most recurrent. The perennial issue of time constraints stands predominant. The time issue spans many levels of concern. Time to seek professional development opportunities, time to redesign delivery methods, and time to implement the new strategies are the major concerns. If teachers consider content area literacy an add-on, they will be less likely to incorporate it simply because it will squeeze an already compressed curriculum.

The teachers I interviewed did not view content area literacy as an add-on; they viewed it as a vehicle for delivering their content in more authentic ways. The research reveals that they are unique in thinking this way. “Few middle and high school teachers feel they have the time or the expertise to teach students how to read. They have been trained in their content area and feel uncomfortable stepping into the role of reading specialist” (Tovani, 2001, p. 13). Research conducted by Tovani in 2004 concluded that the answer is a trade-off. “Only the teacher can decide whether it’s worth giving up some content for the time it takes to design comprehension instruction that means something to students. If teachers don’t value thinking strategies, they won’t give up content” (Tovani, 2004, p. 19).

“Reading as it relates to the various school subjects and activities is now challenging some of the attention that it has long deserved” (Moore et al., 1983, p. 424). The value of content area literacy can no longer take a back seat to other educational reform efforts. New state standards recognize how literacy skills can help secure meaningful learning in all content areas.

**Implications for Practice**

This study explored the resources and instructional strategies used by effective middle school science teachers to improve content area reading skills. Although there are limitations to
the sample size of participants in this study, useful information was gained from the three middle school teachers who allowed me to tell their stories as teachers who incorporate literacy strategies into science instruction to improve comprehension. There are two main implications for practice that stem from the findings of this research: discussions among teachers about content area literacy, adolescent literacy, and science literacy; and the utilization of a literacy coach as a professional development liaison.

**Discussions about Content Area Literacy**

Just as the teachers in this study valued the discussion strategy as a way of gauging their students’ content area comprehension, teachers must foster that kind of discussion with one another at department and grade levels in their schools. The teachers in this study repeatedly expressed the benefit of discussion in assessing student learning and promoting comprehension. In every aspect of their lesson delivery, the strategy of discussion was employed. From vocabulary instruction to the use of technology as a resource, discussion was paramount. It is encouraging to note that literacy discussions among teachers are occurring more and more frequently with Indiana’s upcoming adherence to the Common Core Standards Initiative. Precise literacy goals and benchmarks for mastery have been defined for each content area and each grade level. “Middle and high school teachers can and must teach students to be better readers of their course material” (Tovani, 2004, p. 14). Clearly, content area literacy is assuming its rightful place in the current conversation on improving literacy skills in adolescents. All teachers share in that role. Discussion to that effect would further the cause.

**Discussions about Adolescent Literacy Needs**

In order to understand the role and rigor of content area literacy, teachers must fully understand the literacy needs of the adolescent learner. If teachers fail to recognize that adolescents benefit from instruction that employs resources and strategies to complement the
textbook content and that their students’ literacy needs continue to develop as they leave elementary school and enter middle and subsequently high school, they will also fail to understand the role of literacy in their respective content area classrooms. Change in instruction is dependent first on the teacher having a thorough understanding of the students’ learning needs in that classroom (Dillon et al., 1994). It makes sense to me that teachers would want to know as much as possible about how students learn in order to help them do exactly that. A discussion among teachers of the multifaceted literacy needs of students would imply that effective teaching of literacy strategies in the content areas is on the horizon.

**Discussions about Science Literacy**

Guidelines set forth by the National Research Council in the texts *How People Learn* (2000) and the *National Science Education Standards* (1996) suggest a very different approach to teaching science than most of us experienced during our middle and high school years. The three guiding principles of effective scientific instruction include addressing preconceptions, imparting knowledge of what it means to do science, and teaching students to be metacognitive about what they are learning (National Research Council, 2000). Effective science teaching includes guided inquiry, discovery knowledge of core concepts, and metacognition. Science has the ability to strengthen literacy skills. Both disciplines are inherently focused on the same task: infusing meaning and purpose into learning. Thier and Daviss (2002) heralded that the blend of science and language arts is a natural symbiosis. “Literacy skills strengthen science learning by giving students the lens of language through which to focus and clarify their ideas, conclusions, inferences, and procedures” (Thier & Daviss, 2002, p. 6). The voices of the teachers involved in this study indicate that a sound grounding in the parallel processes of science and language arts can strengthen comprehension in both. Discussions along this vein in middle school science classrooms and beyond would support the cause for content area literacy.
**Literacy Coach as Professional Development Liaison**

