A NEW WAY TO READ: WILL IMPLEMENTING LITERACY STRATEGIES IN THE SCIENCE CLASSROOM INCREASE MOTIVATION AND UNDERSTANDING

by

LeAnn Thongvanh

A professional paper submitted in
partial fulfillment of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2014

STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

LeAnn Thongvanh

July 2014

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF FIGURES

ABSTRACT

Looking to replace the routine of reading a textbook section and filling out worksheets, I wanted to find a way to get 7th grade science students engaged in the readings and motivated to understand the content. Pulling from various proven literacy strategies, I developed a process called Question, Read, Connect, Reflect (QRCR). During the treatment period of four weeks, students worked cooperatively to read five sections of the science textbook. Students started by previewing the text (question), reading the section one heading at a time (read), and using a concept web as a graphic organizer to identify main ideas (connect). The final portion of the process (reflect) had students constructing summaries of the section using the terms from their webs. Students also took time to think back on their participation, effort, and use of new information throughout the QRCR session. QRCR packets, which contained the concept webs and summaries, were analyzed and interviews were given at the end of the treatment. Students were given pre and post-treatment questionnaires to gain insight on students' use of various literacy and textbook skills. Questionnaires and comments on self-reflection forms were also used to track changing attitudes and thoughts on the QRCR process. Findings showed that the majority of the treatment group enjoyed the new reading process. Effort and motivation increased and gains in identification of main ideas as well as organization on concept webs were shown. Despite this, no gains were shown in summarizing skills nor were improvements in writing demonstrated.

INTRODUCTION AND BACKGROUND

Teaching Experience and Classroom Background

Over the past ten years, I have been teaching at Indian Hills Jr. High. Indian Hills Jr. High is located in suburban Clive, Iowa and is part of the West Des Moines Community School District (WDMCS). The WDMCS serves an area of 37 square miles with a population of 55,000. The district has over 9,000 students with 650 students attending Indian Hills. Located in Central Iowa, the WDMCS, while not very culturally diverse, has seen changing demographics over the last ten years. Twenty-five percent of the district population is minority with over 600 English language learners. About 10% of students qualify for special education and 27% of students qualify for free and reduced lunch programs. These statistics continue to climb each year as the suburbs grow west from the capitol city of Des Moines (WDMCS website, 2014).

Indian Hills, while a junior high, incorporates many middle school philosophies including teaming. The school contains both seventh and eighth grade and each grade level is made up of three teams. Each team contains four core teachers of math, science, English, and social studies. Students travel to core classes with their teammates and then have elective classes with other students in their grade. Seventh grade students are enrolled in general level classes with the only chance for enriched classes in math. As a teacher on the Zephyr Team, I have about 100 students of various abilities. Our team includes a special education teacher who serves 15-20 students with mild needs, each requiring an Individual Education Program (IEP). These students attend regular classes and the special education teacher collaborates in all core classes.

The science program in seventh grade at Indian Hills is an introductory course that covers biology, environmental studies, and health topics. In the WDMCS, students do not take a formal lab science class in the elementary grades. During the seventh grade year, there is a large focus on lab skills and class is conducted in a lab setting. This is also the first year students use science textbooks. Improving critical thinking skills has been a school-wide goal for several years, with each department incorporating strategies into their curriculum.

Throughout my time at Indian Hills, I have seen a decline in reading and writing skills. Middle school students have had little prior experience with non-fiction text and lack the reading comprehension skills necessary to decipher science texts. In addition, students’ writing skills were almost non-existent. On assignments, it was a struggle to have students write in complete sentences with correct spelling. Students were unable to communicate and defend their ideas effectively in the written form. In addition, students were not highly motivated to complete science assignments well. Their goal was completion, not understanding of science material. Because reading and writing are essential to understanding science, I wanted to find ways to better teach these skills so students would become more successful science students and more prepared for future schooling. I chose to conduct my research during the months of November 2011 through January 2012. During this time, students used textbooks for the first time. They studied the characteristics of living things and bacteria. The kingdoms of protists, fungi, and plants were the focus during the treatment period.

Focus Question

Concern over students reading and writing skills lead to my primary focus question: Does implementing literacy strategies in science increase motivation and performance? This focus question focused on answering the following sub-questions:

- Will using the reading strategy Question, Read, Connect, Reflect (QRCR) increase understanding and effort?
- Will group work, centered on questioning the text, increase motivation and comprehension?
- Will summaries, constructed by students, help develop better summarizing and writing skills?

CONCEPTUAL FRAMEWORK

Introduction to Science Literacy

According to the National Science Standards (2006) scientific literacy is "knowledge and understanding of science subject matter, that is, the knowledge specifically associated with the physical, life, and earth sciences. Scientific literacy also includes understanding the nature of science, the scientific enterprise, and the role of science in society and personal life" (National Research Council, p.21). Issues involving science in society are widespread, from stem cell research to global warming. However, according to Professor Jon Miller on the website Science Daily (2007), 70% of Americans are able to understand the science section of the New York Times. Reif and Larkin (as described in Fang, 2006) warn that without explicit teaching literacy skills as they apply to science, "students will acquire merely superficial scientific knowledge without an adequate understanding of its purpose without much ability to use it effectively" (p.757). Teaching science literacy requires students and teachers to go beyond acquisition of science facts and theories. It demands that students are able to understand how the science process works and how the disciplines of science are related. As Krajcik and Sutherland (2010) state, "for today's students to participate effectively in tomorrow's decision making as consumers, members of the electorate, and members of society, it is imperative that educators support students in reading, writing, and communicating in science" (p.459). The adoption of the Next Generation Science Standards was an effort to make sure that all students have the skills necessary to join a competitive, modern workforce as well as be informed decision-makers in society. Of the eight practices that the Next Generation Science Standards considers to be crucial, five (asking questions, analyzing and interpreting data, construction explanations, engaging in argument from evidence, and obtaining, evaluating, and communicating information) require not only content knowledge but demand students to be able to effectively reflect on the knowledge (National Research Council, 2012).

Inquiry and activity-based science are current trends implemented in select science classrooms. Inquiry can look different in every classroom though it centers around students finding solutions to their own questions through scientific exploration (Llewllyn, 2007). While activities and labs certainly engage students' interests, in order for the inquiry to be truly successful, students cannot just 'do' science. They need to be able to make judgments and conclusions about what has been done for science is a combination of inquiry and argumentation (Yore et al., 2004). The ability to make viable arguments, both orally and written, is a skill that must be modeled and practiced. Field scientists do not experiment without first reading and writing about their ideas and findings for “without text and without reading, the social practices that make science possible would not exist” (Hand et al., 2003, p.631).

Although inquiry is becoming more prominent in schools across the United States, textbooks still dominate how science is taught with 90% of classrooms regularly using textbooks (Weiss et al., 2001). Because of this, significant attention should be focused on how to best use textbooks to help increase understanding. Although textbooks are considered to be second rank next to labs and other whiz bang activities, the actual reading of a content text, whether it is science information or any other subject, is a valuable skill that students need to acquire in order to be successful in higher education and job sites. A science education program should not neglect learning science from reading when it is agreed that reading is an essential component of doing science (Fang, 2008). Scientists look to written material for information and documentation to support their findings. If students are to understand the process of science, they, too, should be asked to read scientific material. Roe, Stoodt, and Burns (1991) argue that secondary students fail standardized tests not because they do not know the science content but because of their difficulty in reading and comprehending the text. Palincsar and Brown (1984) note that a “practiced reader” proceeds “very differently when they are reading for pleasure… or when they are reading to meet strict criteria for understanding or retention.” They go on to say that the reader “in the latter state proceeds slowly and laboriously, calling into play a whole variety of learning and monitoring activities” (p.119). Students are not yet “practiced readers” and need to be shown how to take the strategies they know and use them to understand the language of science textbooks. This can only happen with consciousness-raising activities, modeling, and continuous practice reading science text (Fang, 2006).

While science content plays a large role in a science classroom, it must not be forgotten that science is more than an accumulation of facts. Thier (2002) states that in order for good science to be taught or learned, good language skills are a must. She goes on to say that, "science and language are inextricably linked in the pursuit, determination, and communication of meaning in the context of the physical world" (p.8). The skills of science are reciprocal to the skills of language. Working with the skills of literacy, which include the disciplines of listening, speaking, reading, and writing science content will not be diminished, it will be enhanced (Anthony, Trippett, & Yore, 2010). It can empower students to acquire and be able to use science knowledge in a more authentic way (Hanrahan, 2008). Understanding these literacy disciplines and becoming aware of strategies that can be used in the classroom will ensure that students leave the science classroom not only with understanding of content, but with thinking and analysis skills that will carry with them throughout their lives.

Reading and Writing in Science- A Case for Classroom Reform

All too often teachers assume that if students can come into their classroom and read the textbook, then those students understand what they are reading. While the basic literacy skills of how to read are taught in the early elementary grades, as students move into middle and high school, new literacy skills must be taught that help students to read purposefully, meld old information with new information, and distinguish fact from opinion. In essence, students need to be taught how to comprehend (Biancarosa & Snow, 2006). One of the biggest differences as students move through the grades is that they are no longer reading storybooks, they are reading textbooks. Throughout the course of a secondary student's day, he/she will encounter seven or eight different classes with the same number of textbooks and teachers. As if this is not overwhelming enough, each content area language has "its own code, grammar patterns, and style of language" (Gee, 2004, p.14). These different social languages need to be learned in context. The language of science should be decoded, analyzed, and practiced in science class as students are doing science.

There are a number of differences in the way science is written that cause students difficulty in their understanding of the content. Wellington and Osborne (as cited in Fang, 2006) note that this is where many students find difficulty in science stating that "the greatest barrier to learning science lies in the learning of its language" (p.507). The language of science is unlike the fiction books that students are used to reading. Science is a language all its own. It is a language that is "dense, technical, abstract, and authoritative" and requires specific skills in order to decode (Fang, 2005, p.35). The English language gives students no breaks. When in a science context, many of the words that students are familiar with have meanings that are different than their use in ordinary speaking and written context. In addition, science is a technical language with over one third of the words being multi-morphemic in nature (Fang), meaning that memorizing vocabulary is a daunting and problematic task. Fang (2006) identifies a number of ways science writing is different than other social languages (Table 1).

Table 1
Summary of Common Language Challenges in Science Text As Described By Fang (2006)

Common Language Issues Found in Science Text
• Technical Vocabulary • Ordinary words with non-vernacular meanings or uses • Multiple uses of prepositions, conjunctions, and pronouns • Omission of words, phrases, or clauses to avoid redundancy (ellipsis) • Abstract nouns (nominalization) • Lengthy nouns • Complex sentences • Passive voice

Students with no prior warning of these differences are put at a disadvantage. Teachers that do not realize that these differences exist set themselves up for disappointment and frustration as to why their students are reading but not learning. As they type of reading changes, so does incentive and motivation. Without specific supports in place to help students tackle the new demands of science textbook reading, students do not progress in reading and content subjects. Lack of motivation and engagement grows through the middle years and reaches epidemic proportions in high school (Biancarosa & Snow, 2006). Reading skills eventually affect a student's ability to support himself. Forty percent of high school graduates lack the literacy skills that employers are looking for (Achieve, Inc., 2005).

Reading and understanding the language of science is only one component to ensure that students are scientifically literate. Writing needs to be an essential part of the science classroom. Even though reading and writing tend to be thought of as going hand in hand, in that good readers are good writers, this is not necessarily the case. Saul (2002) states that writing is "the way we think, organize, reflect, plan, and solve problems" (p.85). Writers need to be able to formulate their own ideas, organize them, and get them into words that make sense on paper whereas readers take those words and form mental pictures (Graham &Perin, 2007). According to the NAEP report, 69% of 8th graders were not proficient on writing goals (2007). Because of this, strategies must be put into place that supports not only reading comprehension but writing development as well. Writing is not only necessary to reflect understanding of content, but is essential for life after graduation. Those who fill out poorly written applications are likely ill fated to be hired for a position. Additionally, over 50% of employers stated that writing skills impact promotion decisions (National Commission on Writing, 2004).

Techniques to Aid in Textbook Comprehension

Decoding the Language of Science

While it is important to point out these differences, students must be taught specific strategies to decode the language (Fang, 2006). To tackle nominalizations, teachers can have students work backwards in the text to give explicit meaning to phrases such as *this process* or *this situation* or even what *it* is referring to. For lengthy nouns, students can use a noun expansion chart to make students aware of how a simple noun can be enhanced with pre-modifiers and post-modifiers. Students can also look through text and their own writing samples to pull out what would be considered lengthy noun examples and simple noun examples (Fang). This, again, makes students aware of the type of writing they will encounter in a content text so that they do not get lost in the complexities of that text.

Increasing vocabulary building strategies is another way teachers can help students work through the complex language of science. Building a content word wall in the classroom will allow students to see new vocabulary everyday as they enter the classroom. The word wall should grow as the year goes on and include words that are developmentally appropriate for the students. Students should give input as to which words are included in the word wall. Different fonts and colors can be used to point out common features of the words (Yates, Cuthrell, & Rose, 2011). Teachers can also teach common prefixes, suffixes, and root origins to help students break apart words that they are unfamiliar with. Fang (2006) states that, "direct instruction of roots and affixes can help students develop control over the technical vocabulary of science and hence more precise understanding of science" (p.508).

<u>Quick Writes</u>

Incorporating writing into a science classroom does not mean that the year is to be filled with five paragraph essays. Science writing can take a variety of forms: descriptive, explanatory, procedural, recount, and persuasive (Douglas et al., 2006). The type of writing that is done in the classroom can change depending on the purpose of the assignment. For any type of writing, what is produced will provide the teacher with tremendous insight into a students' thinking. If a student is not able write about a topic, then the student does not truly comprehend the topic (Their, 2002). The writing sample that is produced, then, provides an authentic assessment. DeFronzo (2006) argues that there is no better way to assess a student than by reading his/her conclusions. Having a variety of writing formats allows teachers the ability to keep students interested and engaged in what they are writing. Through a myriad of styles, writing offers students an additional avenue for expressing their thoughts, questions, and content learning.

Teachers can feel threatened with writing if they feel it will intrude too much on how their room normally runs. This pressure can be alleviated by adding writing into the classroom through small activities such as quick writes, carousel brainstorming, 3...2…1 (facts learned, terms to remember, question to ask), and ticket to leave. These are strategies that foster writing and thinking skills and can be done in minutes (Koteman, Saccani, & Gilbert, 2006). Tovani (2004) encourages writing to occur every day through a conversation calendar. Students chose any topic to write about, forming a dialogue with the teacher. The teacher then responds back, strengthening personal relationships, lending itself to a more open and collaborative classroom.

