THE EFFECTS OF USING LITERATURE CIRCLES ON UNDERSTANDING MIDDLE SCHOOL EARTH SCIENCE CONCEPTS

by

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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.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The use of Literature Circles (LC) in classrooms has been studied extensively as it deals with literacy development. However, there has been little research done using LC with learning science concepts. LC can be used for encouraging the unmotivated students to read to acquire content knowledge. Working with peers promotes accuracy and enjoyment of the subject. When students are expected to prepare to respond to selected readings they pay more attention to the content of their reading selections.

LC promotes metacognitive awareness. Students answered survey questions reporting their use of various reading strategies; this awareness helped them build self-monitoring techniques. Building self-monitoring techniques is essential toward learning difficult content. Based on the data, students who are more metacognitively aware of their learning are more successful in class. Using LC, students are better prepared for formative assessments, as well as summative assessments.

INTRODUCTION AND BACKGROUND

I have been teaching for the past 25 years. Gradually a change has taken place in my classroom in which students are spending less time involved in thought provoking activities, which promote deep understanding. The students' days are filled with activities that teach basic concepts, which can be described as rote knowledge, but there is very little that inspires the students. Students constantly complain that they hate reading in science class. As I reflected on my teaching, I realize that I get joy from learning and inspiring students to gain an appreciation for science. I realize that students need conceptual ideas and challenges to foster thought provoking and inspiring discussions. I strive to teach in a way that promotes conceptual understanding at an emotional level.

It is important that students understand the tools that scientists use toward helping them solve problems and answer science questions. Among other skills and tools, reading is an important tool of the trade. My students did not view reading as an aid to learning. Students were missing motivation to use reading as a vehicle to understand science concepts, science skills, and positive attitudes toward science. I believe in a connection between fostering a love of reading with promoting conceptual understanding at an emotional level. The rationale for my capstone project was to directly address the problem of lack of motivation for reading and understanding science concepts from informational text during science class.

I recently attended a National Science Teachers Association (NSTA) conference. While at that conference, I attended a session that addressed the same problems that I was seeing. The presenter explained how Literature Circles helped her students to overcome their problems with reading within the science classroom. I believed that the incorporation of Literature Circles (LC) in science class would increase understanding of science concepts and help motivate my students. LC is small group discussion where students investigate a text based on questions for specific reading/discussion roles. The roles help build understanding of specific concepts to direct the students' search of the text and help direct them into meaningful conversations. I believed LC would help students become aware of how they process new information for higher order thinking skills.

It is important that I explain what LC in the science classroom would look like before I continue further into my discussion. The roles that I am about to describe are roles developed by Straits (2007). The roles are Discussion Director (DD), Everyday Life Connector (ELC), Nature of Science Investigator (NSI), and Science Translator (ST). The role of the DD leads the group in a discussion by preparing open-ended questions to extend the group's thinking. The DD helps members talk over the big ideas in the reading and share ideas and reactions. The role of the ELC is to find examples of how science in the reading is part of their daily life. ELC is to look for ideas, examples, or events that connect to daily life for themselves and others. The role of the NSI is to recognize that there are many characteristics of science that scientists experience when they do investigations. Some of the possible characteristics found in science reading are: science is full of theories, scientists use creativity and imagination, laws state observations while theories explain them, science is affected by and affects culture/society, science is based on evidence, and there is more than one method for doing science. The role of the NSI is to report to the group examples of these characteristics. The role of the ST is to take note about scientific concepts and vocabulary that are mentioned in the text. They must record what they know from background knowledge or conduct research to further the knowledge and record what was learned.

My focus question for this project was: What are the effects of using LC on the understanding of Earth science concepts? My project subquestions were as follows: What are the effects of using LC on students' long-term memory of Earth science concepts; what are the effects of using LC on students' motivation and attitudes; and what are the effects of LC on my attitude and motivation as a teacher?

The members of my MSSE support group offered valuable information throughout the writing process. Members of my validation team, Deb Mertz and Ashley Churchman served as editors and critics, providing thoughtful insight. Justin Trosper, a friend who recently completed teacher training, provided valuable information as critical friends and observer. Alyson Phillips, Ph.D. student at The University of Alabama, served as an editor and critic to refine all aspects with the caliber and direction of my project. Jewel Reuter, Ph.D. was my Montana State University Master of Science Education instructor and advisor. Jewel provided guidance, direction and critical support. Donna Governor, Ph.D., is an assistant teacher offering astronomy courses at Montana State University; she served as reader on my graduate committee and provided constructive feedback.

I teach sixth grade at Spring Hill Middle School in Bentonville, Arkansas. I have taught science to sixth grade students for the past ten years. The school population is one that spans all socioeconomic levels. Our school has many low-income families and many high-income families. Most of the students are from middle-income families.

CONCEPTUAL FRAMEWORK

This conceptual framework will identify and summarize general themes and patterns in the literature that have led to the implementation of LC as a system of teaching the sixth-grade students in the science classroom. In traditional approaches, students answer questions from their reading and the teacher evaluates their answers to signify if the students comprehend what they read. Research shows that reading comprehension means more than literal story understanding (Harvey & Goudvis, 2000). The literature suggests that when teachers utilize LC students become more invested in the learning because they are more interested and more motivated. Using LC students develop understanding of particular concepts as they explore the text and meaningfully participate in small-group discussions, (Straits, 2007).

The body of research on LC is growing quickly, but LC has many different names. Some may call it literature studies, and others may call it cooperative book discussions. There are divergent ingredients, such as different tasks and different configurations of groups, but the vast support for the LC model is growing. Daniels (2002) conducted research that has linked LC to improving student achievement scores. Low- performing schools received a grant from the Chicago Annenberg Challenge to support the development of science instruction. Teachers received training in the reading strategies that encourage literature circles. The teachers had students who gained by 14% in third-grade reading. In writing, they topped citywide gains by 25% in Grade 3, 8% in Grade 6, and 27% in Grade 8. The teachers were convinced that their literature circles were working to not just help kids become readers, but also to prove that they are readers on the mandated measures of proficiency.

Other researchers have been finding similarly promising outcomes. A study of fourth graders by Klingner, Vaughn, and Schumm (1998) found that students in peer-led groups made greater gains than controls in reading comprehension. The effects of using LC on students' motivation and attitudes were interesting also. The researchers found that groups of students holding LC groups exhibited mostly on task behavior. During the LC meetings, discussion was 65% academic and content related, 25% procedural, 8% feedback, with only 2% off-task.

The students' motivation for reading was found to be a significant factor in the students gaining understanding from what they read (Sutherland, 2008). The research conducted by Johnson and Johnson (1974) confirmed that behavior expectations for group work needs to be taught to the students. They stressed the importance of spending time to train students about cooperative learning skills. These researchers found that it was not enough to place students in groups and expect them to excel. Simply placing students in groups did not, alone, motivate them to participate in the activities. Students were successful in LC when the proper cooperative learning skills were taught to the students.

In the literature Ivey (1999) showed that the long-term recall of concepts is a product of supportive teacher involvement and science text selection. Some teachers examine only readability as an indicator for matching their students with particular texts for learning science, which is an overly simplistic approach. For example, consider this sentence: All matter has mass. While only including four words with one multisyllabic word, this sentence is still complex for sixth- grade students because the complex meanings of matter and mass. When selecting a text for science students, teachers must consider true difficulty of material along with the readability level. Extended research on sentence structure studied the order of sentences within paragraphs and how this order shapes comprehension and retention (Sutherland, 2008). It was found that students had little retention of concepts if concrete examples were given after the abstract ideas. There was greater long-term memory of concepts when sentence structure had abstract ideas following concrete examples. The worst recall occurred when abstract sentences were not connected to concrete sentences at all.

Some students do not understand that the way they should read science material changes from the way they attempt to read for enjoyment, and they are reluctant to read in science because they do not know what to do. Ivey (1999) discussed that science texts are difficult to read for numerous reasons including students being unable to understand the graphs and tables presented, students being unable to summarize the complex ideas, and the readability being too difficult for students to comprehend. The use of LC is an extremely flexible instructional strategy; however, success with LC depends on the selection of the text as well as reading interests and abilities of students. It was found most helpful if reading selected in text parallel concepts taught in class (Straits, 2007).

Harvey and Goudvis (2000) described reading as more than merely recalling literal facts from texts. Constructing meaning should be the goal of comprehension, but many teachers have been trained to check comprehension by asking students to answer questions correctly. Comprehension, for many traditional teachers, was simply about literal understanding of stories and texts. Reading is a multifaceted activity; in highly successful, concept-oriented reading classes, students are thinking, synthesizing new information, and using relevant vocabulary. Harvey and Goudvis professed that deliberate instruction, which focuses students on establishing purposes for reading is essential to understanding nonfiction. Helping students see reading as a helpful tool is a necessary skill for students involved in understanding science concepts. According to Hill, Schlick, and King (2003), when students share their ideas with their peers, reading becomes a more meaningful experience. LC helps deepening students' understanding of and engagement with literature because students are motivated by working in groups. The students in the study developed meaningful responses showing higher levels of thinking. Integrating LC with other subjects and with themes helps students gaining experience, confidence, and insights to do things differently.