The findings of this study have built a case for middle school teachers to advance the discussion of content area literacy and its implications for greater levels of student comprehension. The perspectives, beliefs, and experiences of the teachers portrayed in this study demonstrate that school- and district-level leadership and time are needed for content area literacy to assume its most beneficial position at the helm of content area instruction. Perhaps the best way to accomplish that task is for a literacy specialist or coach to bridge the gap among content area teachers and between all teachers and school administrators. This notion comes from the literature and its demonstrated effectiveness in ensuring the support for content area literacy strategies in schools. The literacy coach serves in a leadership role to help coordinate and support professional development for all teachers in content area literacy strategies and implementation (Sturtevant, 2004). Teachers of all content areas and at all grade levels must teach their students how to effectively learn their content. They must model how to engage in thoughtful reading, writing, thinking, and discussion strategies within their content areas. It would be the leadership and guidance of the literacy coach to help teachers develop literacy plans for their schools. The presence of a literacy coach would save teachers time in seeking their own professional development as well as travel to training sessions. The literacy coach would seek the training and then impart that new knowledge to the teachers in his or her district.

The implications for practice explained above remind me of a major theme that emerged in my data analysis: lack of time to learn about and implement content area literacy strategies. Each of the implications suggested above requires time, and the investment in such is both important and urgent. Tovani (2004) suggested that after making the initial time investment of learning a few literacy strategies that blend well with the subject matter, teachers would be able
to cover more content in less time. If students are able to comprehend what they read more efficiently and proficiently, time would no longer be a major concern.

**Suggestions for Further Research**

The findings and conclusions drawn from this study support the need to further investigate content area literacy and its impact on reading comprehension across the curriculum. Although there exists an abundance of research in proven content area literacy strategies, more attention should be given to how individual teacher’s perspectives and beliefs have changed over time in support of content area literacy instruction and the factors that influence them. Narrative case studies could serve as road maps for teachers who feel reluctant to change and are unsure of the outcomes of making adjustments for the sake of literacy skills acquisition in their content area classes. By reading the stories of other teachers’ journeys to infuse their content area material with language arts skills, teachers might be able to identify with the participants’ concerns and apprehensions. That common ground would be eye-opening to teachers who might lack motivation and confidence for embarking on such change.

It is known that there are many effective literacy strategies with proven effectiveness in the content areas. A longitudinal study would help determine if the routine use of the same literacy strategies would lose their effectiveness over time. A wide arsenal of strategies would allow for change-ups as necessary to keep the students and the teacher motivated. The presence of a literacy coach could help teachers build a repertoire of content area literacy strategies.

The teacher participants in this study were self-selected. This study only investigated effective middle school science teachers who use before, during, and after literacy strategies to complement the content area reading material. A study should be conducted where a given population is studied, as opposed to a self-selected population, to determine if the findings would be the same or different.
I chose to conduct this research in a school with a demographic similar to my own. That allowed me to utilize my background knowledge of that type of school demographic. A similar study should be conducted with a different demographic than the one the researcher is most familiar.

This was a qualitative study that shared the lived experiences of the participants. A quantitative study or a mixed methods study is needed in order to show the effects of such strategies on student learning. A quantitative study focused on content area literacy strategies would demonstrate the effectiveness of such strategies on student comprehension.

There is no way to determine the effect my role as a researcher who is also a language arts teacher had on my participants. A study similar to this one should be conducted by a researcher trained in a different content area. It is a clear limitation to the findings of this study regarding the level at which my participants were more forthcoming or less forthcoming because of my role as a middle school language arts teacher.

Further research in successful professional development practices of content area literacy is needed. Although there is a long tradition of research examining the theory and practice of content area literacy, there have been few attempts to document a district-wide journey toward effective and sustainable professional development required to move content area literacy to the forefront of school-wide reform initiatives. Such a school or district’s efforts could become a model for other schools to follow in designing professional development and ongoing support for incorporating and sustaining content area literacy strategies. Useful information is needed for guiding middle school teachers in the design and implementation of effective strategies that will support the addition of content area literacy standards included in the Common Core Standards Initiative. As Indiana teachers make the transition from aligning their lessons with Indiana Academic Standards and Frameworks to Common Core Standards, further research on content
area literacy before and after aligning with Common Core would prove beneficial for school-wide improvement data.

Finally a study similar to this one, yet with a larger population sample, would provide more than just a snapshot into what is occurring in three middle school science classrooms. More depth on strategies employed or a greater breadth of strategies may emerge for such expanded research. A larger-scale study would serve a greater audience as well. This study, although small in scale, represents a first step in that direction.