Making Connections to the Text

Connecting students to the topic and text that they will be responsible for is an effective strategy for increasing comprehension. Fisher and Ivey (as cited in Sutherland, 2008) state that a student's "engagement and interest play a critical role when looking at comprehension" (p. 171). All too often students feel as though content area topics do not relate to them. In order for students to learn, they must feel as though the subject matter plays a role in their life. A student that is simply reading to complete homework has very little motivation to understand (Sutherland, 2008). Teachers can remedy this by setting a clear and inviting purpose for each reading assignment or activity. Krajcik and Sutherland (2010) suggest a five step method for integrating literacy in an inquiry-based classroom (Table 2).

Table 2

Strategies for Fostering Literacy Adapted From Krajcik and Sutherland (2010)

Literacy Strategies for a Science Classroom
Link to prior knowledge and experiences • Connect science content to students' lives and past experiences
Anchor in questions • Ask questions that are interesting and meaningful to students
Integrate text and visual representations • Purposefully discuss visual elements in a science text. Give strategies to help students make use of graphs and pictures
Make use of ideas • Give students time and experiences to use what they have learned in new situations
Engage in the discourses of science • Model and give time for discussion using science themes and following the processes of science.

In each of these steps students are engaged and active. The first two of these steps, linking information to prior knowledge and experiences while evoking questions that are meaningful to the student helps illustrate the importance of material. Tovani (2004) expands on these two steps with a strategy entitled "So What" which is aimed at getting students connected to the text. With this activity, students make personal comments and connections to specific sections, sentences, or graphics in a text. In addition, they must give a reason as to why this connection helps them to understand the content. This makes readers slow down and process the text, ensuring students make a connection that is meaningful and concrete. Questioning techniques can be used not only to gain interest in a subject but to sustain interest as a student reads and investigates. As students read, questions can help to guide students towards important information and can also help them to develop ideas for future investigations. Teachers can start a unit with intriguing questions that pique students' interest such as: *Why do we say that a soda* *can is sweating? How true is this statement?* and *What is meant by it?.* This gives students a personal investment in what they are going to learn because is specifically relates to their everyday lives. Another way to use questions is to supply students a list of interesting questions before they start a reading. This is often called a preview guide or an anticipation guide. Students can make predictions to these questions before reading and then work to answer them while reading. Students want to know whether their predictions were correct (Textual Tools Study Group, 2006).

Previewing the Text

Previewing the features of a text is another strategy that can be implemented to help students feel comfortable with science reading. Textbooks each have their own format that gives them structure and organization. Where most fiction books just contain chapters, textbooks are filled with headings, subheadings, charts, and graphs (Miller &Veatch, 2010). This can be intimidating to students. They need to be shown where information can be found and what to look for in order to increase students' understanding of the written words (Hanrahan, 2008). Surveying the text allows students to preview what they are about to read thus allowing time for students to formulate their own questions and predictions about the subject (2010). These should be discussed to help build confidence and interest in the reading. Teachers can model how to read through headings and subheadings by asking questions and making connections to prior knowledge (Hanrahan, 2008). This will also help students determine important ideas become introduced to new vocabulary (Miller & Veatch). Previewing allows for students to form a "road map of the material" (Thier, 2002, p.100). Thier also states that as a teacher models, he becomes "the students' exemplar of a good reader: it is up to the teacher to let students in on the secrets that good readers use instinctively" (p.100). If students have confidence before they start reading, they will be more encouraged to tackle the demands of the content.

Concept Webs

Rumelhart (as cited in Douglas et al., 2006) offers six keys to reading comprehension after decades of research. Three are characterized as "deep structure systems" of text: determining importance, monitoring for meaning, and synthesizing (p.138). Graphic organizers provide students a visual way for to see important feature of the text and make connections between those ideas, thus aiding in comprehension. If used properly, advanced organizers like concept webs have been found to increase student achievement by 23% (Marzano, Pickering, &Pollock, 2004).

Concept webs are a specific type of graphic organizer that require students to put each main idea in a bubble on the page. Off each of those ideas, students write supporting details. Finally, students use prepositions to link the details to the main concepts. This is what makes concept webs unique to other types of graphic organizers. Students must think at high levels in order to express the relationships between concepts. This requires students to understand how a text is structured (through headings, subheadings, bolded words, and the like) and relay that onto their web (Oliver, 2009). Subsequently, teachers can more effectively judge whether a student understands the ideas in a reading by viewing his choice of linking words.

Concept webs can be implemented in the classroom in a variety of ways. When students are first introduced to the webs, a framework for the web can be given and students can fill in bubbles from a list of choices. The class can work together or in small groups to come up with how these ideas are related. More advanced students can come up with all necessary information and compare webs during class. Furthermore, concept webs can but used throughout the reading process. Students can use the heading of a reading to pull out main ideas during a pre-read, details can be added while reading, and webs can be revised and compared after reading (Graham & Perin, 2007). While these organizers can be instrumental in helping students focus on big ideas and sift through details, teachers must model how to work through the text to find key concepts (Tovani, 2004). Like with any graphic organizer, concept webs can lose their effectiveness if students receive no support or feedback (Alliance for Excellent Education, 2006).

Summarizing

Teaching students how to effectively summarize is another strategy that can help students pull out important information and synthesize meaning. This is one of the hardest skills for students to learn and for teachers to teach (Jones, 2006). However, it is a skill that is essential for students. Being able to successfully summarize produces a 34% gain in student achievement (Marzano et al., 2001). Summarizing content text requires a high level of analyzing to decide exactly what is important enough to be included. It is crucial that this skill is modeled and worked on collaboratively before students are asked to complete them on their own.

There are countless techniques that can be incorporated into the classroom that practice the skill of summarizing. Having students complete a graphic organizer before they form their summaries can help students write in a more coherent and organized manner (Miller & Veatch, 2010). Another strategy is Refine and Reduce (Jones, 2006). This has students summarize a piece of writing into several paragraphs. Once completed, students are to to revise and rewrite, reducing their writing to one paragraph. This process is repeated to further reduce the summary into one sentence while still keeping the heart of the matter clear and present. Magnet Summaries (Buehl, 2006) is another strategy that has students turning the key ideas into tactile cards that can be sorted and arranged. During this strategy, students write down magnet words that are attracted to a central concept. This word is recorded on a card and is then surrounded by supporting details. Once the reading is completed, students used the magnet card to write a sentence from the details. These sentence cards are they physically organized to form a coherent summery of the reading.

Metacognition

Metacognition requires a student to think about her thinking as she is thinking. This is to help reveal insights on the what, when, how, and why of what she is thinking (Yore, 1993). Metacognition techniques can help students to decipher what type of reading strategy to use when they are unsure of what they are reading (Yore, Craig, & McGuire, 1998). As a student reads a science text, she must be able to identify why she is struggling and then be able to accurately find a way to resolve the issue. This can best be taught explicitly through modeling. Metacognitive strategies can be used before, during, and after reading. This includes asking questions such as, *Why am I reading this? What do I know about this topic?* Such questions are similar to conversations brought up when previewing the text. By reading aloud and specifically noting comprehension strategies as they read, teachers model the process students should use while reading. If there is a particularly demanding section, teachers can stop and model the internal conversations they have while reading (Gee, 2004). This can help students understand what reading strategies are being implemented. Tovani (2004) calls the dialogue a reader has with herself an example of the "interacting voice" (p.63). This is one type of conversation voice that readers can have developed in their head. Another voice is the reciting voice. This type of voice simply reads the words on the page and does not construct meaning from them. The final type of voice is the distracting voice. It is the voice that wanders off with a particular idea or question and disturbs the mind from the reading at hand. Making students aware of these types of voices allows for students to effectively monitor their reading. Readers are making decisions with every sentence they read, deciding whether or not they understand and identifying the strategies needed to achieve reading comprehension (Yore, 1993). By engaging in these interactive reading lessons, teachers can model metacognitive skills so that students can develop and use them as they read independently (Young, 2005).

Journals

Contrary to Klentschey's (2010) model, which uses science notebooks in conjunction with a full inquiry program, writing can occur in the classroom and be documented in science notebooks without following a full inquiry process. Writing in a dedicated science journal has numerous advantages. Using a journal to keep track of frequent writing samples in the classroom allows students to reflect on past learning and see growth as the year continues by reading previous entries. Students can take ownership of their learning by reading back through their journal and finding what they believe to be their best diagram, observation, or conclusion (Kotelman, Saccani,& Gilbert, 2006). This also helps to reinforce metacognitive processes. Students should reflect upon what they have done and learned. Campbell and Fultong (2003) suggest that as students are making their reflections and connections they refer back to content knowledge. Writing summaries to classroom activities allows for students to look back in their notebooks to find evidence that supports their learning. Students' ability to support claims with evidence, another important science process skill, is supported by implementing writing in the science classroom. According to NCTE and IRA, notebooks allow students to "understand the varying demands of different kinds of writing tasks and to recognize how to adapt tone, style, and content for the particular task at hand" (Douglas et al., 2006, p.80). Whether notebooks are used as part of a full inquiry program or used in conjunction with a textbook program, having a permanent record of student writing samples allows for students and teachers to see growth in not only writing and vocabulary skills but in content understanding as well. Reardon emphasizes this by saying that "writing holds our thinking still so that we can revisit, rethink, and revise our plans, our conceptual understandings, our explanations, our theories" (Saul et.al, 2002, p.99).

While writing in science notebooks can vary in format and use in the classroom, it is essential that the writing that is done be read and critiqued by a teacher. A study examined 10 fifth-grade classrooms where notebooks were used ineffectively. They concluded that the following features of notebooks must be present if notebooks were to "assist students' thinking, reasoning, and problem solving:" (a) Teachers must use provide feedback to student entries and (b) allow the students' responses to guide their teaching (Ruiz-Prim, Li, and Shavelson, 2002, p.28). If students' summaries show that they have misconceptions, for example, a teacher needs to re-teach in order to remedy this error. In addition, (c) notebooks need to challenge students to synthesize and organize their knowledge instead of merely copying definitions and data into their notebooks.

Effectively Engaging Students in Literacy Strategies

Teachers can help students become connected to science content by questioning and thinking about their thinking, engaging them in purposeful science topics, breaking down the science text, and organizing information through writing activities. With this connection, reading can become, as Wellington, Osborne, and Yore suggest (in cited in Miller & Veatch, 2010), a "vehicle for engaging minds, fostering construction of concept understanding, supporting inquiry and cultivating scientific habits of the mind" (p.157). While these techniques can individually help increase scientific literacy, two programs offer ways to combine many of these components of a successful literacy classroom in a way that fosters cooperation between peers and gives students ownership of their learning. Reciprocal Teaching (RT) developed by Palincsar and Brown (1984) and the Peer Assisted Learning Strategy (PALS) created by Fuchs and Fuchs (2001) both feature students working together to develop questions, organize and comprehend text.

Reciprocal Teaching (RT) is a classroom-ready technique that includes four instructional strategies mentioned previously: predicting, questioning, clarifying, and summarizing (self-review). The developers state that, "these four activities were selected because they provide a dual function, that of enhancing comprehension and at the same time affording an opportunity for the student to check whether it is occurring" (p.121). During RT, the teacher models the four comprehension techniques during a short section of reading then allows for student practice, often in a small group setting. Meyer (2010) suggests that using RT in a small group centered around student questioning can "lead to increased student engagement and intellectual rigor, deeper engagement with and comprehension of texts, and higher order thinking" (p.41). This increased motivation can be attributed to the support given through various scaffolds, such as question stems and prompts. These scaffolds help students find a focus instead of starting with a blank slate for their thinking. Meyer further developed these scaffolds into a tactile 5W and 1H die that students roll to come up with Who, What, When, Where and How questions (2010). This instills extra confidence and opens up a line of communication that otherwise might be a struggle. RT has shown to significantly increase summarization skills in four of five studies and in six different studies, reading comprehension significantly improved compared to the control group (Sporer, Brunstein, & Kieschke, 2008).

Through the PALS program, students alternate between being the tutor and tutee as they work through a reading passage. The pairing of students is flexible and daptable to any grade or intellect level while still allowing all students to become involved in tasks that can be completed successfully (Vanderbilt Kennedy Center, 2011). Because of this shared responsibility, students showed improved attitudes about reading and showed greater understanding of content (Sporer & Brunstein, 2009). Students complete three reading tasks throughout the PALS experience. Partner reading and retell helps to improve fluency and allows for mastery of basic reading skills. Paragraph shrinking is a summarizing technique aimed at finding the main ideas. Prediction relay is the final activity that asks students to make predictions based on what they have read. These predictions are then checked as students continue the reading passage (2009). In each of these steps the tutor and tutee have specific roles. These roles help to ensure comprehension and keep students motivated and on task. Roles switch during the three activities so that each student has experience in both roles. Like with RT, the PALS process incorporates much modeling and direct instruction from the teacher when setting up guidelines for pair work. Scripts are included with the program as well as video support (2011).

Conclusion

Literacy is not only just teaching students how to read or write. Knowing how to read and write is just the beginning of literacy. As students start to read textbooks instead of storybooks, the demands of literacy change. In order for students to be successful, they need to be explicitly taught strategies to handle this change just as students were taught explicitly how to sound out words. Literacy in science requires complex thinking strategies. These require the reader to decode the complexities of a text and become personally connected to it enough so that the reader can write about what he has learned. Teachers play a critical role by modeling how good readers comprehend. A science classroom must provide opportunities for students to interact and connect with the text through reflections and activities that help students organize and synthesize the information they have read. Reciprocal Teaching and peer assisted learning strategies can provide classroom- ready ways to incorporate many of the necessary literacy techniques into the classroom in a way that keeps students motivated and engaged in learning. Vartan Gregorian, president of Carnegie Corporation of New York, sums up the need for literate students by saying, “if today’s youngsters cannot read with understanding, think about and analyze what they’ve read, and then write clearly and effectively about what they’ve learned and what they think, then they may never be able to do justice to their talent and their potential” (Graham & Perin, 2007, p.10).

METHODOLOGY

Introduction

My capstone project was conducted over the two-month period of November to December 2011 covering the second half of our life science unit. During the treatment period, our study included units on protists, fungi, and plants. Through the first part of the life science unit, students showed little connection to the text they were reading. Textbook worksheets were perceived as 'search and find' missions and understanding of concepts was limited to regurgitating facts. The majority of the dialogue was teacher driven with students answering questions in a large group setting. Because of these concerns, I felt that a new approach to reading was necessary in order to get students interested and understand the text in deeper ways. Contrary to the typical reading from a textbook and filling out workbook pages, during the treatment students worked cooperatively to question and connect to the content they read. I modeled the reading strategies that students used and gave feedback and guidance throughout the treatment period. While all current classes received the same instruction, only three of the five classes were used as the treatment group. This allowed the sample size (N= 55) to remain manageable and let me focus on a heterogeneous mixture of students who were of average intelligence. Results from the treatment group were compared to their assessments and attitudes data collected earlier in the year. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix A).