Bandura (1997) believes that metacognition is related to students' awareness of self-development of cognitive skills. Students that are aware of the ways certain strategies are helping them learn experience deeper comprehension and are led to set goals that will continue to help them learn. Collaborative reading that takes place during LC teaches students to use comprehension strategies while working cooperatively. The research states that students who are aware of reading strategies and talking about them with their discussion groups, results in learners that are in control of their learning behaviors from start to finish.

Scaffolding is an import teaching technique required when teaching students to independently perform a new task or skill (Rasinski, Padak, McKeon, Wilfong, Friedauer, and Heim, 2005). Scaffolding helps students do what they cannot do by themselves. Initially more support is given but gradually the teacher support wanes as the student gains the confidence and skills to do the task on his/her own. Learning to use reading strategies independently is a complex task that requires feedback from the teacher. Wilkinson and Silliman (2000) found that learning for students in seventh grade was correlated with the extent to which the teacher provided scaffolding, supporting the students as they learn new skills. A classroom that uses effective practices, such as providing students with motivational support, and entering into dialogue with students about their learning through reading activities, increases understanding of concepts in comparison to traditional instruction (Wilkinson and Silliman, 2000).

Reading and gaining greater student conceptual understanding of science is closely tied to peer interaction (Klingner et al., 2001). When students work in cooperative groups, individual strengths and weaknesses can be addressed. Each student’s unique abilities support the success of the group. Slavin (1995) explained that not only does cooperative group work have a positive impact on students’ self-perception and involvement level but on the group’s perceptions of the students as well. One study used concept-oriented reading instruction (CORI) in grades 3-5 (Guthrie, Wigfield, Barbosa, Perencevich, Taboada, and Davis, 2004). CORI applied support for student collaboration with a diversity of reading activities. Students’ motivation for using complex comprehension strategies is increased when students are afforded opportunities to share their questions about interesting text, and students learn from each other as they share information gained from the text. Collaborative activity enables students to clarify their understanding of core concepts of science being taught (Guthrie et al., 2004).

Treatment with LC includes scaffolding techniques to help students gain the support they need while increasing students’ understanding of science concepts and motivation to learn (Straits, 2007). The role of the teacher during discussion is that of facilitator. Productive and meaningful group discussions do not just happen; students require support and prompting as they learn to discuss respectfully and productively. Eventually, LC gives students the skills they need to engage in science material, keeping them from becoming overly frustrated and giving up. The teacher has the opportunity to join a group as a member to demonstrate techniques for productive and respectful dialogue. Teacher participation allows students to see an adult's genuine enthusiasm for reading. Effective LC have been shown to increase the teachers' attitudes and motivation by allowing them to help their student more effectively (Ivey, 1999).

Motivation for reading comprehension is more important than once believed. Research conducted by Anmarkrud and Braten (2008) found comprehension for difficult reading material increased as the teacher directly addressed the motivation to read difficult material. This study shows that concept-oriented reading instruction, in combination with motivational instruction, positively impacts student concept understanding.

In conclusion, the philosophy of LC is one that realizes that students need to be taught how to make meaning from what they read. LC fosters literacy behaviors that allow students to gain deep meaning from science text. Using LC students reflect, and LC helps students gain in confidence and skills. Teachers must provide support through scaffolding until the students are ready for the next step on their own. Literature has shown LC to be an effective intervention to help answer the questions for my project. With LC students understand science concepts through greater motivation to use reading as a vehicle toward greater understanding. LC instructional classes support students as they recognize and acknowledge their own self-efficacy. Finally, the teachers' motivation is positively impacted by the knowledge that LC help students learn not only Earth science concepts but also the life-long skill of critical thinking for how to effectively learn.

METHODOLOGY

For this project, a single non-treatment unit and two treatment units were taught in order to best assess which approach was most successful to answer my project questions. Data were collected from the nontreatment unit and treatment units for comparison. The nontreatment unit was taught using a traditional teacher-centered approach such as students independently reading and answering questions about the reading. The treatment units employed LC activities with all reading activities. LC entails students read selected science text, tracks their use of reading strategies as they read, and prepares a task to share during a cooperative literature meeting.

The nontreatment unit, plate tectonics, focused on the layers of the Earth and convection current movements in the mantle. I used methods including reading assignments and discussions, answering review questions, labs, virtual labs, learning from websites, and note taking from PowerPoint presentations. Assignments were completed independently or in small groups. A few labs were conducted within this unit. At the beginning of each lab, I summarized the lab expectations and answered questions.

The students worked with their lab partners while conducting labs. The students created two models during this unit. In one model the students created a model of the layers of the Earth from clay. Next the students built convection current models. The remaining time was spent reading and completing worksheets, which were collected and evaluated. Students were assigned textbook pages with comprehension questions; the students were required to answer the comprehension questions. A pretest and a posttest were administered and evaluated.

The LC training workshop occurred after the completion of the nontreatment unit. Since cooperative learning skills need to be encouraged, students participated in a team-building activity as seen in Appendix D. The use of this activity fostered cooperation and positive interdependence. My students were familiar with cooperative learning because I had used cooperative-learning strategies with them all year. Cooperative-learning activities were not new for my students, but LC was new. A team-building activity seemed like the best way to jumpstart the new method of LC.

During LC training sessions, students received practice as they learned the various responsibilities that were inherent with the LC roles. Positive interdependence was emphasized as the students prepared for the LC discussion. The roles, as discussed earlier, are Discussion Director (DD), Everyday Life Connector (ELC), Nature of Science Investigator (NSI), and Science Translator (ST). All of the roles are important. The role of the DD leads the group in a discussion by preparing open-ended questions and is ultimately the leader of the meeting. It was important that each student understood that they would each have numerous chances to fill each LC role. The role of the ELC, to find examples or events that connect to daily life for themselves and others, the role of the

NSI, to find characteristics of science that scientists experience when they do investigations, the role of the ST, to take note about scientific concepts and vocabulary that are mentioned in the text, are all important roles for the group to share in order to determine the central ideas of the science text.

In order to teach the students the metacognitive skill necessary to become reflective readers, we began by sitting on the floor reading an article from Time for Kids. The article was about the need for public schools to teach Chinese language in public schools. I modeled a method that develops metacognition called Read-Write-Talk. Modeling is an important part of scaffolding. I explained that as I read I have a variety of thoughts that go through my mind. I asked permission to speak out loud as I read, and I proceeded to talk my way through the reading, modeling the reading strategies as I went. I explained that his type of reciprocal learning was important because I would ultimately become a better reader if I could understand my own thinking. Reciprocal learning refers to an instructional activity that takes place in the form of a dialogue between teachers and students regarding segments of text which is structured by the use of four strategies: summarizing, question generating, clarifying, and predicting. In turn the students shared their thoughts as they read, wrote, and talked with partners. The students expressed they felt confident to use these strategies whenever they read; at that point we were ready to employ LC as a means to understand the concepts of Earth's landforms produced by Earth's internal processes.

During Treatment Unit 1 on volcanoes, students were to use LC as the main way of reflecting upon the reading activities. Students were given a pretest in the form of chart, (Appendix F), titled What I Know, What I Want to Know, and What I Learned (K-

W-L) to activate background knowledge before delving into the new topic of landforms caused by Earth's internal forces. This K-W-L chart was used to access their prior knowledge. Then students were given rich, exciting text that taught the various concepts involved. As the students prepared for LC, they were to gain a deeper understanding of the text. The cooperative nature of LC was a vehicle for interdependence. The students spent many days reading text in preparation of the different roles involved with LC.

Surveys were conducted in which the students reported their self perceptions of a variety of self-analysis questions. They were used to measure the students' attitudes throughout the entire project. Students answered questions about their behavior as well as behavior of their peers. The LC survey (Appendix H) was completed at the end of each LC focused activity. In the survey, I asked for two things that worked well and one item to improve before the next LC reading activity. All class work and surveys were collected in order to promote individual accountability, as well as provide further insight into student participation and understanding.

During Treatment Unit 2 concerning Earthquakes, the students continued using LC to enhance better understanding of Earth science concepts. Treatment Unit 2 went deeper and relied more on student interdependence. Students were given a pretest in the form of a K-W-L chart to access their prior knowledge. Students used LC as described in Unit 1 to read Earthquake material. Students learned to rely on each other as they read about disaster relief efforts of areas in danger of future Earthquakes. The texts students were to read about Earthquakes were viewed by the teacher as relevant and motivating.

Data Collection Instruments

Spring Hill Middle School is a large fifth and sixth-grade school located in Northwest Arkansas. Twenty-eight sixth-grade students participated in this project. The academic profile of the students is that six of the students are on academic improvement plans for scoring low on the science benchmark exam in fifth grade. Many of the students read below grade level. The students are from middle class households with either one or both parents working outside the home. The majority of the students were 11 years old with females representing 57% of the class and males 43%. English is the primary language spoken with only one student having English as a second language.

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. Instruction and data collection for the nontreatment unit took place over two weeks. Instruction and data collection for the treatment unit took place over five weeks; the project ran for seven weeks total. A detailed timeframe for the project is provided in Appendix C.

The triangulation matrix shown in Table 1 summarizes the three sources of data that were identified for each question. Triangulation of data helped to provide a more accurate conceptualization regarding the effects of the intervention and reduced the likelihood of misinterpreting a single source of data. Data were collected from both the nontreatment and treatment units to allow for comparison.