Summary

As a middle school language arts teacher for the past 18 years, literacy has always been my passion. Understanding how my students use and refine their literacy skills in other classes has always captured my attention. My role in their literacy learning journey is not one I can overemphasize. The role of other content area teachers in that journey is worth investigating too. Such was the origin of this study. The purpose of this qualitative research study was to determine the resources and instructional strategies effective middle school science teachers use to improve content area reading skills. It was the goal of this study to give both new and seasoned teachers a glimpse into the classrooms of three middle school science teachers to learn how they supplement their adopted curriculum materials in innovative and resourceful ways to increase reading comprehension. This study has identified what three teachers believe to be the most useful literacy strategies for teaching the science content in their respective textbooks.

The noted difficulties students have in reading their challenging middle school science textbooks elevate the need for content area literacy instruction. Limited science instruction in elementary schools necessitates the inclusion of literacy strategies in science classrooms. Such efforts would bridge the missing link between background knowledge and grade level readiness.
The teachers whose stories are revealed in this study believe in the power of discussion during daily science lessons in order to assess what students are learning and guide further instruction. They also engage their students in routine exposure to new vocabulary terms found in the textbook content in order to demystify the technical language inherent to science content. Differentiation allows the teacher participants to cater their delivery methods and alter the literacy strategies they employ during lessons in order to maximize student learning based on individual needs.

The resources used by the participants to make the textbook material easier to comprehend included the following: technology links available in the online textbook, handouts and study guides, and contextual features that exist in and around the narrative passages of the textbook. Worksheets often get scoffed at for requiring lower-order thinking skills. One teacher justified their use by explaining that her study guides are used to direct readers to the main ideas and key scientific concepts in a difficult or lengthy section in the textbook.

Perhaps the most surprising finding was the use of the physical environment of the classroom as an instructional strategy. The physical environment includes strategic desk arrangement, placement of learning resources, proximity of the teacher to the students throughout the lesson, student work displays, wall décor, and a print-rich environment related to science. Nothing about the layout of the classrooms or the items in them is random. Everything is strategically arranged for purpose and procedure, and that contributes to the emphases on science instruction, learning motivation, and organization.

From analyzing the data and presenting the findings, I concluded that the teachers I studied held positive perceptions of content area literacy and its role in their middle school science classrooms. I also concluded that they perceive themselves as teachers of reading as well as teachers of science. They hold strong beliefs regarding the need for further professional
development, while expressing concern that some of their colleagues may feel reluctant and short on the time it takes to include literacy skills in their content areas. They understand the urgency and the benefit of content area literacy and its implications for improving comprehension in science. The participants confess that although they feel like they have taken charge of their own professional development in regard to content area literacy, further training is needed to sustain their momentum and to establish a common language among their colleagues. The significance of support from administration for professional development opportunities in content area literacy strategies cannot be taken lightly.

The time is right. Content area literacy is a strong contender in the race toward student learning and academic achievement across the curriculum. The researchers who have contributed to this formidably growing body of knowledge have cultivated fertile ground for further investigation seeking to connect theory with practice.
REFERENCES


Association for Middle Level Education, formerly National Middle School Association. (2010). *This we believe: Keys to educating young adolescents*. Westerville, OH: Author.


Billmeyer, R., & Barton, M. (1998). *Teaching reading in the content areas: If not me, then who?* Aurora, CO: Mid-continent Regional Education Laboratory.


APPENDIX A: INTERVIEW QUESTIONS FOR MIDDLE SCHOOL SCIENCE TEACHERS

Participants: Interviewer – Melanie Beaver
Interviewee – ___________________________ Middle School Teacher

Location: ________________________________

Date & Time: ______________________________

MB1: How long have you been teaching middle school science?

MB2: What made you decide to become a science teacher at this grade level?

MB3: What unit/chapter are you currently studying in your subject area?

MB4: How will the reading material from your text be covered?

MB5: What pre-reading strategies do you use to spark students’ interest in the content?

MB6: While the unit/chapter is being studied, how do you assess comprehension before you test them? How do you know students are comprehending the material?

MB7: In what ways do you make accommodations for students who are struggling with reading the text or comprehending the text content?

MB8: How do you accommodate different learning styles?

MB9: What do you do when you have students who cannot pronounce the words in the text?

MB10: How do you teach the students to attack new vocabulary words in the reading?

MB11: What supplemental resources and materials do you use to help students understand the text content?

MB12: How do you give feedback during the lesson and after the lesson?

MB13: What ‘during reading activities’ do you use to help students understand the material?
MB15: When you’re finished teaching and assessing the content of the textbook chapter, what do you do to make sure they retain and transfer the information?

MB16: In what ways do you evaluate student learning of the course content?

MB17: In what ways could you consider yourself a reading teacher?

MB18: Where did you learn the reading strategies you employ for helping your students understand the science content?

MB19: What structural features exist in the course textbook to help students understand the content?