Treatment Process

Over the course of four weeks, students were assigned to read five sections from the textbook. For each of these sections, the QRCR (Question, Read, Connect, Reflect) strategy was used. I modeled this strategy so that students would have a chance to see the strategy in action and ask questions prior to having the students work on their own. For this strategy, students were given a preview sheet, the QRCR Discussion Organizer (Appendix B), based off a model from the International Reading Association (2010), to make their initial predictions and connections to the text. Students had several minutes to look through the textbook section. Students made connections and recorded information they didn't understand, surprising or interesting items, and new vocabulary. Next, students were put in groups of two to four to discuss their thoughts. Then, the textbook section was read piecewise, pausing after each sub-heading. During this break, students went back to the text and pulled out key terms and ideas. These were organized in a concept map on the Magnet Summary Sheet based off of a model of the same name (Buehl, 2006) (Appendix C). Finally, students wrote a short summary on that sub-heading. Students repeated this process until all sub-headings were read (Table 3).

Table 3
Summary of a Typical QRCR Session

Step	QRCR Process	Who Was Responsible
1	Fill out QRCR Discussion Organizer	Individual
2	Read one heading of assigned section	Group w/ assigned roles
3	Complete concept web on Magnet Summary Sheet (W1)	Group w/ assigned roles
4	Complete summary sentence on Magnet Summary Sheet for W1	Group w/ assigned roles
5	Continue steps 2-4 until section is complete	Group w/ assigned roles
6	Fill out QRCR Self- Assessment	Individual

After the readings were complete, the whole class came together to talk about the summaries, compare concept maps, and answer any questions that were not answered in the text.

For this study, a variety of data collection methods were used to test the effectiveness of the treatment. I used the following data collection methods discussed in detail below:

- Reading and Writing in Science Questionnaires
- QRCR Student Self- Assessment
- Magnet Summary Rubric
- Student Interviews
- Teacher Observations and Reflections
- Assessment Data

Reading and Writing in Science Questionnaires

Data collection began prior to the treatment period with a Reading and Writing in Science Questionnaire (Appendix D). This was given at the beginning of the life science unit to record preliminary thoughts about reading and writing in science. These questionnaires helped me to determine student likes and dislikes as well as attitudes on the importance of reading and writing. Responses from this questionnaire allowed me to narrow my treatment to areas where the students were less comfortable and also allowed me to cater to their preferred learning styles. Research in literacy strategies, as indicated in the literature review, is diverse and extensive. While students indicated that they knew about strategies such as predicting and making connections, they also told me that they do not use these strategies to help them with their reading. Because of this, the focus of my treatment allowed students a chance to actively use questioning and summarizing.

Students also mentioned that they preferred to read cooperatively. This was included as part of the treatment to not only motivate students but it also gave them an outlet to communicate the strategies they focused on. Readjusting my implementation plan before beginning the treatment showed me just how valuable good data collection tools are to make teaching fit the needs of my students. A modified version of the questionnaire, QRCR Thoughts (Appendix E) was given at the end of the research phase to chart any changes that have taken place regarding attitudes towards reading and writing in science as well as how important students felt the strategies were to their success.

QRCR Student Self- Assessment

After each of the four QRCR sessions, students monitored their performance using the Self- Assessment (Appendix F). Students assessed themselves on their participation and contributions to the discussion. They were also asked whether their group used key ideas and vocabulary, made connections, and whether the discussion over the text cleared up their questions. Students rated the statements on a scale from *very good* to *needs improvement*. In the concept attainment section, students marked on a one to five scale. By comparing these ratings as the treatment progressed, I was able to see whether students became more involved in the textbook discussions and whether the discussions increased their understanding of the section. These self-assessments also allowed me to focus on students who struggled with sharing their ideas and groups who did not use time effectively. Students were moved to more efficient groups to help motivate more reserved students to participate. This was another example that showed the importance of on-going assessment to constantly monitor student performance.

Magnet Summary Rubric

The Magnet Summary Sheet was used by students during each of the QRCR sessions. Magnet Summary Sheets from the QRCR session were graded using the Magnet Summary Rubric (Appendix G). The rubric contained two sections, one to grade the concept map and the other to grade the summary. Each section was evaluated on a four-point scale, with the points totaled after each section. To score well, concept webs must have included all new vocabulary and incorporated all key ideas. The web also needed to be clearly organized with supporting details present. For the summary sentences, students must have had a properly written sentence that included the main ideas with no inaccurate information. Strengths and weaknesses in both the concept maps and summaries were analyzed and compared to other forms of data, such as observations and interviews. Also, the average scores for each week were determined to show progress over the treatment period.

Student Interviews

I asked for feedback after the treatment on the QRCR strategy using the Interview Questions-QRCR Strategy (Appendix H). This interview took place several days after the last section was read. Six students volunteered to give their viewpoints on the QRCR strategy as well as their views on how the strategy has impacted their learning of science material. Of the six students, three were girls and three were boys. Students represented all of the sections in the treatment, with two students from each class period. Because of time constraints, students were interviewed in a small group to allow for a more freeflowing conversation. The interview lasted 20 minutes during the students' study hall. Students answered in a round-robin format with answers building off others' comments. All interview questions were answered and I also asked many clarifying questions during the interview session. Feedback on the interview questions also helped me to validate how students answered on their QRCR self-assessment forms; it made the rubric scales more personal.

Observations and Teacher Reflections

Informal observations of both my teaching and student interactions were recorded during each of the QRCR sessions. Observations were collected on the Teacher Reflection and Observation Form (Appendix I). Observations focused on student motivation, whether or not students were engaged in productive discussions, and the discourse heard as students were doing the Magnet Summary Sheets. My observations were compared with student interview responses as well as their self- assessments to see if my thoughts of how things were going were what the students were feeling. The reflections that were made offered me a place to put down my frustrations and challenges associated with changing my teaching routine. Also, I was able to use it as a place to record successes and reflect on what could change for the next QRCR session. Observations and reflections were analyzed to find lasting problems as well as note where changes were made that could account for student growth in understanding and motivation.

Assessment Data

While the Protist and Fungi Quiz (Appendix J) and Intro to Plants Quiz (Appendix J) were not part of the treatment, results were compared to the same quizzes taken by students in 2010. Test scores from three heterogeneous classes very similar in make-up and skill level were used from the 2010 school year. The quiz covered the main ideas from the protist and fungi sections, the first two sections covered in the treatment. The Intro to Plants quiz covered material from third treatment section, plants. Students from the 2010 school year took the quizzes after the standard teaching method, reading the section and answering questions, were used. Information from the fourth and fifth sections was not assessed using traditional methods. Both quizzes contained a variety of quiz questions, ranging from multiple choice to fill in the blank to short answer. Student averages for the three sections of students were compared for both the quizzes.

QRCR Coding

The Magnet Summary Sheet (Appendix C) provided the bulk of the data used to determine whether the QRCR strategy improved student understanding. Because of the amount of webs, summaries, and criterion that were analyzed, the data was coded. Webs were coded as W1 (for the first web of that section), W2, and W3. Summaries were related to the web they summarized. Only the protist and fungi section had a third web and summary. Because of this W1 and W2 for the four sections were compared unless otherwise noted. Because of the small amount of data gathered for the fifth session, data was used as a supplemental data point (Table 4). Since mastery of content was the goal of this treatment, data was analyzed using the highest score ranking, a four, unless otherwise noted.

Table 4
Overview of QRCR Sessions and Content Covered

QRCR Session	Content Covered	Section Headings	Data Point
1	Protists	Day 1: Introduction to QRCR Guided practice-What is a Protist	n/a
		Day 2: Animal- like Protists	W1
		Plant-like Protists	W2
		Day 3: Fungus-like Protists	W3
2	Fungi	What are Fungi	W1
		Reproduction in Fungi	W2
		Roles of Fungi in Nature	W3
3	Plants	What is a Plant	W1
		Adaptations to Life on Land	W2
4	Seed Plants	What is a Seed Plant	W1
		How Seeds Become New Plants	W2
5	Roots, Stems, Leaves	Jigsawed section within class period. One or two groups per class did the Roots section, Stem section, or Leaves Section	various

Conclusion

In order to help students become more connected with the textbook readings, the QRCR (question, read, connect, reflect) strategy was implemented during a four-week period. Students utilized these literacy strategies in small groups. This allowed students to foster communication about the topics instead of passively reading and answering questions with the intent that student understanding will be increased. Student questionnaires, self- assessment forms, summaries, interviews and teacher reflections were all used to gather data throughout the treatment period and are summarized in the Data Triangulation Matrix (Table 5).

Table 5
Data Triangulation Matrix

Will implementing literacy strategies in science increase motivation and performance**?**	Observations	Interviews	Questionnaires	Reflection Responses	
Secondary Questions:					
a.) Will using the *QRCR* strategy increase understanding and effort?	Assessment scores	Questionnaires	Rubrics	Reflection Responses	
b.) Will group work, centered on questioning the text, increase motivation and comprehension?	Questionnaires	Interviews	Reflection Responses	Observations	
c.) Will summaries constructed by students help develop better writing skills and increase students summarizing abilities?	Questionnaires	Rubrics	Observations		

DATA AND ANALYSIS

<u>Vocabulary</u>

Of the five areas of the concept webs that were analyzed using the Magnet Summary Rubric (Appendix G), vocabulary had the highest percentage of students scoring the maximum score of four throughout the QRCR sessions. In order to score a four, a student must have included all of the new vocabulary words on their web. Seventy-five percent of students scored a 4 on W1 for the protist section, 78% on the fungi section, 96% for the plant section, and 98% on the seed section. Scores lowered slightly for W2 with a 72% as the average percent of students that scored a rating of 4 (Figure 1).

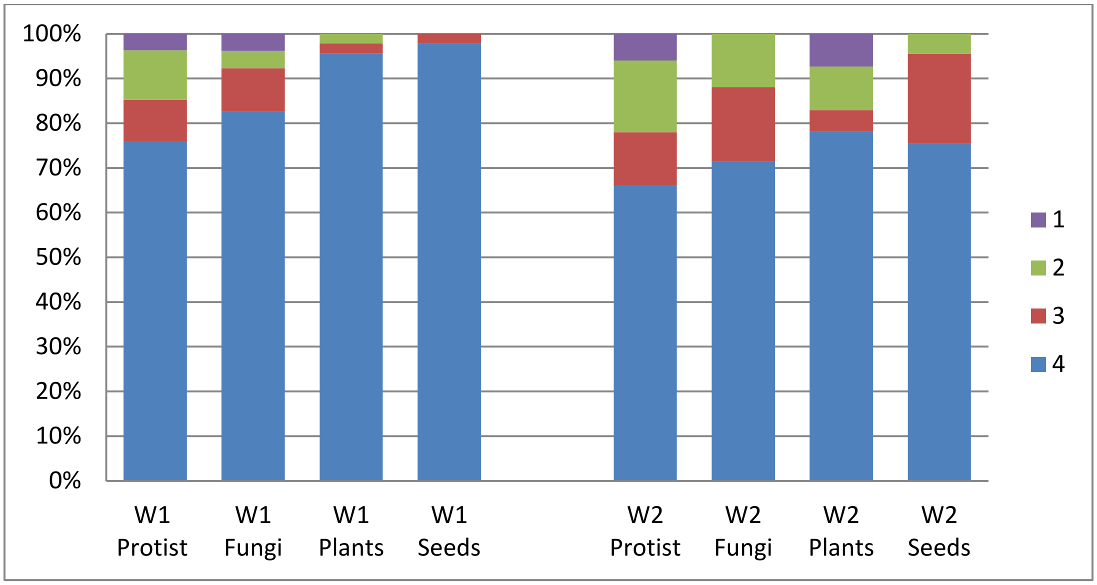


Figure 1. Vocabulary scores for W1 and W2 (note that *N*= varies for each section. Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 47*)*. 1= vocab words not used, 2=some words included, 3=most words included 4=all words included.

Additionally, 89% of the groups for the Roots, Stems, Leaves section scored a 4 for the vocabulary section. Despite the fact that student webs contained the appropriate new vocabulary words, comments on the Self-Assessment sheets (Appendix F) indicated that students had problems with these new words. Forty-two comments indicated that students felt they needed to work harder on vocabulary or that the vocabulary was their *Muddiest Point*. Several students indicated that pronouncing the words was a challenge and one student went on to say that because of this she "just skipped" the words. This is reflective of student responses to the pretreatment questionnaire question *Vocabulary is easy to learn*, with only 30% indicating that they *very much agreed* with this statement. My observations also showed that students continually mispronounced words. While I observed groups that helped each other to pronounce words correctly, more often than not, students quickly gave up on words they couldn't easily say and moved on with their reading. This was true even when I pronounced the word and had students recite the word back to me. Still, students gave up and wanted just to move on.

Organization of Concept Webs

Scores for web organization also increased for each QRCR session. Webs showed high levels for organization if similar concepts were grouped together so that connections between ideas could be easily made. Lower scores had words scattered around the web with no apparent connections or reason for placement. For W1 50% of students scored a 3 or 4 on the protist section. Scores increased to 70% for W2. Fungi scores increased by 15% from W1 toW2, matching the protist percentage. Plant section scores remained steady at 85% for each web. By the final section, seeds, 90% of students scored at a 3 or 4 on W1 with an increase of 5% for W2. Seventy-six percent of those earned a score of 4 (Figure 2).

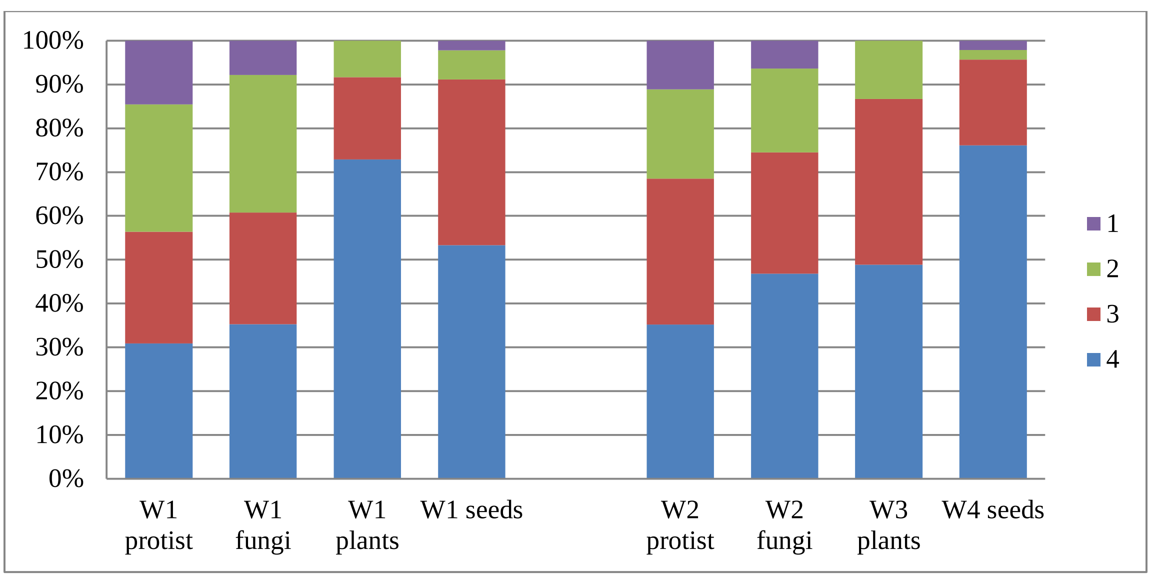


Figure2. Organization scores on W1 compared to W*2* (note that *N*= varies for each section. Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 4). 1= skill not present, 2=undeveloped skill, 3=emerging skill 4=developed skill.