Table 1
Triangulation Matrix

Project Questions	Data Source 1	Data Source 2	Data Source 3
Effects of using LC on the understanding of Earth science concepts?	preunit and postunit concept maps with interview questions	preunit and postunit interviews with questions about KWL chart	preunit and postunit assessments followed by surveys
Effects of using LC on students' long-term memory of Earth science concepts?	postunit and delayed unit assessments	postunit and delayed unit interviews with concept questions	postunit and delayed unit concept maps
Effects of using LC on students' motivation and attitudes?	preunit student survey postunit unit surveys	preunit student interviews postunit student interviews	teacher observations using engagement checklists
Effects of LC on my attitude and motivation as a teacher?	daily reflections	peer review of LC lessons analyzed with checklists	preunit survey postunit survey

In order to determine the effects of LC activities on the understanding of Earth science concepts, data were collected using, KWL charts, concept questions, and pre and posttests at the beginning and end of the three units. The use of pre and postassessment data in the units allowed for the comparison of percent change in student understanding. Appendix B, I, and J include the assessment that was used for the pre, post, and delayed unit assessments for the nontreatment unit and treatment units. To evaluate student responses on open ended questions, I used a rubric that rated responses based on completeness. Each assessment question could receive a score of 4 if the thoughts were presented in a cohesive manner that showed deep understanding of concepts; the score of

3 was given to students who showed basic understanding of concepts with no misconceptions stated; a 2 was given if the student showed limited understanding of the concepts with possible misconceptions that may confuse the student; a 1 was given if the student had many misconceptions and flaws in their understanding of the concepts; students scored 0 if their respond was blank or totally incorrect.

Data were collected for the purpose of analyzing the effects of LC on understanding of Earth science concepts. A classroom observer kept a record of peer interactions as he tracked the interactions with six different students throughout the treatment unit lessons. Six students were selected: two high achievers, two average students, and two low achievers. These six students were selected using a purposeful sampling method based on their availability to meet outside of class. They were interviewed as they constructed concept maps. The students created concept maps during preunit, postunit, and delayed unit interviews. Students were given key terms to construct concept maps (Appendices O). Evaluation was based on the constructed map and oral explanation using the rubric found in Appendix O.

Assessments that were used for vocabulary development included concepts maps, graphic organizers, and vocabulary quizzes. Concept maps were constructed during times when large amounts of vocabulary needed to be applied to accomplish tasks such as writing lab reports about Earthquake and volcano labs. All students completed concept maps using word banks of vocabulary required for the understanding of the lesson.

The effects of using LC on students' long-term memory of Earth science concepts were assessed using delayed unit concept maps during student interviews. Students were also interviewed using concept questions and oral explanation was analyzed using a rubric based on Bloom's levels of cognitive understanding. The rubric can be found in Appendix O.

Delayed unit assessments were given two weeks after each unit. The delayed unit assessments were compared to the postunit assessment data for both the nontreatment and treatment units. The use of pre and postunit assessment data in both units allowed for the comparison of percent change in student understanding. The assessments can be found in Appendices J and K.

The effects of using LC on student motivation and attitudes were assessed using questions from interviews, surveys, and my classroom observations regarding student behaviors. The use of both student perception and my own observations provided a clear picture of student motivation and attitudes. Triangulation as seen in the table previously mentioned was used to provide a more accurate depiction regarding the effects of the intervention. Using more than one source of data reduced the likelihood of misinterpreting a single source of data.

Preunit and postunit surveys were conducted with the nontreatment and treatment units. Student surveys were conducted asking the students about the various reading strategies on which they relied (Appendix L). Data that were collected with the surveys were summarized by tallying the possible various responses. The mean was found and reported for each question looking for tendencies in the data with regard to student confidence with reading strategies.

Once a week, the students were given prompts (Appendix E) to allow them to reflect on positive interdependence, individual accountability, equal participation, and overall feelings toward science class. These surveys were analyzed to view the value or the difficulty students were finding in working interdependently. All class work and questionnaires were collected in order to provide insight into student participation and understanding.

Throughout the study, an outside observer made observations and took notes regarding student motivation and attitude either during or directly after class. These observations were guided by several prompts involving student use of LC, attitude toward LC, attitude toward lesson, engagement with the material, and problems working in groups. These prompts can be found in Appendix L.

The effects of using LC on my attitude and motivation as a teacher were assessed using daily teacher reflections, classroom observations regarding student and teacher behaviors, and preunit and postunit surveys. I used reflective journaling with prompts (Appendix M) to focus on my behaviors and attitudes throughout the nontreatment and treatment units. I used the data for comparison. My reflections were recorded after each class using the following journal prompts: general reflections on overall success of the LC activity, and my attitude toward the activities and students. I also completed a self-evaluative survey, which can be found in Appendix R. A peer observer evaluated me on several occasions, both during the nontreatment and during the treatment units. The observer used an observations guide (Appendix N) while making the observations. Peer review of LC lessons analyzed with checklists helped provide a better understanding of how different teaching strategies impacted my attitude toward the LC activities and students.

DATA AND ANALYSIS

Data from the nontreatment and treatment units were compared in order to determine the effects of LC on student understanding of Earth science concepts and analyze the topics of my subquestions. The nontreatment unit included reading assignments and hands-on labs whereas the treatment units included LC activities.

The plethora of data collected showed many positive outcomes. Results of the data collected show that when compared to traditional reading assignment tasks, the students preferred reading assignments with LC requirements. The project questions were addressed as data were collected and analyzed. For organizational purposes, my analysis will address each question individually; however, some questions do overlap, and the data that addresses one question also coincides with another project question.

To examine the effects of using LC on the understanding of Earth science concepts, nontreatment and treatment pre and posttests were administered for each of the units. Each pre and posttest consisted of seven open-response questions. The nature of the questions was that students could answer questions with short, knowledge level answers or they could give answers showing complex understanding of the questions. Included here is an example of one of the open response questions: Explain the different seismic waves occurring during and after earthquakes. Explain how those waves are measured. What are the effects of the different seismic waves? How do you know? Each question was graded on a 4-point scale, with the most in-depth understanding demonstrated receiving the highest score. Figure 1 shows the average pre and posttest scores for each unit.

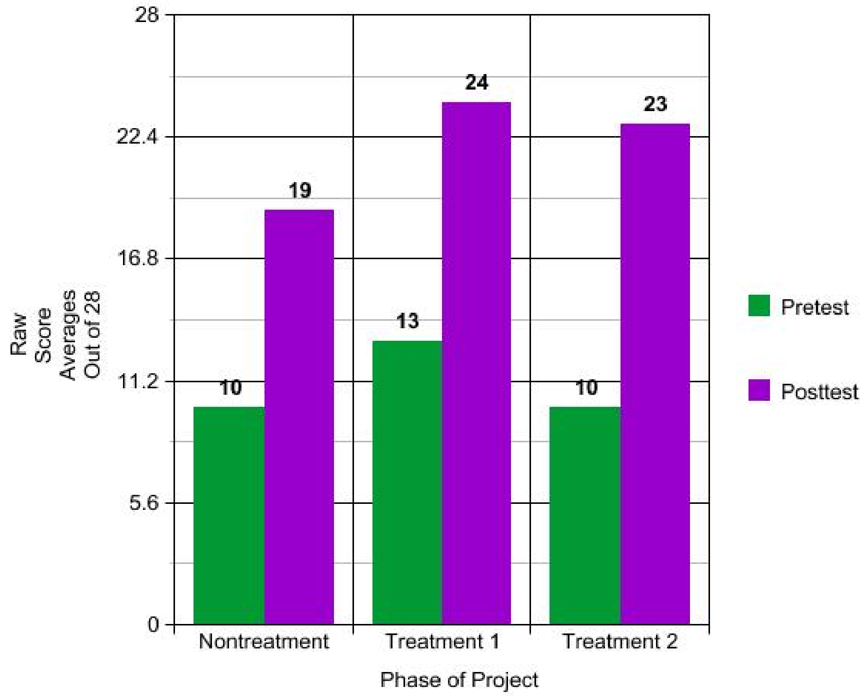


Figure 1. Student Pretest and Posttest Scores for Each Project Unit, (*N*= 28).

As the pretests for each unit were analyzed, it was evident that the students had limited knowledge about Earth science concepts. The students made gains during all three units as seen from pretest scores being lower than all posttest scores. As found in the graph, the students made the greatest gain during Treatment Unit 2. Treatment Unit 2 covered concepts about earthquakes. The data showed that the students learned the most using the instructional strategy of LC to learn about earthquakes.

I wanted to know the average that the students received per question. The goal of my district is to have students performing at a proficient level. A score of 3.0 is considered proficient. Figure 2 shows the average that students scored per question.