MB20: What structural features exist in the course textbook that students struggle to comprehend?
APPENDIX B: CONSENT TO PARTICIPATE IN RESEARCH

Resources and Instructional Strategies Effective Middle School Science Teachers Use to Improve Content Area Reading Skills

You are asked to participate in a research study conducted by Melanie Beaver, who is a doctoral candidate from the Department of Curriculum, Instruction, & Media Technology at Indiana State University. Mrs. Beaver is conducting this study for her doctoral dissertation. Dr. Susan Kiger is her faculty sponsor for this project. Your participation in this study is entirely voluntary. Please read the information below and ask questions about anything you do not understand, before deciding whether or not to participate.

You have been asked to participate in this study because you teach science at South Vermilion Middle School. You are eligible to participate in this study if you employ before, during, and after literacy strategies in the delivery and instruction of your science lessons. You are also eligible to participate because you have been identified as a highly qualified teacher in the science content area as identified by provisions in the No Child Left Behind Act of the Indiana Department of Education. The six science teachers in your building will be invited to participate in this study.

• PURPOSE OF THE STUDY

The purpose of this study is to determine what resources and instructional strategies effective middle school science teachers use in conjunction with the adopted classroom textbook to help their students become better readers of the content material. We hope to use this study to provide both new and seasoned teachers an idea of what effective middle school science teachers do to supplement their adopted curriculum materials in innovative and resourceful ways to increase reading comprehension.

• PROCEDURES

If you volunteer to participate in this study, you will be asked to do the following things:
Participate in the following 7 meetings with Melanie Beaver:
Meeting #1: Project Explanation & Informed Consent Signing if willing to participate
Meeting #2: Interview using the attached questionnaire
   This session will take approximately one-hour and will be conducted in your building in a location of your choosing. To ensure that I am able to capture all the information you share, this session will be audio-taped.
Meetings #3-5: Observation of your science lesson on three separate occasions
Each observation will take place in your science classroom and will last approximately one class period. These dates will be arranged at your suggestion. The observations will be audio-taped.

Meeting #6: Validation of Transcribed Audio-Recordings
Once I have transcribed the audio-recordings from the interview and the observations, I will share the transcripts with you to validate accuracy of the transcription process.

Meeting #7: Sharing findings after the dissertation defense
Upon successful completion of the dissertation defense, I will share the findings of my study with you.

**POTENTIAL RISKS AND DISCOMFORTS**

We expect that any risks, discomforts, or inconveniences will be minor and we believe that they are not likely to happen. If discomforts become a problem, you may discontinue your participation.

**POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY**

It is not likely that there are any direct benefits to you as a result of participation in this project. The potential benefits to society that may be expected include a narrative on what six middle school science teachers are doing to support literacy in the content area of science.

**CONFIDENTIALITY**

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of a code number or pseudonym to let Mrs. Beaver and Dr. Kiger know who you are. We will not use your name in any of the information we get from this study or in any part of the dissertation product. When the study is finished, we will destroy the list that shows which code number or pseudonym goes with your name. Information that can identify you individually will not be released to anyone outside the study. Mrs. Beaver will, however, use the information collected in her dissertation and other publications. We also may use any information that we get from this study in any way we think is best for publication or education. Any information we use for publication will not identify you individually.

The audiotapes will not be reviewed by anyone outside the study unless we have you sign a separate permission form allowing us to use them. The tapes will be destroyed three years after the end of the study, as required by law. The audiotapes and this informed consent document will be stored separate locked locations from the typed transcripts in Mrs. Beaver’s home.

**PARTICIPATION AND WITHDRAWAL**

You can choose whether or not to be in this study. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits to which you are otherwise entitled. You may also refuse to answer any questions you do not want to answer.
There is no penalty if you withdraw from the study and you will not lose any benefits to which you are otherwise entitled.

- IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about this research, please contact

Mrs. Melanie Beaver, Principal Investigator
Dept. of Curriculum, Instruction, and Media Technology
Indiana State University
Terre Haute, IN 47809
812.243.8474
mbeaver@sycamores.indstate.edu

Dr. Susan Kiger, Dissertation Chairperson & Associate Professor
Dept. of Curriculum, Instruction, and Media Technology
Indiana State University
Terre Haute, IN 47809
812.237.2960
susan.kiger@indstate.edu

- RIGHTS OF RESEARCH SUBJECTS

If you have any questions about your rights as a research subject, you may contact the Indiana State University Institutional Review Board (IRB) by mail at Indiana State University, Office of Sponsored Programs, Terre Haute, IN 47809, by phone at (812) 237-8217, or e-mail the IRB at irb@indstate.edu. You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with ISU. The IRB has reviewed and approved this study.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

________________________________________
Printed Name of Subject

________________________________________
Signature of Subject                     Date