Students' attitudes on the use of graphic organizers changed over the course of the treatment as did their ability to use them. On the pretreatment questionnaire, 41% of students *very much agreed* that graphic organizers helped them to understand and organize information. After the treatment, 64% of students said that it was easy for them to organize information on the webs. Additionally, 36 comments were made on the Self-Assessments where students felt that they *did a good job* on the webs with only 3 comments made under the section *I need to work harder next time on* _________. While organization scores increased, students that were interviewed after the treatment commented that this was still something that they found to be challenging. During the first QRCR session, I observed that about half of the groups for each class period struggled with how to effectively place their ideas on the web in order to show connections between ideas. To help guide students, I put a template on the overhead and offered suggestions on how to group like ideas. About 75% of students closely copied this template for the protist W2. After going over the webs for that section, I observed students were much more confident in their ability to place ideas on their webs. In almost all groups at least one member served as the leader and helped the others with proper organization. On the post-treatment questionnaire, QRCR Thoughts (Appendix E), 60% of students indicated that they *very much agreed* that it was easy for them to pull out concise bits of information and put it on their webs. One student noted, "I like webs better than notes since they are easier to find things." Another said, "I organize it so that someone who has no clue gets it."

<u>Key Ideas</u>

Students generally improved over the five sections in regards including key ideas on their webs. The most growth for this area was shown on the protist section. For W1 43% of students identified all key ideas (scoring a 4) with an increase of 9% on W2. The three other content sections also showed some improvement, with fungi W1 scores up 4% from the protist W1 and a 21% increase of for the seed section as compared to the protist W1. The plant section was an outlier and showed that 91% of students were able to identify the main ideas.. This understanding is echoed on the Self- Assessments with 69% of students agreeing with the statement that they used key ideas and vocabulary during the discussion of the plant section. This percentage is more than a 15% increase compared to any other section. Despite this growth, other than the protist section, the other QRCR sections decreased their percentages for W2. The plant section showed the largest decrease or 38% from W1 to W2. Over half, 55%, of the Root, Stem, Leaves groups scored at a 3 for this section.

Contrary to what their webs showed, 62% of students indicated on the final questionnaire that it was easy to find the main idea. Numerous students indicated that they used textbook headings and bolded words to help them with this. One student wrote that it is easy to identify the main ideas but for “longer sections, it is harder.” The Self-Reflections yielded 19 responses that *understanding* was one something that the students’ felt they did a good job at.

Summary Sentences, the second part of the Magnet Summary Sheet, also tested whether students were able to identify the key idea of the section. Summaries for W1 showed a slight increase over the four sections with protists at 37% mastery to seed plants with 68% mastery. Contrary to the high *Key Ideas* section for the concept webs, the plant section summaries were substantially lower with 53% of students who expressed the main idea in their summary. Scores for W2 again increased slightly from W1 for protists but then were markedly lower for the other three sections (Figure 3).

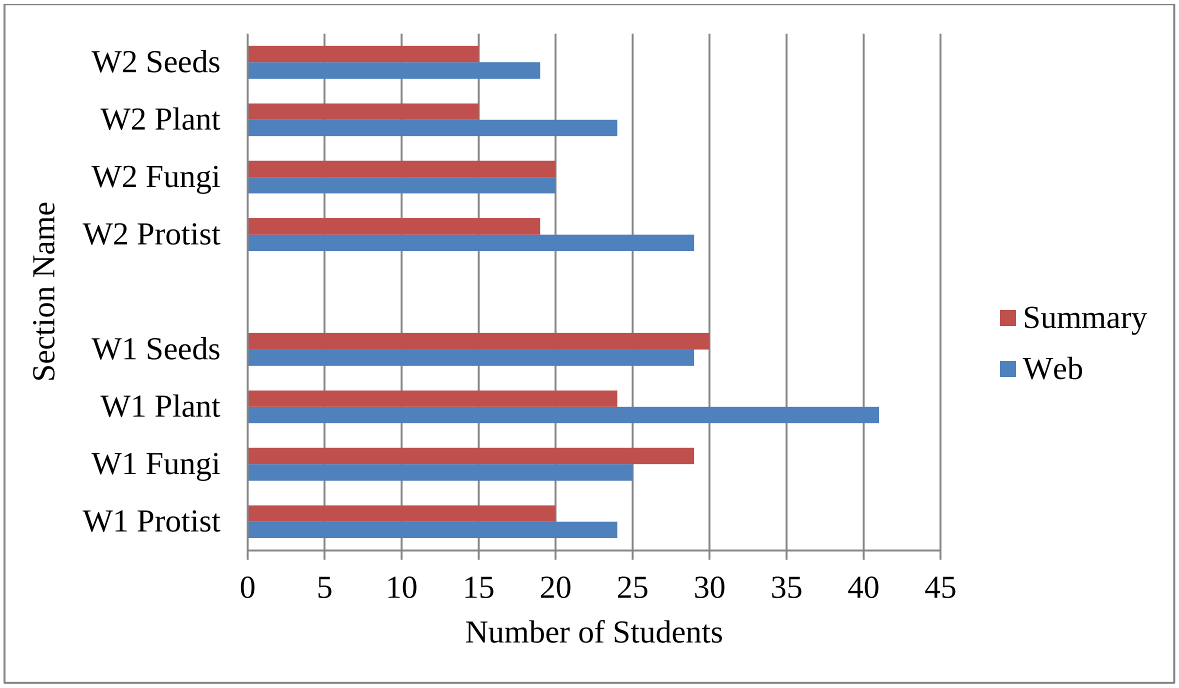


Figure 3. Identification of key ideas on webs compared to summary sentences (note that *N*=varies depending on section Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 47).

Prior to treatment, 47% *very much agreed* that summarizing was easy for them while only 34% agreed after the treatment period. Almost the same number, 28%, indicated their confidence level at a 6 out of 10 or below. Students that we were interviewed felt pressure to "get everything in one sentence" and found that to be stressful. One student wrote on the post-treatment questionnaire "I tend to overwrite so it worries me to summarize." During the interview another student mentioned that it was hard to try to relate the first ideas in the section to the later ideas which complicated the summaries. While some students felt as though the webs helped the summary process, "it clears my mind of the fluff," others mentioned that lack of understanding was the major factor that lead to difficulties in summarization. “It is hard because we read so much new information,” another student wrote.

As I went through the packets I made the observation that while webs seemed to improve, the summaries, on a whole, did not show as much growth. According to the pre and post questionnaires, students’ confidence in their ability to use good writing skills decreased by 5%, with 52% of students who very much agreed that it was easy to use these skills. Additionally, the number of summaries that scored a four in the well written category had less than 7% growth throughout the sections. There was only one section, plant W2, that students scored over 60% at a 4. All other sections had less than 53% of students writing with correct grammar, punctuation, and sentence structure (Figure 4).

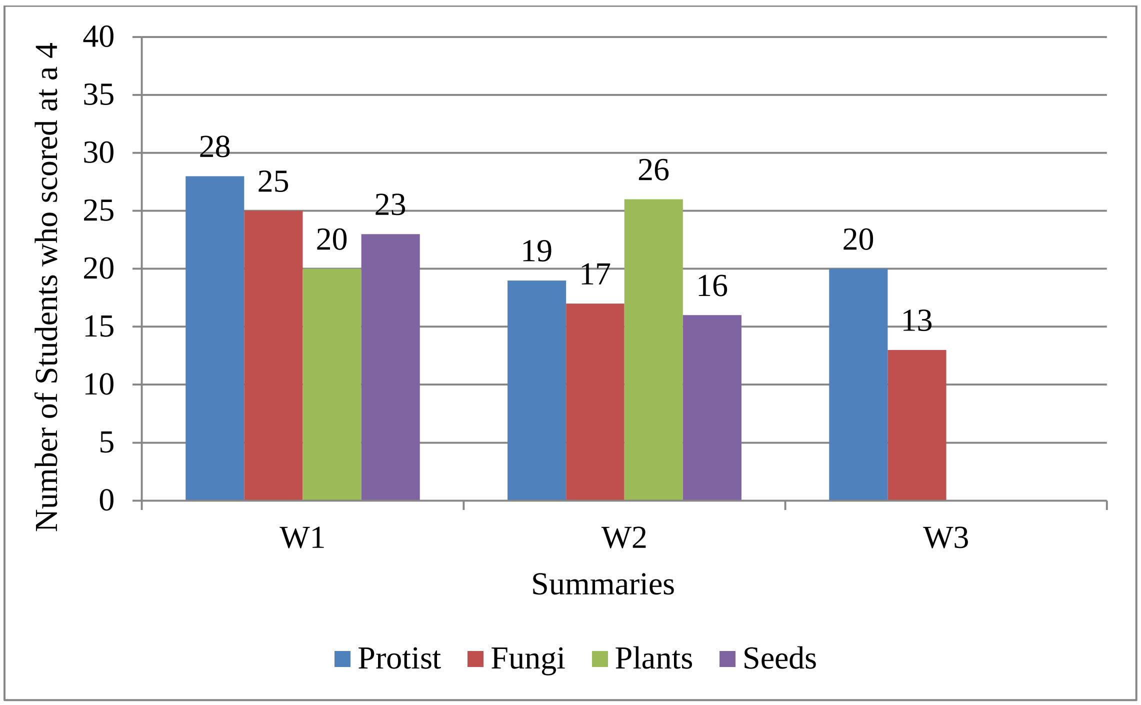


Figure 4. Summaries scoring 4 on well written (note that *N*=varies depending on section Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 47).

The inclusion of appropriate details and accurate information on the webs was another indicator of whether students understood the key concepts. Whereas students showed improvement on organization, there was almost no growth in the number of students that were including essential details about the key ideas. The only growth between W1 and W2 was for the protist section with 44% of students whose webs included a majority of details increasing to 55% on W2. The fungi and plant sections held steady at 30% and 60% respectively, whereas the seed section saw a slight decrease from 57% scoring in the 4 range on W1 to 54% on W2. However, across the board, students showed a high level of accuracy with every section on W1 and W2 at 55% proficiency or higher. Accuracy remained high for the Roots, Stems, Leaves section at 67%. All four sections showed growth from W1 to W2 with percentages increasing for each section. The exception, the fungi section, showed a 10% decrease in accuracy.

I noted in my observations that as we worked through the sections, students' webs became much more involved. After the first QRCR session, students quickly figured out their style and had very clever ways of organizing information so that the key ideas and details were both present. During the fungi section, however, I did have to remind students that concept webs were different than bulleted lists. Several students in each class period wanted to have the key idea listed around the web and then put supporting details under that heading. Even the struggling students seemed to find success with the web making approach. Below is one such student's web from the protist section to the fungi section. Notice the increased organization, inclusion of main ideas, and supporting details from image A to image B (Figure5).

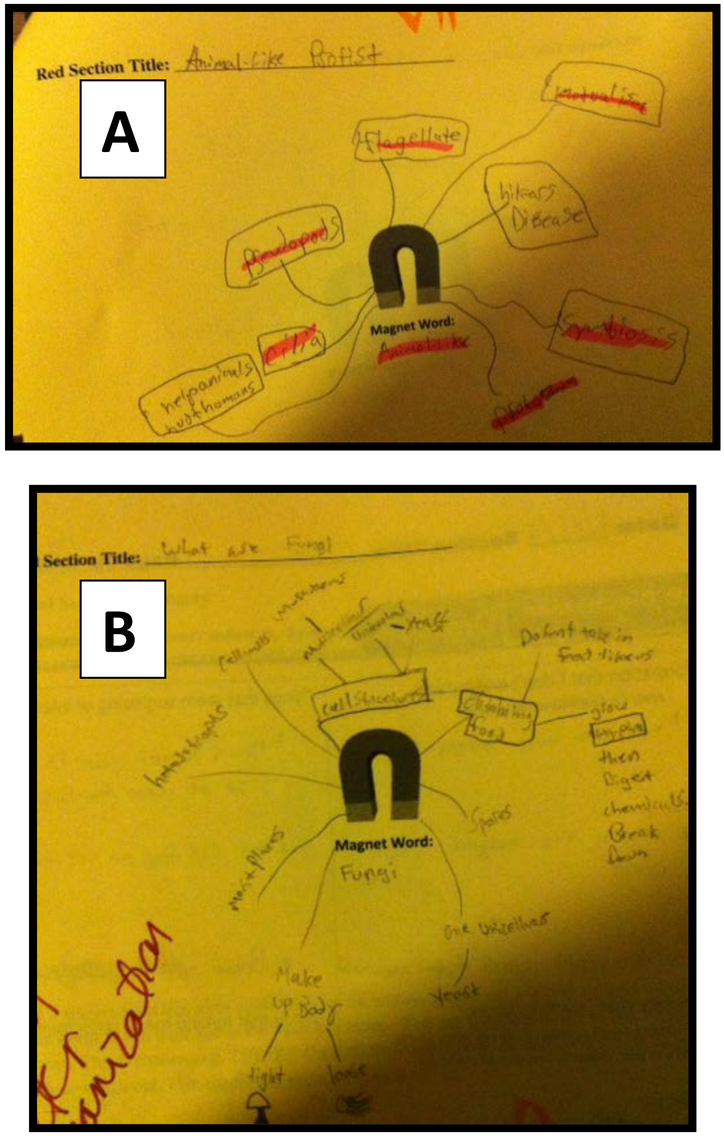


Figure 5. Sample of student growth on concept webs.

<u>Assessments</u>

Total comprehension of the sections can be shown through analyzing assessment scores from the end of the protist and fungi unit and the end of the first part of the plant unit. The average quiz score on the Protist and Fungi Quiz (Appendix J) from the 2010 classes was an 81%. On the same quiz taken after two QRCR sessions, students had an average score of 89%. Scores from the Intro to Plants Quiz (Appendix K) saw similar gains from 2010 to 2011. Students averaged 79% on this quiz in 2010. In 2011 after the 4 week treatment period, scores increased by 10% to 89% (Figure 6).