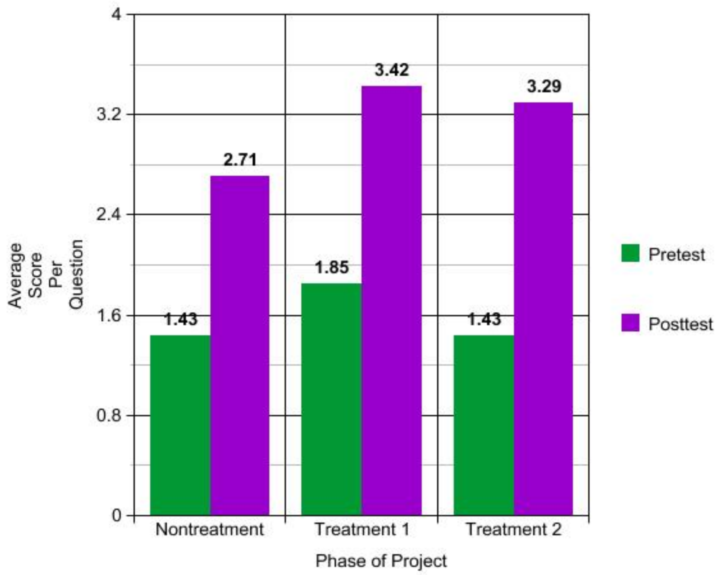


Figure 2. Student Pretest and Posttest Average Scores Per Question for Each Project Unit, (*N*= 28).

In the analysis of figure 2, the pretest showed that the students on average earned 1.43 points per question on the nontreatment and on treatment unit 2, demonstrating limited prior knowledge about the topic of plate tectonics and earthquakes. The pretest for the first treatment unit showed students had a little more knowledge before we began the study of volcanoes; they earned 1.85 points per question, again demonstrating limited prior knowledge for the first treatment unit. From the pretests for each unit, it was obvious that the students needed the concepts developed in a way that would enable them to build deep concept knowledge.

The first and second treatment units showed the students gained proficient mastery according to my district's standards. The posttest assessment on the first treatment unit showed the students earned an average of 3.42 per question. The posttest on the second treatment unit showed the students earned an average of 3.29 per question. The scores on the nontreatment unit were just below the acceptable level as they score below 3.0 on the posttest. The data show that there was a difference of student posttest scores between the nontreatment unit, the first treatment unit, and second treatment unit. The instructional intervention of LC may have helped the students gain in knowledge to achieve a level of proficiency.

Next, I wanted to see the percentage change between the pretest to the posttest scores to see how much the students learned. Figure 3 shows the percentage change from pretest to posttest for each project unit.

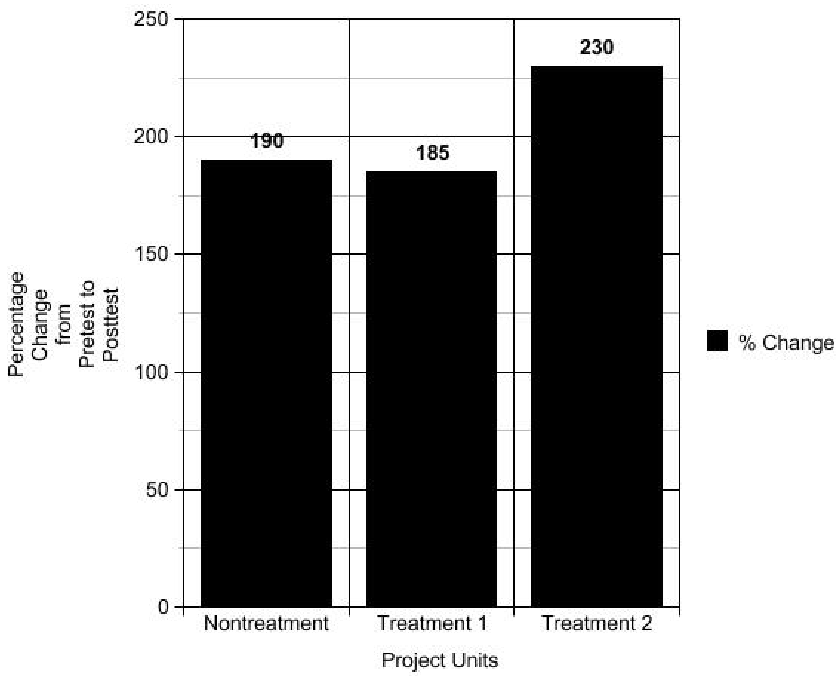


Figure 3. Student Pretest and Posttest Percentage Change for Each Project Unit, (*N*= 28).

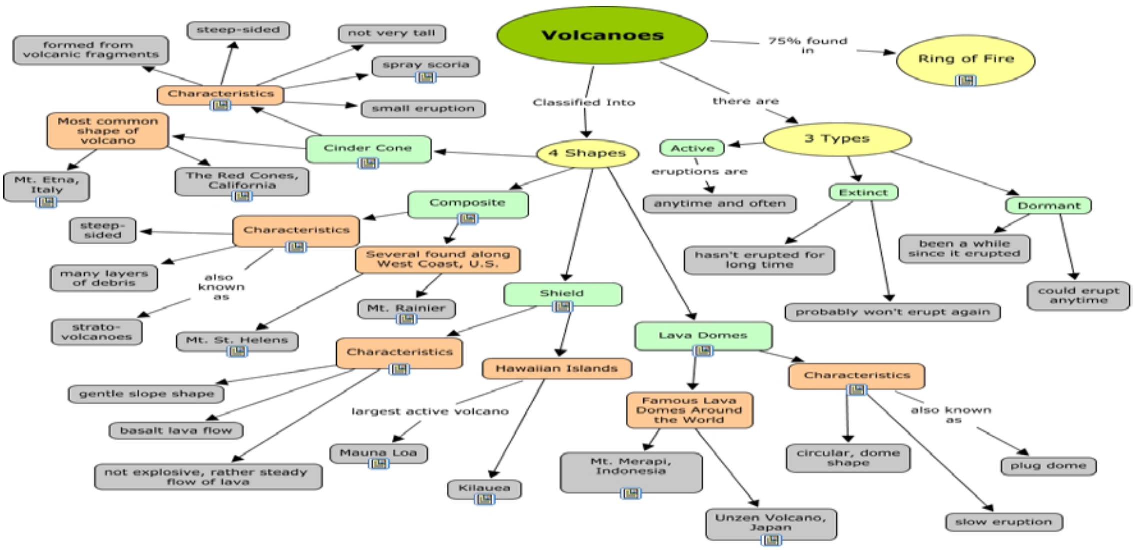
The posttest results for the nontreatment unit revealed that the students demonstrated 190% change from pretest to posttest score for the nontreatment unit. The students averaged 2.71 points per question. This data shows good gain for the students in regard to the instruction they received to learn about plate tectonics. The nontreatment unit percentage of change was slightly higher than the percentage of change on the first treatment unit. In the first treatment unit, the students demonstrated 185% change as compared to 190% change for the nontreatment unit. An explanation for that outcome may be that students entered the first treatment unit with more prior knowledge, thus their pretest scores started off higher.

In the second treatment unit, the students demonstrated 230% change from pretest to posttest scores. The students performed well, averaging 3.28 per question on the posttest. Again that is quite a large percentage of change from their pretest of 1.43 points per question. I believe the gain was largely due to the intervention of LC because the students were more engaged and worked well within their cooperative groups.

The students made great gains with each of the three units. Overall, the students gained greater concept knowledge during the treatment units. There are some possible explanations for the increased growth gained throughout the treatment units. One explanation would be that LC expect students to dig deeper, to think more reflectively, and to share their findings with their groups. These types of activities help students gain deeper understanding of concepts. Another possible reason that the gain was greater during the treatment units is that the nontreatment unit helped students develop the understanding necessary for them to understand landforms, volcanoes, and Earthquakes.

Concept maps were administered at the beginning of each unit and at the conclusion of each unit. The concept maps were scored using the rubric in Appendix Q. Essentially, the rubric assigned a value to connections and associations the students were able to make between the various vocabularies contained within each of the three units taught during the project. The concept maps were scored according to branching as seen on the concept map rubric (Appendix O). The nontreatment unit map was linear with little branching, but the concept maps for the treatment units were more complex and possessed cross-links to indicate connections between the various components in the concept map. Students cross-linked terms such as plates, plate boundary, colliding plates, spreading plates, Ring of Fire, types of volcanoes, magma, lava, and eruption. Figure 4 shows an example of how concept maps are designed with multiple layers, connections and links.

Figure 4 Volcano Concept Map



Six students were selected to conduct interviews as they worked on their concept maps: two high-achieving students, two average students, and two low-achieving students. The same six students were interviewed for various data collection sessions. I asked them about if they liked doing concepts maps. Five of the six students said they liked doing concept maps after the unit was complete. I asked the six students if they saw any value in concept mapping. Once again, five of the six replied that concept maps help them really see the connections in a new way. One of the students said they like how there was no “right or wrong answer.” I asked him if he thought of himself as creative, and he said that he had never thought about it before, but yes he now sees himself as creative.

Table 2
Preunit and Postunit Concept Map Scores(N=28)

Students	NT Preunit	NT Postunit	T1 Preunit	T1 Postunit	Percent Change NT	Percent Change T1
H1	12	20	25	32	66%	28%
H2	15	22	18	29	46%	50%
A1	9	20	22	34	122%	54%
A2	8	15	18	29	87%	61%
L1	5	12	10	22	140%	120%
L2	3	8	8	13	166%	62%

Note. In the table above, NT and T1 represent the nontreatment unit and treatment unit 1 respectively. H1, H2, A1, A2, L1, L2 represent two high-achieving students, two average students, and two low-achieving students. The numbers represent score based on the rubric.