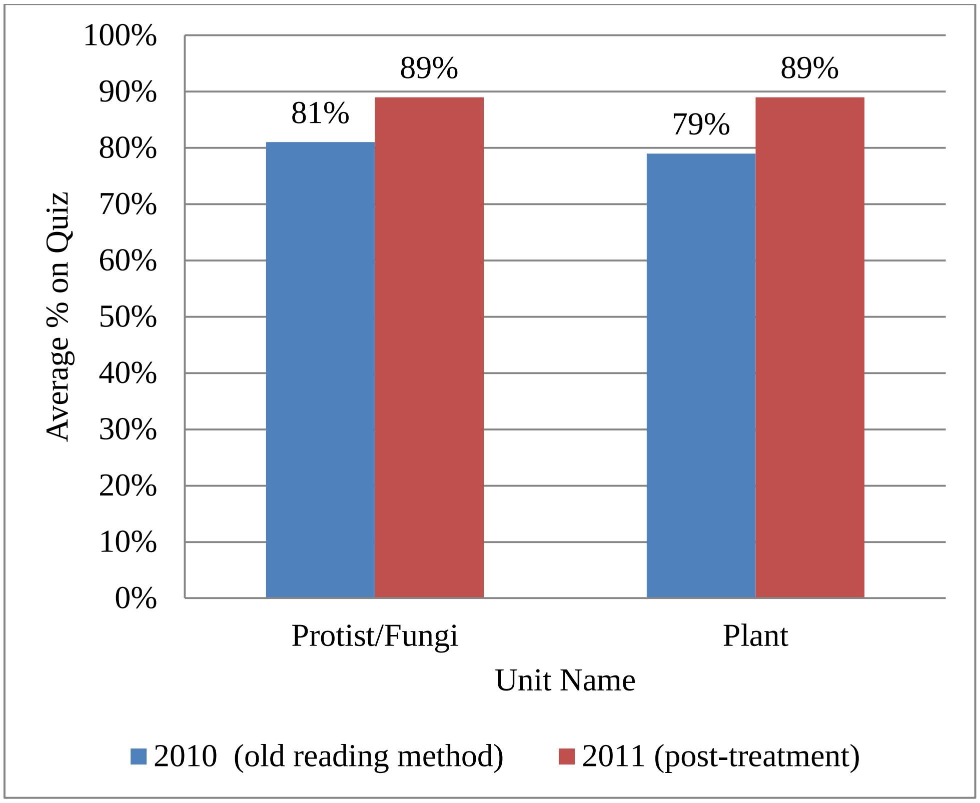


Figure 6. End of unit assessments average score in 2010 vs. 2011 (2010 *N*= 62, 2011 *N*=57).

<u>Treatment Effects on Motivation, Confidence, and Effort</u>

<u>Questioning and Connecting</u>

The Discussion Organizer (Appendix B) intended to help students question the text, immediately was a source of frustration and struggle. One student on their Self-Assessment commented that their Muddiest Point was "Why did we even do the Discussion Organizer?" Another wrote on the post questionnaire "I sometimes like scanning quickly so I can get an idea, but mostly it [the Discussion Organizer] was a waste of time." I observed distain throughout the first three sessions with 55% of the students that marked that they either *somewhat disagree* or *disagreed* on the post questionnaire that the reading preview using the Discussion Organizer was helpful. From observations, students spent a substantial portion of the given time looking at what others were doing or using stall tactics such as pencil tapping or doodling. In each class period, there were three to four students per session, approximately 24% of the treatment group, who filled out less than 50% of the sheet. When interviewed, one student said, “I don’t think that it helps me learn better.” Contrary to the students’ dislike, 45% of students indicated on the first Self- Reflection that the they agreed with the statement *Today’s discussion helped to clear up the questions I had on the Discussion Organizer*.

A challenge with the Discussion Organizer was the first indication of students’ difficulty making personal connections to the reading. Despite their dislike, almost 50% of students *very much* agreed that they made connections on the pre-treatment questionnaire. For the statement *I connected knowledge from previous sections and my personal experiences when I participated* on all four of the Self- Assessments, students marked *For the Most Part* and *Could Use Work* more than any other question. Despite this, some improvement was shown. For the protist and fungi section, students responded with 65% and 64% of the total responses in this category. One student wrote, “I don’t know how we are supposed to connect to this stuff [the protest section].” Responses declined by 8% for the third QRCR session and ended with 45% of students who marked that connecting was still a challenge. Despite this drop, nine comments on the Self-Assessment specifically addressed that connections were still a challenge. In my reflections, I noted that students would not write down particular connections to the reading because they felt as though the connection wasn’t, as several students told me, “good enough.” I wrote that as I went around the room I had to tell each class that “even if you think of something small, write it down. A connection is any way you can relate to the material in the textbook. There is no wrong or right way to connect." While student confidence was low regarding connections, students were still actively engaged in the QRCR process. For three of the sessions 70% of students responded that they *answered others questions and were respectful of their thoughts.* Responses to this question on the fungi section, however, were substantially lower, with 40% of students agreeing.

<u>Group Work</u>

When in the cooperative groups, students went through the QRCR process without much teacher guidance. While 55% of the class indicated on the pre-treatment questionnaire that they preferred to read on their own, 70% of students remarked on the final questionnaire that reading in the pairs and small groups during the QRCR strategy helped to keep them motivated. Additionally, 70% of students felt as though they understood more reading using the QRCR strategy. One student noted, "I like getting help from others and getting their ideas and thoughts." Another wrote, "When I'm working with (student's name), I'm always on topic and wanting to finish." Additionally, 27 comments on the Self- Assessments specifically indicated that students felt they did a good job participating and helping their partner(s) to understand the section. This was indicated by comments such as "my group really helped me understand" on the statement *I feel as though I did a good job at* _________.

Group work also had challenges. As one student indicated on the final questionnaire statement *Working in pairs/groups helps me stay motivated*, "It's [the score's] in the middle. It depends on who you're working with and what you're working on." In my first reflection on the QRCR process, I noted that although I spent much time trying to come up with cooperative groups that had a mix of abilities and personalities, not all groups ended up working effectively. After trying new groups for the second session and still finding that, on average, two to three groups either did not communicate well enough to get through the process (talked too much and did not stay on task or did not share at all), I allowed the students to pick their groups for the next two sessions. Students were also aware that finding the correct partner was tough. During the interviews students mentioned that while they did not always like the partners they were assigned to, they also did not all like picking their own partners. “Sometimes you get left out or you work with someone you always work with. Then you don’t learn as much,” one student commented. Another student wrote on the final questionnaire, “you ask questions and someone explains it you get a variety of ways to look at it,” while yet another said, “no because we get off task.”

Overwhelmingly the most common comment on the Self-Assessment reflection statement I *need to work harder next time at* ________ was to be “on task.” This was written 95 times over the 5 sessions. However, progress in this area was recorded. On the question *I remained on topic and helped my group stay focused* 33% of students agreed with this statement during the first session with the number increasing to 59% by the final session (Figure 4). Even though students were in assigned groups for the last session, I observed that they were very motivated to complete the webs and worked diligently on the task in the time given. One student in the interview mentioned that she liked the “variety of the type of groups.”

QRCR Strategy

Whereas students had different experiences with their groups, they also had differences in opinions on the effectiveness of the QRCR strategy. According to the Self- Assessments, more students marked *Very much agreed* to the statements *Today's discussion helped to clear up the questions I had on the Discussion Organizer* and *I feel comfortable with the information I read about in this section* and *I shared my ideas and gave reasons for my options* as the QRCR sessions progressed. Only the fungi section saw a slight decrease in the *questions answered* section, dropping 5% from the protist section to 40% in agreement. A larger decrease was on the statement *comfortable with the information*, with a drop of 13%, from the protist to the fungi section. Ratings increased to 70% and 82% of students who agreed that they were comfortable with the content covered in the fourth and fifth QRCR sessions, respectively (Figure 7).

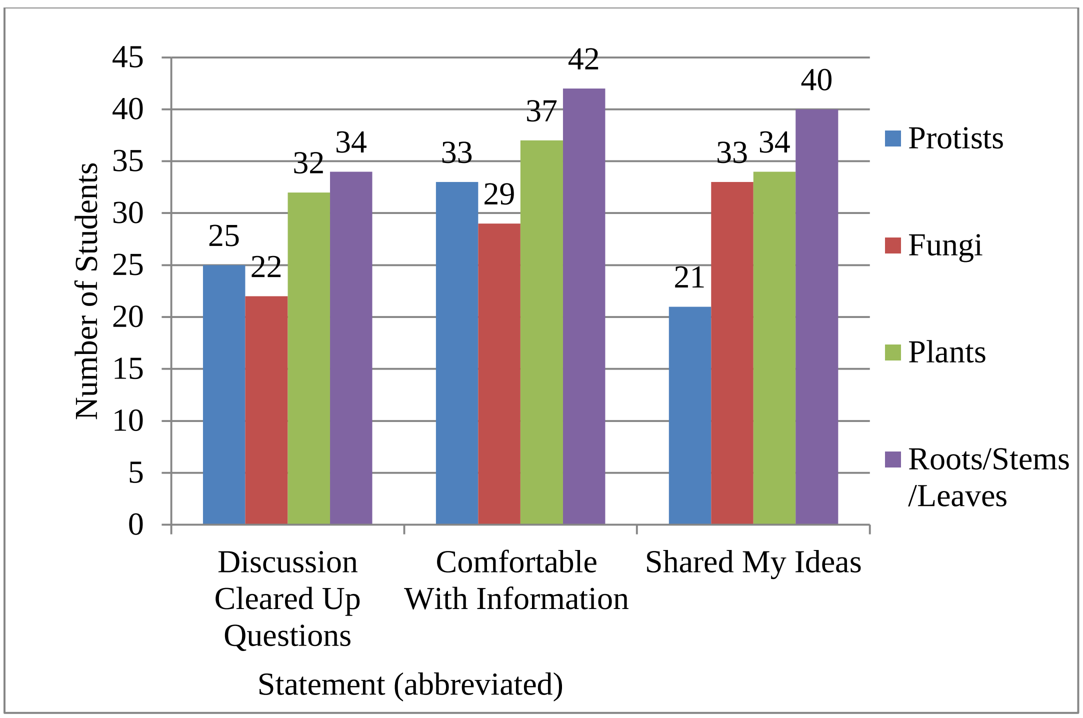


Figure 7. Self-assessment growth throughout QRCR sections (note *N*=varies depending on section Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 47).

One student commented that "It's [QRCR] easier and I understand more in groups." Another said "I learn more than on my own but not as much as in a whole group." In my reflections I commented on the fact that I didn't feel as though I needed to go over content as much as I did in the previous years, especially with the protist section. I wrote "students had a good base with their webs and after we went through the webs as a class, it seemed as though they were able to make sense much quicker than when they were just given a worksheet to demonstrate understanding."

Scores on the Magnet Summary Sheets, on a whole, showed a slight decline from the first web and summary of the section to the final web/summary combination. This was most evident on the first two QRCR sessions where there were three webs and summaries produced. When looking at the combined scores of 3 and 4s earned by students in key ideas section, for the protist scores decreased from 84% of students in the 3/4 range to 58%; fungi saw only a slight 2% increase during this period. For the details section, protist scores dropped 22% from W1 to W3, with fungi scores dropping 18%. On the effort score, scores dropped 27% and 9% respectively. Similar drops were shown in the plant and seed sections for W1 and W2 (Figure 8).

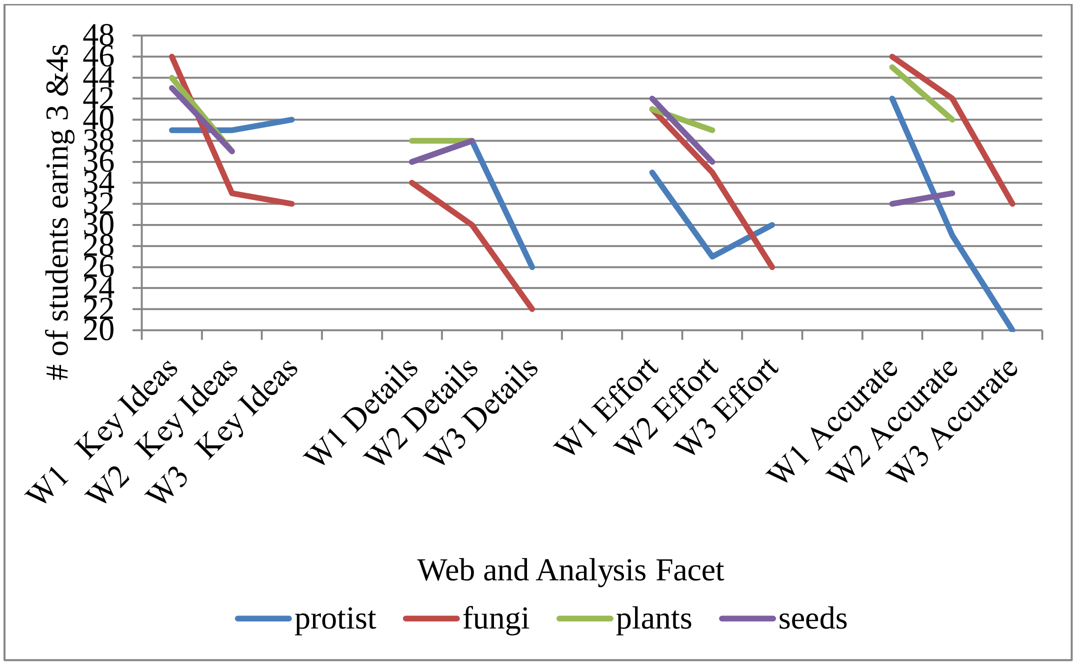


Figure 8. Multiple webs: effects on ideas, details, and effort (note *N*=varies depending on section Protist *N*= 55, Fungi *N*= 54, Plants *N* = 47, Seeds *N*= 47).

From observations, I noted that students started each session excited and got to work quickly on the Magnet Summary Sheets. There was high energy and students remained on task. However, as the class period went on, I had to refocus groups more frequently. Contrary to this, students generally performed better in all analyzed areas as they progressed through the QRCR sessions. Students showed the most proficiency in the Plant section and the least proficiency in the Fungi section.

Fifty-six percent of students either *very much agreed* or *agreed* with the final questionnaire statement that the QRCR strategy was better than the old reading method. However, only 40% of students *very much agreed* that the webs and summary kept them engaged in the reading. Sixty percent indicated on the pretreatment questionnaire that they liked doing worksheets (done after reading) and 67% felt that they really learned the topics (after using the old reading method) after a unit. Twenty-eight percent agreed that they used reading strategies prior to treatment (Figures 9 and 10).

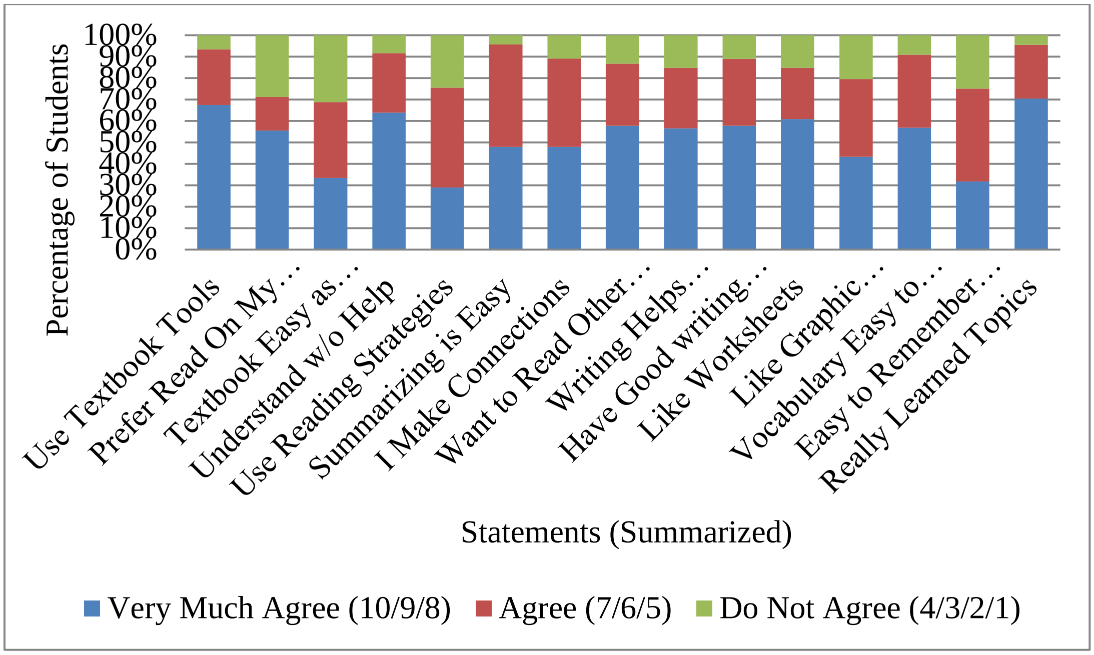


Figure 9. Reading and writing in science questionnaire, (*N*=46).

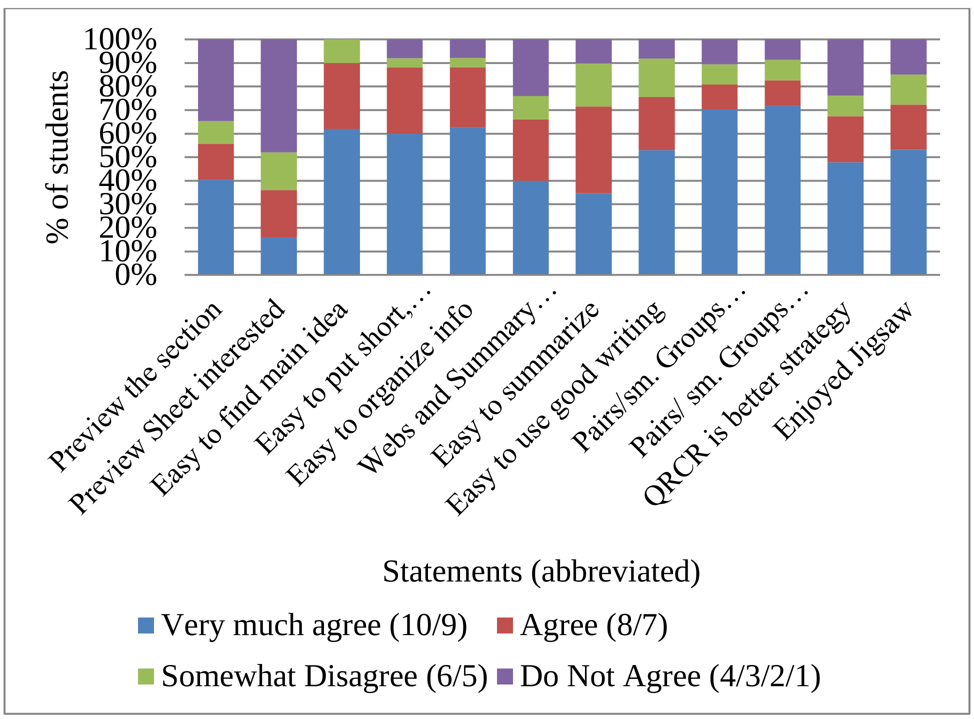


Figure 10. QRCR thoughts, (*N*=50).

Students that interviewed said that they like the fact that with the QRCR roles that they got to be “an expert” and teach others. Another commented that the role of connector was hard because “it was hard to be able to make a connection everyone understood.” Another student wished that the concept webs were more visual: “maybe we could try using Inspiration [computer software] next time.” One student said that this strategy made her “think about it [the content] instead of just copying it.” As the sessions progressed, I noted that I was surprised at how easily the kids adapted to the new classroom routine. I expected there to be more resentment as to why we were doing things this way or that we had to do the QRCR strategy again. On the contrary, there was only a small handful of students that openly voiced their dislike. I further observed that students seemed to thrive under the tutelage of their peers. A student wrote about the benefit of working together by saying “you can ask questions and someone explains it, you can get a variety of ways to think about the content.” While it was still evident that there were leaders and followers, my observations showed that students seemed much more engaged in the process set forth by the QRCR strategy than they had been earlier in the year or in previous years.

INTERPRETATION AND CONCLUSION

In response to my focus question “Does implementing literacy strategies in the science classroom increase motivation and understanding?” the results from my classroom research indicate that there were slight gains in both student motivation and understanding. While gains were small, it became clear to me that science understanding and reading ability are very much connected. Any time that can be spent directly teaching students how to better comprehend the reading is time well spent.

My first sub-question asked if the new reading strategy, QRCR, would increase student understanding. Through careful analysis of the QRCR process and the student work that was produced, it is clear that students showed growth in their ability to identify key ideas and organize that information. While scores fluctuated from one section to the next, the general trend showed improvement in all areas analyzed, thus showing that students' skills were polished as the QRCR sessions progressed. While I wanted to make the grading scale on the rubric as objective as possible, the scales did have a subjective quality to them. This became very noticeable as I went through the analyzing process. For instance, with the vocabulary section I found that as I graded, it didn't mean a whole lot, in terms of understanding, if a particular vocabulary word was on the concept web. What I wanted to see was that the vocabulary word was there and there were details and/or a definition to help me see that students understood that word. Because this was not part of the rubric, however, I had to stick with the criterion that was part of the rubric. Other parts of the rubric showed similar discrepancies causing some scores, in my opinion, to be inflated. However, because of the variety of data sources, I still feel as though students gained understanding and grew throughout this process.

My second sub-question questioned whether the group work aspect of the QRCR strategy would increase motivation. Student input on the questionnaires and comments on the Self- Assessment lead me to believe that they enjoyed the change in routine on how we previously read sections from the textbook. While the QRCR process took substantially longer, the fact that students had to use higher order thinking skills and communicate with each other to derive meaning was worth the extra time. The data helped me to see that while students did well with this new technique, it is best done in short sections. Having students work with the QRCR strategy over multiple headings, without coming back as a whole group to discuss, caused scores to decrease. Especially since this was our first time using the QRCR strategy, I think student gain would have been more substantial if I included more opportunities to model how to organize the webs and synthesize that information to get a clear picture of what the section was about.

Because students had to construct webs and summaries in their own groups, I believe that their motivation and effort were much higher than when they were asked only to fill in blanks on a worksheet. I was truly impressed on how students rose to the occasion and embraced this new strategy even though it was much more demanding than what they were used to. While I am generally hesitant to allow students to work in groups because of the fear of losing control of the classroom, through the QRCR process, it was demonstrated that students, when in a variety of groupings, were able to focus on a task and perform well.

My third sub-question asked whether student constructed summaries would improve the students' summarizing and writing skills. The use of the web as a graphic organizer helped students to organize the information they were to summarize. However, the ability to use the graphic organizer to make sense of the information still required work. This was evident by the lower scores on the section summaries. Students had difficulty correctly identifying the overall message of the section. Lower scores on this section could be because of flaws in the grading rubric. The rubric for the summaries again showed a subjective nature to how the summaries were graded. I erred on the side of *I think they know what the main idea is by what they have down* instead of looking for a strict idea. However, the more evident reason for the lower scores is because of a lack of proper time, modeling, and practice. While I did show students how to use the web to gather main ideas and with those, construct a sentence, because this was such a new skill for students, they could have used more guided practice. This was shown with the large number of students who indicated that summarizing was hard or made them apprehensive. It was also shown by the wide varieties of summaries that I saw. Some were one sentence, usually regarding the last paragraph's idea, while others tried to rewrite everything the book talked about.

One of my main purposes for putting a summarization component in, other than its proven benefits to understanding, was to allow students an opportunity to improve their writing. Even though the summaries only required a few sentences of writing per section, this is more writing that students were used to. I wanted students to realize that it was important to be able to synthesize their thoughts in a coherent manner and get them on paper, that this showed true understanding. However, this aspect of the treatment was overshadowed by the time consuming nature of the actual reading and web making in the QRCR process. The process took much more time to implement than was planned, thus, I had to cut out the time I would have spent on reviewing sentence structure and other writing skills. Without being able to properly write sentences, it was hard for students to come up with summaries that made sense. This, coupled with the lack of guidance on the summaries, was something that I hope to improve on in future units.

The strategies that were implemented in this project were chosen to allow students more interaction with science text. This interaction forced students to make connections and think in ways they previously had not been required to do. The breadth of my project was just too immense to achieve results that definitively answer the research question.

Because of the number of strategies that were used, it would be interesting to see, when tested separately, which of the strategies is able to increase student performance the most. Furthermore, do certain strategies work better with a particular type of student?

VALUE

2011-2012 Reflections

The largest benefit from the process of implementing the QRCR strategy was just that: implementing it. I have complained for years that the way we, me and my 7th grade colleagues, read the textbook and used worksheets to test for understanding was just not the best we could do. It was, however, the safe thing to do. Having to commit to the QRCR process and see it through, while uncomfortable and nerve racking, was definitely a boost to my confidence that I *can* implement something I feel strongly about and make needed changes in the classroom. After finishing my literature review dealing with the variety of ways to implement literacy in the classroom, I had so many great ideas that I wanted to find a way to incorporate them all. On paper, everything looked as though it would play out perfectly. Each device was carefully orchestrated to match a piece of research that I found to be valuable. However, the real world quickly showed me that I bit off way more than I could possibly implement effectively. This was shown in my classroom study where I had a dizzying number of steps, student roles, worksheets, and assessment tools. Even though I had a plan on how the implementation process would look, the needs of the students had me modifying the QRCR process on a daily basis. Time was my biggest enemy as I had to sacrifice much of the pre-teaching and re-teaching that has been shown to be so important in order for students to have time to get a task completed. While the constant changes made the analyzing the process difficult, it showed me that nothing is set in stone and ultimately whatever is best for the students is what needs to happen. While I didn't get overwhelming results that showed that the QRCR process is the end-all-be-all of literacy strategies, gains were positive enough that I am motivated to continue to revise and improve some of the QRCR steps.

Since the treatment period, I have modified the QRCR process in a variety of ways. Based on the questionnaire and interview results, I decided to cut out the formal preview section (the Q). Students did not feel that this was valuable and I did not feel as though I got the results that I would have wanted for the time it spent for the students to look through the text. The questions seemed forced and irrelevant. The connections were nonexistent. I do believe that it is important to make the connections, however, we have tried to work together to do this through introduction activities.

As I scored the webs from the QRCR packets, I found that a majority of students had trouble organizing their information and expanding on the terms and ideas that they found to be important. While they could identify the correct ideas, I did not have a good sense of WHY they felt they were important. Because of this, I felt that students needed more instruction on how to organize their webs so that they could show connections between ideas. To help students with this, I developed a set of 'bare-bones' webs for a subsequent chemistry unit. Each web was a bit less structured than the web before. The first web had all key terms identified and connected. There were also spots included on the web to allow for additional relevant information to be added. This first web was done together and we talked about why certain terms were placed where they were. I also asked probing questions to help students recognize the connections on their own. With the subsequent webs, fewer terms were identified though spots were left for students to fill them in with the final webs having only the starting ideas represented (Figure 11).

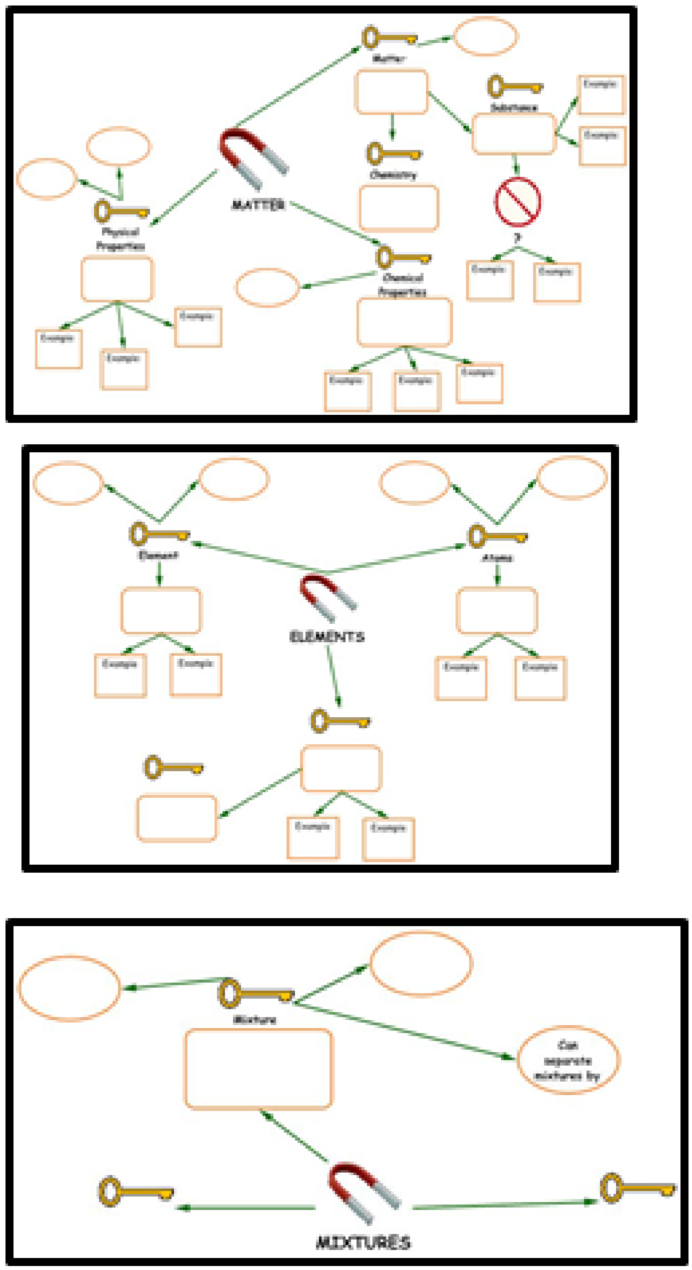


Figure 11. Sample of revised QRCR web progression from structured to student generated.