The results from these two different concept maps suggest that the treatment was not as effective in assisting students in understanding Earth science concepts as those employed during the nontreatment unit. Students made gains between preunit concept maps and postunit concepts maps as shown by the gain for both units, but they made better gains during the nontreatment unit. A possible reason that the students made better gains during the nontreatment unit was the students started with less prior knowledge about plate tectonics. When the students made the concept maps for volcanoes, they had much more prior knowledge because the volcano unit built on knowledge learned during the nontreatment unit. The postunit concept map scores for treatment unit 1 were higher than the postunit concept map scores for the nontreatment unit.

The interviews revealed metacognitive aspects of the students' attitudes. Some of the students did not like the amount of work necessary to complete concept maps. It was obvious that when the six students answered interview questions, they felt overwhelmed by the expectations of the concept maps. Some of them did not like having to be responsible for piecing all the concepts together. During the interviews one student said, "All this information seems to run together so much that I feel like I am saying the same thing over and over again. I don't really know if I'm right." When the students were asked, "How do you think you learned so much about Earthquakes?' One student said, "We've been studying a lot. There are lots of parts, but we work on it so it makes more sense." When asked, "How did LC help you learn concepts?" A student responded, "You get to discuss it. LC has helped me understand by listening to my group's explanations."

The students made KWL charts for each unit. KWL charts were analyzed at the beginning and the conclusion of each unit by scoring the responses for the KWL. At the conclusion of each unit, students were interviewed, during which time the students were asked to explain new knowledge that was gained throughout the unit. Each student was asked, "How did you learn the things that you included under the heading of "L" for learned?" Many of the students attributed the new knowledge they gained during the nontreatment unit as a result of hands-on activities. The students said that the reason they understood concepts related to plate movement and fossils was due to the labs that taught them about these concepts. Yet, many of the students attributed the new things they learned during the treatment units as a direct result of reading activities that used LC. One student said, "I learned most of what I know about how volcanoes erupt because of the work we did in LC." Another said, "I learned a lot about plate tectonics when we made models of the Earth, but I learned about where Earthquakes happen when I read about it in the Earthquake book. My group helped me understand how and why Earthquakes happen.” Reading in science is important, and I found that LC gave the students the motivation and the skills they needed to glean new knowledge from reading informational text.

Six students were interviewed after each LC during the treatment units. Appendix H contains the questions that were asked after each LC meeting. Surprisingly, many of the students said that being responsible for sharing a task with their group helped them pay attention better. I also found it interesting that four out of six students said that what helped them understand what they read was being aware of the reading strategies they used as they read. One student said, “When I ask myself questions as I read, it helps me understand more because I answer some of the questions as I read.” All students filled out a strategy use checklist every time they read. Although students complained about having to fill out a reading strategies checklist, they seem to think that activity helped them understand what they were reading.

The students maintained concept knowledge gained through each unit. They showed long-term retention of the Earth science concepts that were learned during the units. Each student was given the same seven question open response assessment two weeks after each unit was complete. Posttest and delayed test data was compared. Figure 5 shows the results of the test data.

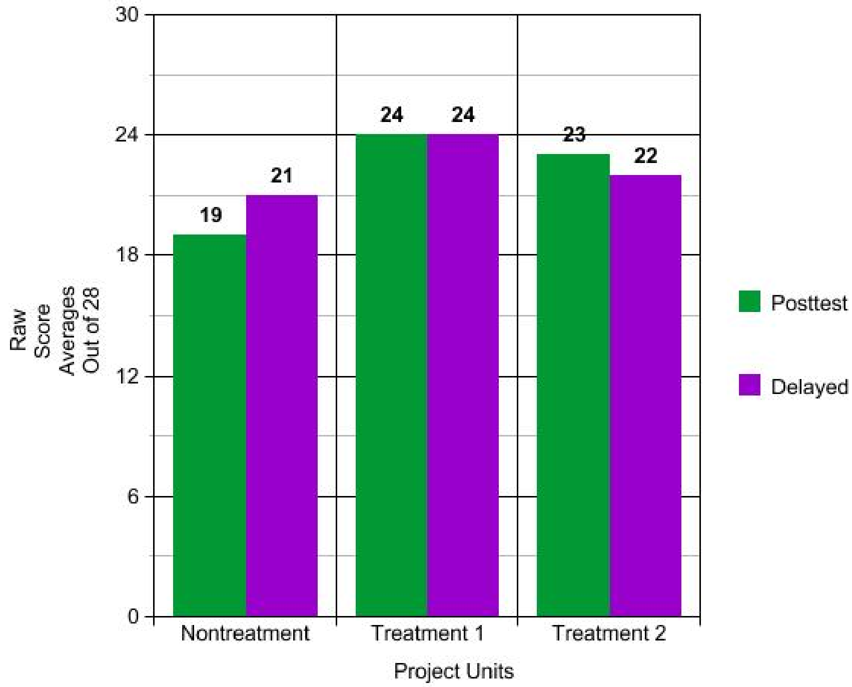


Figure 5. Student Posttest and Delayed Test Scores for Each Project Unit, (*N*= 28).

The nontreatment unit showed a gain in the delayed assessment. One possible explanation is that the students gained in the plate tectonics unit because the following unit covering land forms and volcanoes helped students better understand plate tectonics, thus, when the students took the test two weeks later, they gained deeper insight about how the movement of plates affect the Earth's surface. Because the unit assessment for treatment unit 3 about earthquakes coincided with the March 11th Earthquake and tsunami in Japan, I expected to see delayed assessment to rise from the post test scores. My science classes discussed the breaking news as Japan was experiencing that terrible 9.0 earthquake and all of its resulting effects. My students wrote news stories that explained what Japan's citizens were experiencing. Yet, student scores dropped from a 23 posttest score to a 22 delayed post test indicating a slight difference in concept retention, I was satisfied with the students' long-term memory for all three units.

Data were obtained and analyzed through use of student surveys to help answer my subquestion regarding how LC affects student motivation and engagement. Surveys were given at the completion of LC once a week throughout the treatment units. Students shared that LC helped them with understanding complex concepts.

Students were surveyed in order to determine what had the most influence on their desire to learn and participate in class. Students reported that the thing that helped them pay attention was their responsibility to the group during LC. Many students said they really tried to be creative as they completed their LC task. They also reported that a thing that worked well with their LC was the way they took turns in a fair way. Overall, students expressed that using LC created an enjoyment for reading science text as well as an appreciation for being able to work in a creative way.

Some students expressed concerns about working in groups where students do not do an equal amount of work. Some of the students were concerned about being placed in a group with other students they do not get along with. I understand the students' concern because not all groups function well. For example, one rather antisocial young man responded in the following way to surveys about the LC: How did you help someone and how did someone help you? He said, "I helped no one and no one helped me" When asked what was learned in LC, he said, "I learned nothing." Student surveys about how LC revealed that some students were content, yet others seemed overwhelmed as revealed in one student's statement, "LC can sometimes be frustrating." These feelings expressed by some students led me to closely facilitate to assure that the negative attitude would not ruin the experience for all students. Some surveys also revealed that the students never felt that I gave enough time to complete the task. Thus, I initiated a strategy to help with that problem. I taught the students "Status of the Group." The leader, DD, was to poll the group and report to me how much time they needed for everyone to complete their job. I always had something for the students to do if they were finished early.

Overall, the students generally reported that the thing that helped them understand content materials they read was LC. One student said, "Group talk and asking and answering questions of each other is the best way to learn about things I'm reading." When asked what worked well with their group using LC, it was reported that, "All students read the story and the talking stick really gave each person a chance to talk." When asked what they like most about science class, some said, "Labs and LC because they are fun and you get to talk in a group." Another student responded, "What I love about science class is all of our opportunities."

Most students seemed to be motivated by the fact that they may be helping each other, however a few children did not agree. Comments ranged from, "I helped someone else by helping them figure out what an ash cloud is." Another said, "I helped someone by explaining a seismograph to them. Someone helped me understand their connections to the passage." Another student said, "I listened to each person's explanations today. I learned that the volcanoes underwater are also above water in a different formation." A rather unmotivated girl said, "I was really happy when I could help my group understand what viscous means. I am not usually the one helping my classmates." This describes what I wish for all of my students. Students learn best when they are actively involved in the process. Students working in successful cooperative groups appear more satisfied, motivated, and interested.

Peer observations were made by Justin Trosper. Justin is a talented, enthusiastic new teacher. Justin spent the first semester in my class while he successfully completed his student teaching. I respect Justin for the maturity and passion he brings to the profession of education. He worked in a successful business for the first 15 years of his career, but he longed to be a teacher. He was happy to help me with my project because he values the process involved in the capstone project. He made observations and took notes regarding student motivation and attitude at various intervals of the treatment units. These observations were guided by several prompts involving student use of LC, attitude toward LC, attitude toward lesson, engagement with the material, and problems working in groups. The Justin noticed that the students had an underlying set of standards for which they held each other accountable. A team building activity that was conducted at the onset of the first treatment unit helped the students develop important skills they needed to be successful in groups. The students learned ways to improve communication and social skills when involved in group work. They appeared engaged and involved during the team building activity. Many of the students said that we should do activities like that more often because it helped them see issues from other points of view. The observer noted, “The students had a subtle way of immediate correction of minor misbehavior problems of their classmates preventing any major acting out.” It was also noted, “The class shows a great level of positive energy in group work while staying on track.” Lastly, it was noted that the students showed each other mutual respect.