The thought was that students would be able to use what the previous webs' structure showed them to find identify the main ideas and create their own connections between terms. As we worked on the first web, students seemed interested in filling in the correct terms. Through our discussion we were also able to work on the skills of paraphrasing and distinguishing important from supporting details.

I was able to share my experience with the QRCR strategy with my fellow seventh grade science teachers. Hearing that students were more engaged in the science readings and that scores on the end of unit assessments increased from the previous year, one colleague decided to implement the revised QRCR webs during our chemistry unit. After implementing these in her classroom, she mentioned that observed a change in effort and motivation during the chemistry reading. Because of this success, I hope to continue to modify and rework the QRCR strategy in my classroom. While I feel as though the webs have greatly increased motivation, I plan to find different ways to work on summarizing as well as provide more modeling of good reading and thinking skills.

Looking back on the project as a whole, I feel as though I wanted to do too much at one time. While I like the QRCR process, it was a lot to implement at one time. Often I forget that when trying anything new with seventh graders, it takes two or three times the amount of time than anticipated. With our short class periods, trying to get in all of the steps in the QRCR process was one of the biggest struggles. Because each day felt rushed, I felt as though nothing was done as well as it could have been. This may explain why there were not huge gains seen in any of the aspects that were measured. This process did, however, help me to focus on areas that I knew were a problem and start making strides to correct them. Even though the data did not show huge gains, I have already found ways to modify the work from my capstone research project help students continue to become better readers and writers.

Reflections since 2011-2012

In the years since the action research-based classroom project, I have taken much that I learned during the literature review and the implementation processes to better incorporate reading and writing into the classroom. Since the capstone project, our district adopted a new textbook series. In the spring of 2012, the science department at my school (both 7th and 8th grades) decided to go with a textbook series that allows students to write in, thus interacting with, their science text. I was very adamant about going with the Prentice Hall Interactive Science series as it was the manifestation of many of the best practices in reading and writing that I had researched.

There are several features of the book that support the classroom research that I conducted. First, at the beginning of each chapter is a thought provoking question that gets students thinking of the main theme of the chapter. In addition to this activity, there is a reading preview that tests student readiness through a short reading passage. If students have trouble with this passage, there are supplemental readings that make sure students have the background information to read the chapter. Then, at the beginning of each section, students have a Planet Diary entry that again engages students into the topic by bringing to light real world applications to the ideas that will be covered. All of this very closely mimics the question and connect section of the QRCR process. As students read, they see the new vocabulary words highlighted in the text and key ideas bolded in the text. This helps students to be active readers and helps them to develop good reading strategies such as picking out the big ideas in a selection. Throughout the reading there are multiple opportunities to interact and reflect on what they have read. We call these thought boxes as they are separate from the text- usually incorporated into figures and diagrams off to the side of the text. Students need to digest what they have read in order to answer the questions or complete the tables and charts. These thought boxes are the part of this text that really set it apart from any other textbooks we have had. Students get the opportunity to write directly into the text right next to where the reading took place. They are connecting and reflecting to that text while still having full access to the material.

While it has been difficult for some students to get used to this new way of thinking and reading because it is now a much more active process than reading has been in the past, we have seen tremendous changes in the motivation and interest of the students. Students are forced to slow down their reading because of the thought boxes. When students read, we require them to fill out all of the thought boxes as well as highlight the definitions of the new vocabulary words. We alternate doing this as a whole group, listening to the text online and discussing together, as well as having students work in small groups or pairs. Having the thought boxes and the highlighting gives us many opportunities to assess whether students understand the material. By looking at the answers to one or two thought boxes, we can see what concepts are understood and where re-teaching needs to take place.

Another change that we have made because of the classroom research was making vocabulary more of a priority. We now post vocabulary on a vocabulary wall so that students have access to all of the new words that we are learning on a continuous basis. This helps them to see that words that we learned in chapter one are not just going to be memorized and forgotten- they are going to become part of our vocabulary. For each section of the text we prepare vocabulary cards for the students. The word is on the front of the card and the definition is on the back. Instead of using the definition that is found in the glossary of the book, we have put the definitions into what we call seventh grade language. We do this to help students learn how to put definitions into terms that they can understand. While the vocab cards are premade, we have the students add to them. On the front, they need to visually represent the word with a picture. On the back, they need to enhance the definition with either more information or an example that will help them to understand more deeply. Just as the change in the textbook reading took some time, doing the vocabulary cards in this fashion was a struggle for the first couple of chapters. However, it has been a valuable tool for us to really know whether a student understands a word. If a student can't come up with a picture, we can ask some probing questions to help that student come up with something that will work for the word. By looking at the pictures, we can then ask students *how does this picture help you to understand the word?* We can then gain insight into where that student is in terms of comprehension.

These two changes, the new textbook routine and the vocabulary cards, have done a world of difference in how our classroom runs. Students have clear expectations at what needs to be done for each section. They have multiple ways to connect and interact with the text through reading, writing, and drawing. Students are constantly being questioned by the thought boxes in the book and demand them to think about what they are learning. They are not just passively reading to get to the end of the section. Because students are engaged, they take more ownership to the material. Varying the ways that we read- with a partner, small groups, and as a whole class- there is much opportunity for discussion and students remain excited to read and learn. One area that we are still trying to develop is finding additional opportunities to have students write. While the thought boxes do require the students to write every day, a definite change from past practice, we would like to continue working on ways to help student summarize and express what they know on paper in a more thoughtful way.

In conclusion, going through this research project changed me as a teacher in several ways. First, I learned that implementing a research project in the classroom, while daunting at times, can lead to many unforeseen advantages. Even though the QRCR process had some flaws, because I took the chance and implemented it, I was able to put some of the best practices that I had read about into my classroom. Before this project, I would have read about a practice and then in my head gone through all of the ways that method would not work for me or my students. Through the research project and after, I have been able to tweak these methods to make my teaching more effective and increase students' engagement in class. This has given me more confidence in my teaching skills to try to include other research proven pedagogy, such as differentiation. Another important change that I have made as a teacher as a result of this project is to focus on one skill at a time. Going through the QRCR process, I soon realized that there was just too much to teach and expect the students to properly learn. I often catch myself trying to cram as much into a class period at a time but after reflection I remind myself of the project and find one big goal to teach. Finally, the biggest change that I have taken away from the project is how important it is to explicitly teach reading skills in science. Through the literature review, I was overwhelmed at research that shows how advantageous this is. I am excited to continue learning about best practices and helping my students become the best readers and science students they can be.

REFERENCES CITED

Achieve, Inc. (2005). *Rising to the challenge: Are high school graduates prepared for college and work?* Washington, DC: Author.

Alliance for Excellent Education. (2006). Reading and Writing in the Academic Content Areas. *Alliance for Excellent Education Issue Brief,* 1-7.

Anthony, R., Tippett, C., Yore, D. (2010). Pacific CRYSTAL Project: Explicit Literacy Instruction Embedded in Middle School Science Classrooms. *Research Science Education*, 40, 45-64.

Biancarosa, C., & Snow, C. E. (2006). Reading next—A vision for action and research in middle and high school literacy: A report to Carnegie Corporation of New York (2nd Ed.).Washington, DC: Alliance for Excellent Education.

Buehl, Doug. (2006). *Classroom Strategies for Interactive Learning*. Newark: IRA.

Campbell, B., & Fulton, L. (2003). *Science Notebooks: Writing about Inquiry*. Portsmouth: Heinemann.

Douglas, R., Klentschy, M., Worth, K., &Binder, W. (Eds.) (2006). *Linking Science and Literacy in the K-8 Classroom*. Arlington: NSTA Press.

Fang, Z. (2005). Scientific literacy: A systemic functional linguistics perspective. *Science Education*, 89, 335–347.

Fang, Zhihui. (2006). The Language Demands of Science Reading in Middle School. *International Journal of Science Education*, 28, 491-520.

Fang, Z. et al. (2008). Integrating Reading into Middle School Science: What We Did, Found, and Learned. *International Journal of Science Education,* 30, 2067-2089.

Fuchs, D., & Fuchs, L. (2001). Peer-assisted Learning Strategies in Reading: Extensions for Kindergarten, First Grade, and High School. *Remedial & Special Education*, 22, 15-21.

Gee, J.P. (2004). Language in the science classroom: Academic social languages as the heart of school-based literacy. In E.W Saul (ed.), *Crossing borders in Literacy and Science Instruction: Perspectives on Theory and Practice* (p.13-32). Newark, DE: International Reading Association, Inc.

Graham, S., & Perin, D. (2007). *Writing next: Effective strategies to improve writing of adolescents in middle and high schools – A report to Carnegie Corporation of New York.* Washington, DC: Alliance for Excellent Education.

Hand, B., Alvermann, D., Gee, J., Guzzetti, B., Norris, S., Phillips, L.,et al. (2003). What is Literacy in Science Literacy? *Journal of Research in Science Teaching*, 40, 607–615.

Hanrahan, Mary (2008). Bridging the Literacy Gap: Teaching the Skills of Reading and Writing as They Apply in Science School. *Eurasia Journal of Mathematics, Science, & Technology Education*,5, 289-304.

International Reading Association (2010). Seed Discussion Organizer. *ReadWriteThink*. Retrieved October 13, 2011, from http://www.readwritethink.org/classroom-resources/printouts/seed-discussion-organizer-30632.html

Jones, R. (2006). Summarizing. *ReadingQuest.org: Making Sense in Social Studies.* Retrieved October 11, 2011, from http://curry.edschool.virginia.edu/go/readquest/strat/summarize.html

Klentschey, M. (2010) *Using Science Notebooks in the Middle School*. Arlington: NSTA Press.

Kotelman, M., Saccani, T., & Gilbert, J. (2006). Writing to Learn: Science Notebooks, a Valuable Tool to Support Nonfiction Modes/Genres of Writing. In Douglas, R., Klentschy, M., Worth, K., &Binder, W. (Eds.) *Linking Science and Literacy in the K-8 Classroom*. (p. 149-162). Arlington: NSTA Press.

Krajcik, J. & Sutherland, L. (2010). Supporting Students in Developing Literacy in Science. *Science*, 328, 456-459.

Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom Strategies that Work Research Based Strategies for Increasing Student Achievement*. Alexandria: ASCD.

Meyer, K. (2010). 'Diving into Reading': Revisiting Reciprocal Teaching in the Middle Years. *Literacy Learning: the Middle Years*,118, 41-52.

Michigan State University (2007, February 27). Scientific Literacy: How Do Americans Stack Up? ScienceDaily. Retrieved February 26, 2010, from http://www.sciencedaily.com/releases/2007/02/070218134322.htm

Miller, M., & Veatch, N. (2010). Teaching Literacy in Context: Choosing and Using Instructional Strategies. *The Reading Teacher*, 64. 151-165.

National Commission on Writing. (2004, September). *Writing: A ticket to work… or a ticket out: A survey of business leaders*. Retrieved January 23,2012, from http://www.writingcommission.org/report/html

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* Washington, DC: The National Academies Press.

National Research Council. (1996). *National Science Education Standards*. Washington, D.C.: National Academy Press.

Oliver, K. (2009). An Investigation of Concept Mapping to Improve the Reading Comprehension of Science Texts. *Journal of Science Education and Technology*, 18. 402-414.

Palincsar, A., and A.Brown. (1984). Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities. *Cognition and Retention*, 2. 117-176.

Roe, B. D., Stoodt, B. D., & Burns, P. C. (1991). *Secondary School Reading Instruction: The Content Areas*. Boston: Houghton Mifflin.

Ruiz-Primo, A., M.Ki, and R.Shavelson. (2002). Looking into student science notebooks: what teachers do with them. *CRESST Technical Report*, 562. Los Angeles, CA: CRESST.

Saul, W., Reardon, J., Pearce, C., Dieckman, D., & Neutze, D. (2002). *Science Workshop Reading, Writing, and Thinking Like a Scientist*. Portsmouth: Heinemann.

Sporer, N, Brunstein, J., & Kieschke, U. (2008). Improving Students' Reading Comprehension skills: Effects of Strategy Instruction and Reciprocal Teaching. *Learning and Instruction*, 19, 272-286.

Sporer, N. & Brunstein, J. (2009). Fostering the reading Comprehension of Secondary School Students Through Peer-Assisted Learning: Effects on Strategy, Knowledge, Strategy Use, and Task Performance. *Contemporary Educational Psychology*, 34, 289-297.

Sutherland, L. (2008). Reading in Science: Developing High- Quality Student Text and Supporting Effective Teacher Enactment. *The Elementary School Journal*, 109, 162-180.

Textual Tools Study Group. (2006). Developing Scientific Literacy Through the Use of Literacy Teaching Strategies. In Douglas, R., Klentschy, M., Worth, K., &Binder, W. (Eds.) *Linking Science and Literacy in the K-8 Classroom*. (p. 261-285). Arlington: NSTA Press.

Thier, M. & Daviss, B. (2002). *The New Science Literacy Using Language Skills to Help Students Learn Science*. Portsmouth: Heinemann.

Tovani, C. (2004). *Do I Really Have to Teach Reading? Content, Comprehension, Grades 6-12*. Portland: Stenhouse Publishers.

Vanderbilt Kennedy Center (2011). *Peer Assisted Learning Strategies: Strategies for Successful Learning.* Retrieved October 11, 2011, from http://kc.vanderbilt.edu/pals/

Weiss, I., Banilower, E., McMahon, K., & Smith, P. (2001). *Report of the 2000 National Survey of Science and Mathematics Education.* Chapel Hill: Horizon Research.

West Des Moines Community School District (2011). *West Des Moines Community Schools About Us.* Retrieved February 1, 2011, from http://www.wdmcs.org/district/about/index.php

Yates, P., Cuthrell, K., & Rose, M.(2011). Out of the Room and Into the Hall: Making Content Word Walls Work. *The Clearing House*, 84, 31-36.

Yore, Larry. (1993). Middle School Students' Metacognitive Awareness of Science Reading, Science Text and Science Reading Stratgies: Model Verification. Unpublished professional paper. National Association for Research in Science Teaching.