What were the effects of LC on my teaching, attitudes, and motivation? Journaling, self-evaluation, and peer observations helped to determine the impact of LC on my teaching and attitude. LC required a shift on my part toward finding engaging reading passages that would help the students learn about specific content within the Earth science content. I needed to peruse material ahead of time, knowing that the reading tasks fit the students' skills and abilities. The group work had to be made relevant. All these things took an extensive amount of time commitment prior to teaching. Even though these activities take a greater investment of time, is the time worth the effort? Am I more motivated to teach using LC and willing to put in the extra time?

I kept a journal called "This and That." I summarized the information from the self-evaluation displayed in Figure 4. The results indicate positive changes in my teaching, attitude, and motivation in the treatment unit as compared to the nontreatment unit. In the nontreatment unit-with a teacher-centered classroom, I felt as if nothing exciting was happening. I had less energy and enthusiasm. That all changed when the students got interested in group work. Their cooperation gave me energy. What accounts for my increased enjoyment and motivation for using LC rather than traditional methods is that I found students working in groups increased their ability to solve problems, and I saw the students understanding the material better. As students worked collaboratively in the treatment unit, they were more willing to ask questions within their group and the students found many answers on their own. For example, as students were talking about submerging plate movement, they had questions about exactly how volcanoes and trenches happen along these plate boundaries. Instead of giving up when the question was raised, the students helped each other. They found information from a convection current lab that we had done together. It was refreshing to see the students dig deeper and make connections to previous labs completed in science class. Knowing that my students care and have become problem solvers really caused me to get excited.

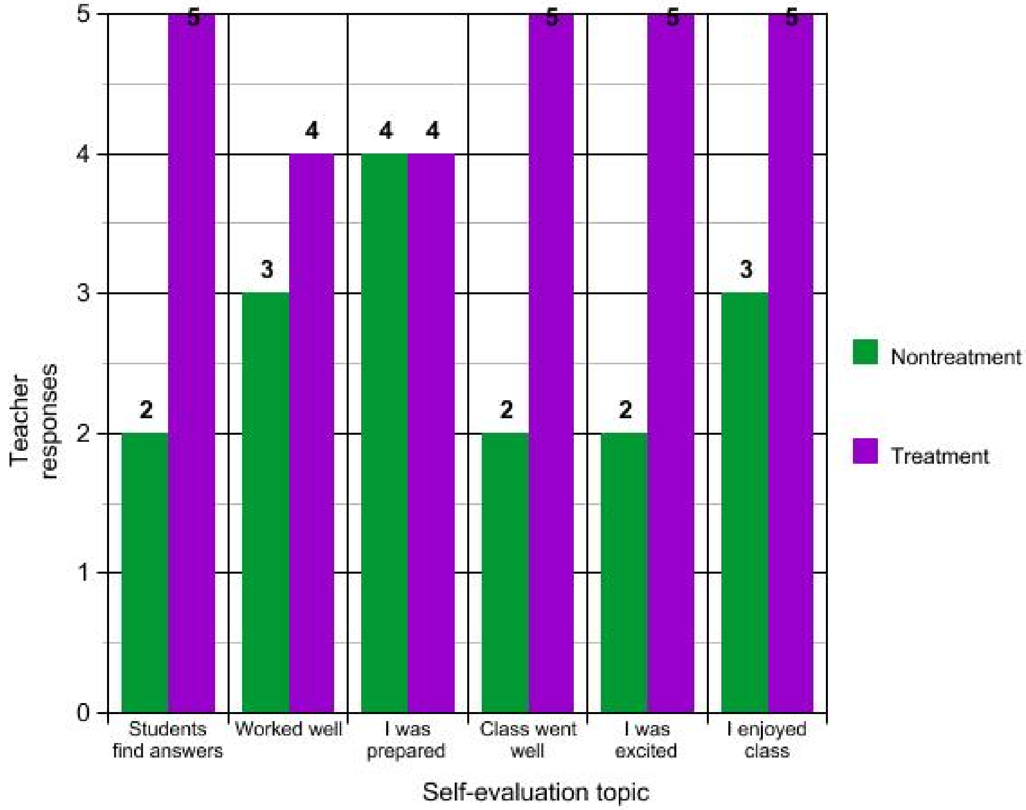


Figure 6. Average Response to Teacher Self-Evaluation
Note. 5 = Strongly Agree, 4 = Agree, 3 = Indifferent, 2 = Disagree, 1 = Strongly Disagree

Peer observations supported my self-evaluations and journaling, which showed an increase in motivation and a more positive attitude in the treatment unit. My peer observer, Justin Trosper, used a teacher checklist to give me feedback about teacher attitudes (Appendix L). He related that I showed a great level of positive energy and encouraged the students to keep moving along. I demonstrated a positive, helpful attitude with the students, especially the ones who needed redirection. My observer noticed that I had additional one-on-one follow-up questions, which were thought to help clarify student learning. It was noted that the students' enthusiasm about the coursework demonstrated that the teacher was able to lead the class enthusiastically. My rapport with students was praised.

INTERPRETATION AND CONCLUSION

The purpose of my action research project was to seek out and examine effective reading strategies and efficient methods for teaching reading strategies so that my students would better understand Earth science concepts. Upon completion of my capstone project, I feel confident that I will be able to effectively and efficiently teach reading to enable my students to understand passages they read about Earth science or any science content.

My results indicate that traditional reading activities are less effective than LC strategies. Metacognition is the awareness of one's own thinking and learning process. Students are more successful when they are aware of their thought process. Students showed they were able to learn best when they were aware of reading strategies they used. Students used checklists and reflective journaling to analyze how reading strategies helped them. Students reported that they stopped and checked to verify they understood what they were reading, and if they did not understand they stopped and reread to understand more.

Data were analyzed to answer my focus question on the effects of LC on student understanding of Earth science concepts. Evaluation of the data collected from the project suggests use of LC assisted students in developing a greater connection with the topics and a more complex understanding of the concepts than traditional methods.

Triangulation of the data suggests LC enabled all students to forms strong connections among the various content topics and to explore concepts and construct new knowledge with peers. The use of LC seemed to promote greater participation of all group members.

Long-term memory was developed using LC techniques. Students learned to determine the central ideas of a text and provide an accurate summary of a text. Long-term memory was developed through the various activities used during all three units. Students maintained the knowledge gained pertaining to Earth's plates, formation of land forms, and earthquakes. Evaluation of the data collected from the project suggests use of LC, along with the incorporation of hands-on activities enabled students to produce long-term memories of the concepts taught during the project.

Students' attitudes and motivation were positively affected during the project. Data from all sources revealed that students enjoyed the learning opportunities afforded them as each unit unfolded. From my project, experience, and results, I was also able to infer that effective motivational strategies center around offering interesting reading passages, balancing conceptual understanding and procedural skills, and scaffolding for students to hold quality LC. The specific science-related tasks for each role in LC enriched the students' science learning experiences. The scaffolding that I provided allowed the students to carry out their LC roles confident that they were participating effectively. Together, these factors were key toward motivating the students.

Interviews provided me with insight into what the students thought about reading, learning science concepts, and LC. Students responded about the strategies they learned and how well they could transfer their skills to make connections to the world around them. I was surprised that every student answered "yes" to the question about whether or not they felt LC was helpful. The majority of students supported their answer stating that LC gave them a chance to discuss their ideas with their classmates.

One of my goals was that students would learn to agree to disagree, and the class would be exemplified by a sense of mutual respect. The unanimously positive response to the team-building activity convinced me that including team-building activities are essential to cooperative group work. The students explained that the team-building activity helped provide better communication skills by having people who never talk possibly becoming friends. Students explained that the opportunity to look at different opinions from people can help find a solution to problems.

To motivate my students, I must build a rapport and a sense of fairness in the classroom. When using LC, it is essential to first develop their understanding of the cooperative nature of LC. This understanding will boost the students' self-esteem, giving them confidence, and motivating them intrinsically. The second step in motivating my students is teaching the students to monitor their reading strategies. The students in my study were really excited about reading activities. I am excited to continue to use LC to teach concepts in my science classes.

VALUE

This capstone project has provided me with the opportunity to develop within my teaching style. I have explored new teaching strategies. Learning about using a greater variety of assessment tools with my students caused me to value students sitting down and conducting interviews. In my personal view, interviews are extremely valuable because it shows what students know and think. My role as the teacher in the class was challenged by the information I was gaining from the students. As a result, I learned about the importance of students working within a student-centered educational setting. When I served as a facilitator of the different conversations, students gained more ownership of their learning.

Incorporating LC for learning science content gave me the opportunity to focus on the important skill of reading in the classroom. An integrated model of literacy emphasizes that the processes of communication are closely connected. The expectations of reading, speaking, and listening require that students be able to write about what they read. A good program should include lessons that help students practice the communication connection. The use of LC provided appropriate practice for reading, speaking, and listening; it is my expectation that students will share finding from self-selected research.

The Common Core State Standards (Standards) for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects promotes shared responsibility for students' literacy development. LC is a strategy that will allow science teachers the opportunity to explore ways to offer the interdisciplinary approach to literacy promulgated by the Standards. Using LC provided me with the opportunity to impact literacy development in ways consistent with my values. This teaching strategy provided me the framework for students to practice communication skills, while at the same time, gaining deep knowledge of content information. I am in hope that science teachers within my school look at my findings from this project and consider adopting LC in their classes. I know that the science teachers will be required to incorporate literacy standards next year. I can think of no better strategy to achieve an integrated model of literacy than using LC.