Yore, L., Craig, M., & Maguire, T. (1998). Index of Science Reading Awareness: An Interactive-Constructive Model, Test Verification, and Grades 4–8 Results. *Journal of Research in Science Teaching*, 35, 27-51.

Yore, L., Bisanz, G., & Hand, B. (2003). Examining the Literacy Component of Science Literature: 25 Years of language Arts and Science Research. *International Journal of Science Education*, 25, 689-725.

Yore, L., Hand, B., Goldman, S., Hildebrand, G., Osborne, J., Treagust, D., et al. (2004). New directions in language and science education research. *Reading Research Quarterly*, 39, 347–352.

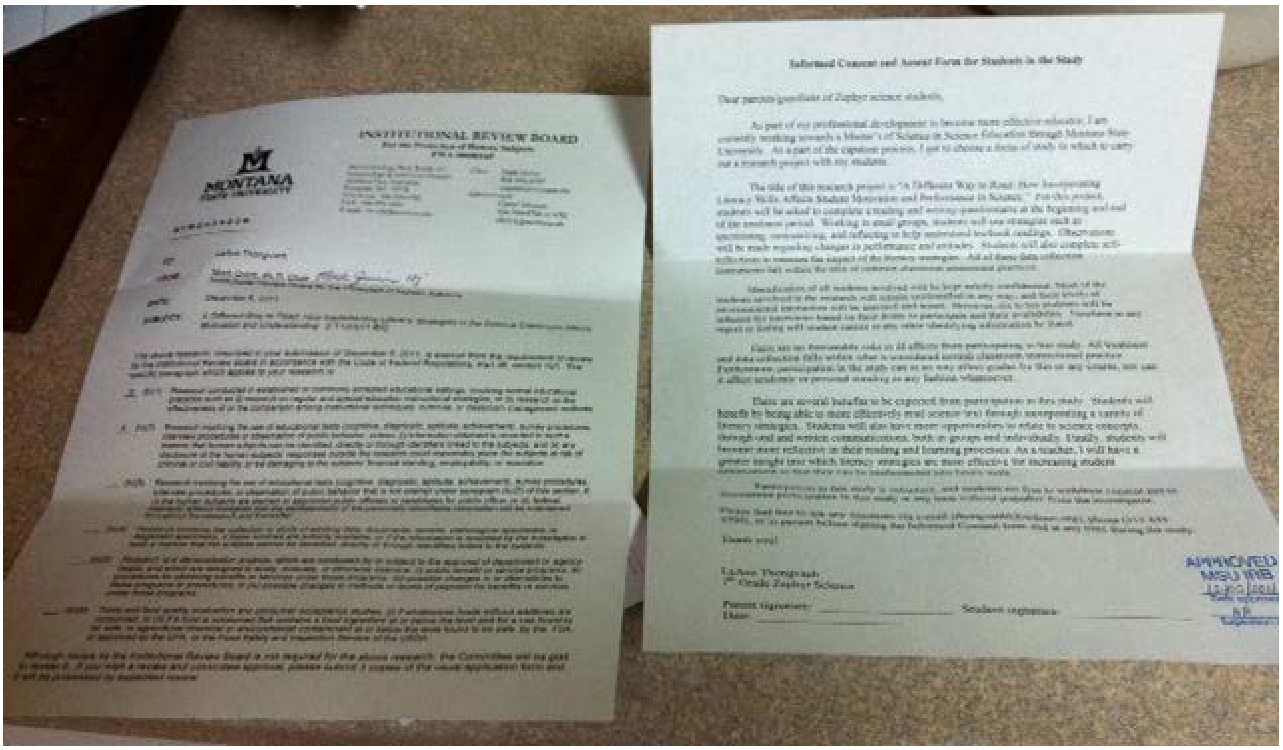
Young, Edyth. (2005). The Language of Science, the Language of Students: Bridging the Gap with Engaged Learning Vocabulary Strategies. *Science Activities*, 42, 12-17.

APPENDICES

APPENDIX A

IRB DOCUMENTATION

Evidence of IRB Documentation



APPENDIX B

QRCR DISCUSSION ORGANIZER

Date: ________ **Section Title:** ___________________________ **Page #s** _______________

QRCR Discussion Organizer

readwritethink

Information that I don't understand:	Things that seem surprising or interesting:
1. 2. 3.	1. 2. 3.
Vocabulary that I want to know: KEY TERMS from the section PLUS any other words you find in your scanning that you do not know	**Things that remind me of other things I know:** 1. 2. 3.

APPENDIX C

MAGNET SUMMARY SHEET

MAGNET SUMMARY SHEET

Concept Web:

1.) BEFORE YOU READ: Under the picture of the magnet, write the main topic of the section- the *MAGNET WORD*.

2.) AFTER you read the section, go back and add key ideas that help you to understand the main topic. These ideas are ATTRACTED to the magnet word. Blue headings will give clues to important info.

3.) Connect your key ideas to the magnet word (and other key ideas) with linking words that help to show how the terms are related.

Red Section Title: ____________________________________

Magnet Word:

Section Summary:

Using your concept map, write a summary sentence using the magnet word and the key ideas that describe it (the details).

APPENDIX D

READING AND WRITING IN SCIENCE QUESTIONNAIRE

Statement	Rate 1- 10 10= very much agree 1 = do not agree	What is your reason??
EXAMPLE: Mrs. Thongvanh and Mrs. Flaugh are the best science teachers ever.	10	They are really smart and they care about me. They let us do labs and explain science concepts well.
1. Textbook tools such as headings, the glossary, figures, bold words, and pictures help me to understand the reading.		
2. When we read in science, I prefer to read on my own.		
3. Reading a science textbook is just as easy as reading a free reading book.		
4. When assigned a section to read in science, I usually understand what I read without much help from the teacher.		
5. When I read a section from the textbook, I use reading strategies such as predicting and questioning to help me understand.		
6. After reading, it is easy for me to summarize what I have read in writing.		
7. It is easy for me to make connections about what we learn about in science to things I already know or have experienced.		

8. I wish that we could read other things about science besides the science textbook.		
9. Writing in science helps me to remember what I have learned.		
10. It is easy for me to use good writing skills (complete sentences, spell correctly, use good grammar) in science.		
11. The best way to help me remember what I have read is to fill in worksheets.		
12. Taking notes using graphic organizers helps me learn and organize information.		
13. It is easy for me to learn new vocabulary words on my own.		
14. It is easy for me to remember things that we learned at the beginning of the unit.		
15. When I take a test for a unit, I feel as though I have really learned about the topics we covered.		

APPENDIX E

QRCR THOUGHTS

QRCR Thoughts

Statement	Rating 1= do not agree 10= agree	what do I need to know to help you be successful? To help class be more interesting?
I think it is helpful to preview the section before I read		
The reading preview sheet helps me get interested in what we are reading		
I find it easy to pull out the main ideas as I read		
It is easy for me to put short, concise bit of information on the webs		
It is easy for me to organize the information on the webs in a way that makes sense		
Using the Magnet Webs and Summary sentences keeps me engaged in the reading		
It is easy for me to summarize what I have learned from the section		
It is easy for me to use good writing skills (full sentences, correct spelling and punctuation) in science		
Working in pairs/small groups helps me stay motivated		
Working in pairs/small groups helps me understand more than working on my own or with a whole group		
The QRCR strategy is a better way to read compared to reading with the CD and filling in worksheets		
I enjoyed the jigsaw activity (roots/stems/leaves) as a way to read and learn		

APPENDIX F

QRCR STUDENT SELF ASSESSMENT

QRCR Self- Assessment

Type of Contribution	Agree	For the most part	Could Use Work	Disagree
I took my role seriously and fulfilled my responsibilities to the best of my ability.				
I remained on topic and helped my group stay focused.				
I shared my ideas and gave reasons for my opinions.				
I answered others' questions and was respectful of others' thoughts.				
Today's discussion helped to clear up the questions I had on the Discussion Organizer				
I used key ideas and vocabulary terms when I participated				
I connected knowledge from previous sections and my personal experiences when I participated				
I feel comfortable with the information I read about in this section				

I feel as though I did a good job at:

I need to work harder next time at:

My "Muddiest Point" about today:

APPENDIX G

MAGNET SUMMARY RUBRIC

Summary Sentences	4	3	2	1
Sentence is well written (grammar and spelling)	Only slight errors. Sentence makes sense	Several small errors. Sentence is readable	Major errors. Sentence hard to understand	Too many errors to make sense
Key idea is presented	Has the majority of the main idea presented	Includes most of the main idea	Some of the main idea is included but major parts missing	Main idea is not present
Information is accurate	All information is accurate	Most of the information is accurate	Has correct info but also several errors present	Majority of the information is incorrect

Concept Webs	4	3	2	1
All of the vocabulary terms are included	All are present	One missing	More than 1 missing	Many missing, cannot read
All of the key ideas are included	All key ideas clearly represented	Most are included	Many missing	Most missing
Web is organized clearly and effectively	Includes headings and subheadings	Has headings and some subheadings	No subheadings	Unfinished, unclear organizatio n
Supporting details are present	Has several details	Has some details	Has one detail	Has no details
Effort is shown	Web is complete, much effort shown	Web mostly complete, good effort	Web maybe incomplete, poor effort	Much missing from web, little to no effort

APPENDIX H

INTERVIEW QUESTIONS- QRCR STRATEGY

Interview Questions

1. What do you like the most about the new QRCR strategy? Why?
2. What do you like the least? Why?
3. Explain your thoughts about the discussion starter (preview sheet).
4. Tell me how it has been working with small groups of 3 or 4? Pairs? Which did you like best?
5. What benefits does working with others have for learning science?
6. How do you like the QRCR strategy compared to the old method (reading with the CD, filling out worksheets)?
7. Tell me about your comfort level completing the webs and summary sentences. What is easy? What is hard?
8. How have the magnet webs and summary sheets helped with your understanding of the material? Explain.
9. How has the QRCR strategy affected your motivation and participation? Explain.
10. What would you change about how we do reading in class?
11. What would you change about how we take notes/review what we learned (worksheets, projects, activities…)?
12. Anything else you'd like me know?

APPENDIX I

TEACHER REFLECTION AND OBSERVATION FORM

Observation Focus Area and Attributes to Look For	Rating (1 to 5)	Comments/Student Quotes
Student Motivation Students are alert and enthusiastic, actively working		
Groups On Task all group members are engaged and participating		
Science Language Students are using the terms and ideas from the book in questions and while making connections		
Understanding Students are helping each other understand. Questions are being asked. Students use their books to find answer		
Summaries Students are having success finding key terms. Groups are able to help themselves without teacher guidance. Summaries are concise and accurate.		
Other		

Teacher Reflection Form

Date: ________________ Period: _____________ QRCR Session #: __________

Textbook Section: ________________________________

Group Reading Reflection:

Overall I would rate this day a(n) A B C D

Reflections:

Focus on strengths/weaknesses/things that were unusual/things that didn't go according to plan….

Items to remember for next time:

APPENDIX J

PROTIST AND FUNGI QUIZ

What do you KNOW about PROTISTS and FUNGI??

Learning Goals Quiz

Directions: Pick 5 of the questions from the protist section to answer. Pick 5 questions from the fungi section to answer. Do ONLY the ones you are MOST comfortable with. There will not be extra credit for doing more.

PROTIST SECTION: Pick 5 to answer. Each question is worth 2 points.

1. Name the 3 groups of protists and give an example of each.
2. What are three ways that protists are able to move?
3. How does a contractile vacuole help a protist?
4. Draw a picture of an amoeba OR a paramecium OR a euglena. Label and explain 2 parts on the organism.
5. How do animal-like protists differ from plant-like protists?
6. How are animal- like protists similar to fungus-like protists?
7. What is the difference between mutualism and parasitism?

FUNGI SECTION: Pick 5 to answer. Each question is worth 2 points.

8. What are two UNIQUE characteristics of fungi?
9. Name the 3 groups of fungi and give an example of each.
10. Explain how hyphae helps fungi eat.
11. How does hyphae determine what fungi looks like?
12. What are spores used for? Describe how they move from place to place
13. How do fungi aid in the production of food?
14. Explain how fungi cause disease and cure disease.
15. What is the purpose of a fungus-plant root association?

APPENDIX K

INTRODUCTION TO PLANTS QUIZ

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

____ 1. All plants are
- a. eukaryotes.
- b. unicellular.
- c. heterotrophs.
- d. prokaryotes.

____ 2. In what plant cell structure is water stored?
- a. chloroplast
- b. cell wall
- c. vacuole
- d. cytoplasm

____ 3. The leaf's cuticle
- a. stores water.
- b. reduces evaporation.
- c. transports water in the leaf.
- d. absorbs water for the leaf.

____ 4. The raw materials(reactants) of photosynthesis are
- a. sugar and water.
- b. sugar and oxygen.
- c. carbon dioxide and oxygen.
- d. carbon dioxide and water.

____ 5. Vascular plants are different from nonvascular plants in
- a. how they make food.
- b. where they obtain materials.
- c. how they transport materials.
- d. how they reproduce.

____ 6. Photosynthesis in plants produces
- a. oxygen and carbon dioxide.
- b. carbon dioxide and water.
- c. sugar and oxygen.
- d. water and sugar.

____ 7. Photosynthesis takes place in a plant cell's
- a. nucleus.
- b. chloroplasts.
- c. cell wall.
- d. vacuole.

____ 8. The energy that powers photosynthesis comes from
- a. water.
- b. chemicals.
- c. oxygen.
- d. the sun.

____ 9. What happens in the phloem?
a. Water moves up from roots.
b. Food moves down from leaves.
c. Food moves up from roots.
d. Water moves down to roots.

____ 10. Germination will not happen unless a seed
a. is dispersed far from the plant that produced it.
b. absorbs water.
c. uses its stored food.
d. grows stamens and a pistil.

____ 11. Gases pass in and out of a leaf through the
a. phloem.
b. xylem.
c. cuticle.
d. stomata.

Modified True/False

Indicate whether the sentence or statement is true or false. If false, change the identified word or phrase to make the sentence or statement true.

____ 12. All plants are <u>eukaryotes</u> that contain many cells. ___________________________

____ 13. In plants, sexual reproduction occurs when a sperm cell and an egg cell unite to form a <u>zygote</u>. ___________________________

____ 14. During photosynthesis, <u>carbon dioxide</u> and water combine to produce sugar and oxygen. ___________________________

____ 15. The main function of leaves is to carry out the food-making process of <u>germination</u>. ___________________________

Completion

Complete each sentence or statement.

16. A(n) ____________________ is a group of similar cells that perform a specific function in an organism.

17. A waxy, waterproof layer called the ____________________ covers the leaves of most plants.

18. The leaves of most plants appear green because they contain the pigment ____________________.

19. The gas produced during photosynthesis is ____________________.

20. Water and minerals enter a plant's roots and move through the ____________________ into the stems and leaves.