This project has implications for further study. LC helped promote literacy acquisition in the science class at the same time as it helped students better understand science concepts. I measured the effects of LC on the cognitive domain quite extensively throughout the project. In the future, I would like to study how much LC affects students' affective domain. I also would like to study the effects that LC has on higher level thinking skills. I think it would be interesting to see how this intervention affected students' application, synthesis, and evaluation level as well as knowledge level. I also would like to know the degree to which the higher level thinking skills can be affected by students' metacognitive awareness.

Next year, my expectation will be that all of my science classes will be taught to learn to read science content by employing LC. I learned that the science task sheets for LC are beneficial to all students. The students thought the tasks were fun. Students benefit from consistency, and LC helped the students with the consistency they require in order to learn science content from reading and understanding of informational text during science class. In the future, I hope to gain a larger library of science related text that students will enjoy and enjoy sharing with their peers. If I am to use LC with all of my students, I must develop a better science reading library!

Exploring LC has revitalized my teaching, which I felt needed to be more relevant to the students. LC motivated students because they were given the opportunity to be creative in response to their specific science readings. The LC tasks were designed to build relevance into the reading activity, namely students were making connections that were helping them to apply what they learned from the reading assignment. LC created an atmosphere where the students began comparing information gain from experiments, simulations, and videos with that gained from reading text on the same subject.

Something that I learned about myself from doing the project is the importance of peer observation and collaboration with other teachers in my school. I enjoyed working with fellow teachers. Other professionals have many ideas to offer and suggestions for ways to tweak my lessons. Working with my colleagues has given me more energy and enthusiasm for my profession. I also learned that employing LC enabled me to develop professionally by focusing on strategies which better engage my students. I know I must work more closely with the literacy teachers in my school, and that the literacy and science teachers have a lot to offer to each other and to our students. I plan to continue to use LC to teach science content.

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APPENDICES

APPENDIX A

CONCEPT MAP INTERVIEW QUESTIONS FOR NONTREATMENT UNIT OF PLATE TECTONICS

Plate Tectonics Concept Map Interview Questions

A suggested list of words is found below. Please use words that connect the word and show how the words relate. Use additional words as needed.
Word bank for concept map: Plate tectonics
Crust, mantle, core, lithosphere, plate boundary, convection currents, fault, continental drift

In what ways do these terms connect?

How can your concept map explain how Earth's moving plates create landforms?

How can your concept map explain how the theory of plate tectonics explains Earth's features?

APPENDIX B

NONTREATMENT UNIT PRE, POST, AND DELAYED ASSESSMENT

Plates and Mountains Assessment

1. Explain how magma in the mantle causes plates to move.

2. Explain the landforms created by tectonic plates moving.

3. At which type of boundary would you least likely find a volcano? Explain

4. During convection what happens to the warm magma? Explain

5. The Ouachita Mountains are what type of mountain?

6. What evidence can be used to help geologists determine Geologic time?

7. Explain what happens at each boundary.

APPENDIX C

BASIC PROJECT TIMELINE

Project Timeline

January 10 Tectonics Nontreatment preunit Assessment.
Started nontreatment preunit concept map interviews.
Daily teacher reflections using likert scale
January 11- 13 - Identify and diagram the layers of the Earth
January 14 Review the rock cycle
January 17- Model the layers of the Earth and review the rock cycle
January 18 – Bill Nye "Layers of the Earth" video
January 19- Convection Currents Lab
1st observation by colleague using checklist to watch six targeted students
January 20- Convections Current Lab Report
January 21- Review vocabulary and review for test.
January 24- Nontreatment postunit assessment.
Nontreatment postunit concept map interviews.
January 25-Internal Forces Shaping the Earth Mountain Building
Treatment Units 1&2 preunit assessment. Team Building activity
January 26
No school due to snow.
January 27- Literature Circle (LC) training workshop with "Time for Kids" article- After 69 days miners in Chile are rescued.
January 28- LC training workshop using Leveled Readers that accompany the science textbook.
January 31- Introduced different landforms caused by Earth's internal forces
February 1- SubSurface Activity:Mountains using specific readings from Mark Twain Media Inc., Publishers using LC
February 2- Lab Mountain Building with Squeeze Boxes followed by specific support reading using LC
2nd observation by colleague using a checklist
February 3- Learn the types of mountains that are in Arkansas with specific reading lessons using LC
February 4 – Compare and contrast different landform caused by internal forces
February 7- Nontreatment unit delayed assessment
February 7-8 Volcanic activity relates to mountain formation
February 9 – Volcano lab and lab report.
February 10-11 – School cancelled due to snow
February 14- Mountain Building Test Review
February 15- **Mountain Building Treatment Unit 1 postunit assessment.**
Treatment Unit 1 postunit concept map interviews.
Treatment Unit 1 postunit survey.
February 16 - Start Treatment Unit 2 Earthquake Introduction Direct Instruction
February 17- Ring of Fire Connection to plate tectonics
February 18- Start USGS Web-search "The Rolling Earth"
February 21- LC about Earthquake websites
February 22- Internet search for mapping recent volcanoes and Earthquakes share using LC
February 23-25 Conduct research using LC expectation.   Readings are articles that I had printed to help students understand Earthquakes.
February 25- LC meeting about articles. View Bill Nye Volcano and Earthquake video.
February 28- Earthquake lab
3rd observation by colleague Using checklist provided
March 1 – Read textbook lesson about Earthquakes using LC tasks

March 2- Take notes using PowerPoint and Looking at websites
March 3 – Use seismograph machines to illustrate seismometer readings
March 4- Test review for Treatment Unit 2
March 7- Treatment Unit 2 postunit assessment.
Treatment Unit 2 postunit concept map interviews.
March 8- Treatment Unit 2 postunit student surveys.
March 9 - Treatment Unit 1 delayed assessment
March 11- Japan Earthquakes rocks the world with 8.9 magnitude Earthquake. Students used laptops to look review USGS maps and look up facts about events as they were unfolding. Students wrote news articles as though they were the journalists.
March 21 - Treatment Unit 2 delayed assessment

APPENDIX D

TEAM BUILDING ACTIVITY

Team Building Activity

Objectives: The students will

I. engage in team-building and class-building activities.
II. identify ways to improve communication and social skills when involved in class projects.

Warm Up Activity (Anticipatory Set): Getting to Know Each Other
Part of working together as a class is the feeling of familiarity and class identity. One way to help improve relations among students is though get-to-know-you activities such as Inner-Outer Circle. Many of these activities can be refined to be used as mastery-learning activities when content is inserted into their structure.

The Inner Outer Circle:

Have students stand in a big circle. Every other person should take one giant step inside the circle and turn around facing those in the outer circle. In other words, there should be two circles with the outer circle people facing inward and the inner circle people facing outward, and everyone should be face to face.
The teacher should generate a number (5 is plenty) of questions that will reflect the personal interests and experiences of the students. This may need to be adapted to the students' age and grade level. Some possible questions include:

1) What was the best movie you watched this year and why did you like it?
2) What qualities make a good friend, teacher, sibling?
3) What is the most embarrassing experience you ever had involving your parents?
4) Rate your town's performance on recycling to the best of your knowledge.
Include at least one good reason why you rated it the way you did.
5) What is the most fun you have ever had at school?

For each question, students should exchange information with the person facing them. Then have either circle move a certain number of people to the left or right. So the teacher says after every question: "Inner circle move ___ (insert number) to the left (or right). The outer circle is then given a chance to rotate as well. A question is asked for every rotation. Continue until questions run out.

A Cooperative Discussion Activity (Instructional Input): "Take A Stand"

A) Develop a number of discussion questions based on your lesson dealing with issues. These issues might include:

Where Do You Stand Discussion Questions

1) Helmets should be required when children ride bikes.

2) An increasing number of Americans should be required to recycle.

3) People should buy cars that get more than 35mpg.

4) Martin Luther King's dream of equality for all Americans is closer to reality than ever before.

5) Smoking should not be allowed in any public place.

6) If I were a parent of a teenager, I would let them watch any TV shows or listen to any CDs that they wanted to.

B) Place a large card in each corner of the room that says one of the following:
Strongly agree Agree Disagree Strongly Disagree

C) Have students write their response on scrap paper before physically moving to either corner of the room. This prevents the "herd instinct" from taking over. Then allow them to stand under the card that best fits their opinion.

D) Have students discuss their viewpoints according to where they stood.

E) Have students defend someone else’s point of view by handing the students someone else’s paper.

APPENDIX E

PREUNIT AND POST UNIT STUDENT SURVEYS

Student Surveys

1. How did you help someone else today? How did someone help you? Explain.
2. What is one thing that you did well today? What did you learn? Explain.
3. What did you do to ensure that everyone participated equally? Explain.
4. What is it you like most about science class? Explain.

APPENDIX F

KWL CHART

Name: ___________________________ Subject:

Teacher Name: Date: ___________________

K **What I *Know***	W **What I *Want* To Learn**	L **What I Have *Learned***

APPENDIX G

LITERATURE CIRCLE ROLES

Name: ___________________________ Class Period/Subject: _______
Book/article: ____

Everyday Life Connector

Science is not just something that scientists do in laboratories or that we learn about in class. Science is real and a part of our daily life.

YOUR JOB: In your reading search for examples of how science is a part of daily life. Look for ideas, characters, or events that make you think of daily life. For example, if you read about a student riding the bus to school, one way his experience relates to life is that the bus wheels are an example of the simple machine, wheel and axle.

Page Number	Real Life Science Example	Science Concept this Example Relates To

Adapted from (Straits, 2007)

Name: _________________________ Class Period/Subject: _______
Book/article: ____

Discussion Director
It is important for scientists to work together as a team to share ideas. Often when scientists work together they can share areas of expertise and give new perspective to an investigation.
YOUR JOB: Lead your group of scientists in a discussion by preparing open-ended questions to extend your group's thinking. In your reading search for things that make you wonder or topics you think your group should discuss. Don't worry about the small details. Your role is to help members talk over the big ideas in the reading and share their ideas and reactions. The best discussion questions come from your own observations, thoughts, feelings and concerns as you read.

Questions for my Literature Circle Meeting:
1. Question:
____
____
Answer (pg. or paragraph to support answer ___)
____
____
2. Question:
____
____
Answer (pg. or paragraph to support answer ___)
____
____
3. Question:
____
____
Answer (pg. or paragraph to support answer ___)
____
____
4. Question:
____
____
Answer (pg. or paragraph to support answer ___)
____
____
5. Question:
____
____
Answer (pg. or paragraph to support answer ___)
____
____
Adapted from (Straits, 2007)

Name: ___________________________ Class Period/Subject: _______
Book/article: ____

Nature of Science Investigator

There are many characteristics of science that scientists experience when they do investigations.

YOUR JOB: When you are reading today, look for examples of these characteristics and record them below.

***Some possible characteristics that you might find include:**

1. Science is full of theories
2. Scientists use creativity and imagination
3. Laws state observations, theories explain them
4. Science is affected by and affects culture/society
5. Scientific knowledge is tentative (it can change)
6. Science is based on evidence
7. Some knowledge is based on inferences that lead to theories
8. There is more than one method for doing science

Page Number	Characteristic of Science:	Example

Adapted from (Straits, 2007)

Name: __________________________ Class Period/Subject: _______
Book/article: ____

Vocabulary Enricher: Clarifies word meanings and pronunciations. Uses research material to shed light on interesting or unknown words. Add essential vocabulary to the Word Wall.

Vocabulary for my Literature Circle Meeting:

1. ___Vocabulary Word and Definition:____

____ __________________________

Page word is on. What does the word mean in text?

____

___________________ ____ _

What connections can my group make with the word?

____

____

____

_____________________________________ ____

2. ___Vocabulary Word and Definition:____

____ __________________________

Page word is on. What does the word mean in text?

____

___________________ ____ _

What connections can my group make with the word?

____

____

____

_____________________________________ ____

3. ___Vocabulary Word and Definition:____

____ __________________________

Page word is on. What does the word mean in text?

____

___________________ ____ _

What connections can my group make with the word?

____

____

____

_____________________________________ ____

4. ___Vocabulary Word and Definition:____

____ __________________________

Page word is on. What does the word mean in text?

____

___________________ ____ _

What connections can my group make with the word?

____

____

____

_____________________________________ ____

5. ___Vocabulary Word and Definition:____

____ __________________________

Page word is on. What does the word mean in text?

____

___________________ ____ _

What connections can my group make with the word?

APPENDIX H

PRE-UNIT AND POST-UNIT LITERATURE CIRCLE INTERVIEWS

Literature Circle Interviews

1. What helps you to understand science? Explain.
2. What helps you to understand what you read? Explain
3. What helps you to pay attention? Explain.
4. Have you been feeling like you want to learn science? Explain.
5. What class activities make you want to learn science? Explain.
6. Tell me two things that worked well with your team using literature circles today. Explain.
7. Tell me one thing that needs to happen to improve literature circles before your next meeting. Explain.

APPENDIX I

TREATMENT UNIT 1 PRE, POST, AND DELAYED UNIT ASSESSMENT

Name ____
Period# _________
Landforms: Mountains and Volcanoes
1. Which kind of volcano is made of very runny basaltic lava and has wide gentle sloping sides? Explain how the volcano forms. Explain how you know.
2. Explain each landform that can occur at convergent plate boundaries. Explain why these landforms occur.
3. What is the location called where volcano forms in the middle of a plate and not at a boundary? Explain where this volcano is created. Explain how the volcano is formed.
4. Explain why the Circum-Pacific Belt is called the Ring of Fire. Explain why most of the world's Earthquakes and volcanoes occur in this region.
5. Why do mountains form at convergent plate boundaries?
6. After completing a lab on volcanic mountains, your lab group must describe each lava flow. Explain what you should do next.
7. Draw and label the parts of the volcano.

APPENDIX J

TREATMENT UNIT 2 PRE, POST, AND DELAYED UNIT ASSESSMENT

Name ____
Earthquake TEST

1. Explain what happens during the sudden release of energy within the Earth's crust. What is this known as? What are the resulting effects of the sudden release of energy in the form of seismic wave?

2 Most Earthquakes in Arkansas occurring along the New Madrid Fault are in which part of the state is the New Madrid Fault? Explain what happens along this fault?

3 Which surface waves cause the most damage to buildings? Why?

4 Most of the world's Earthquakes and volcanoes occur near the Circum-Pacific belt. Why? What happens as a result? What is another name for the Circum-Pacific belt?

5 What is the Richter scale?

6 Explain the different seismic waves occurring during and after Earthquakes. Explain how those waves are measured. What are the effects of the different seismic waves? How do you know?

7 Explain where most of this country's Earthquakes occur. Why do they occur there?

APPENDIX K

TEACHER DAILY REFLECTION WRITING PROMPTS

This and That about Class

1. Did I encourage my students to find answers? Explain.
2. Did I encourage my students to work well together? Explain.
3. Was I prepared? Explain.
4. Did class go well? Explain.
5. Was I excited about the class? Explain.
6. Did I enjoy my interactions with the students? Explain.

APPENDIX L

PEER REVIEW CHECKLIST OF TEACHER ATTITUDES

Checklist of Teacher Behavior
Rate each item on a 1-5 scale.

1. Teacher has high standards for the students. __________ Explain.
2. Teacher encourages the students to work cooperatively. ___________ Explain.
3. Teacher understands the roles of LC and expresses them clearly to the students. ________ Explain.
4. Teacher has a fair discipline system that creates a safe learning environment. ___________ Explain.
5. Teacher shows enthusiasm and is highly motivated. ___________ Explain.
6. Note any other circumstances indicating evidence of teacher’s attitude or motivation.

APPENDIX M

TREATMENT UNIT 1: POST AND DELAYED UNIT CONCEPT MAP

Volcanoes Concept Map Interview Questions

A suggested list of words is found below. Please use words that connect the word and show how the words relate. Use additional words as needed.

Word bank for concept map: Volcanoes

Composite, shield, cinder-cone, plates, convergent, divergent, Circum-Pacific belt, magma, lava, vent, magma chamber, ash cloud

In what ways do these terms connect?

How can your concept map explain how Earth's moving plates create volcanoes?

How can your concept map explain how the different types of volcanoes occur?

APPENDIX N

TREATMENT UNIT 2: POST AND DELAYED UNIT CONCEPT MAP

Earthquakes Concept Map Interview Questions

A suggested list of words is found below. Please use words that connect the word and show how the words relate. Use additional words as needed.

Word bank for concept map: Earthquakes

Release of energy, New Madrid Fault, seismic waves, P waves, primary waves, secondary waves, surface waves, Richter scale, Ring of Fire

In what ways do these terms connect?

How can your concept map explain how Earth's moving plates create Earthquakes?

Why is it important to have a good emergency response plan?

APPENDIX O

RUBRIC FOR SCORING STUDENT CREATIVE WORK

Scoring Rubric for Concept Map

Map Component	Possible points	Awarded points	Special things noticed about map
Proposition			
Clear and meaningful to the central topic	2 each		
Beyond given set of terms	3 each		
Not properly linked	1 each		
Vague	1 each		
Branch			
Top	1		
Successive branches	3 each		
Levels of hierarchy (general to specific)	5 each level		
Cross Links	10 each		
Examples	1 each		
Total			
Overall Reaction to student work			

APPENDIX P

TEACHER SURVEY

Teacher Survey

Please rate the following 1 (strongly disagree) to 5 (strongly agree) and explain your answers.

1. I am excited to start the day.
2. I am prepared for the day.
3. I needed to use my first period prep to finish preparing the lesson.
4. I feel motivated today.

APPENDIX Q

READING STRATEGY CHECKLIST

Reading Strategy Checklist

Name: ________________________________ Date: __________________________

Directions:

1. Check those statements that reflect the reading strategies you use.
2. Write any comments you have about your reading on the back.

Strategies I Use Before Reading:

_______ I ask questions.

_______ I predict.

_______ I think about what I know about the topic.

_______ I skim pictures, charts, and graphs.

_______ I read headings and boldface words.

Strategies I Use During Reading:

_______ I stop and check to see if I understand what I'm reading.

_______ I use pictures, graphs, and charts to help me understand confusing parts.

_______ I stop and retell to check what I remember.

_______ I make mental pictures.

_______ I reread to remember more details.

_______ I reread to understand confusing parts and unfamiliar words.

_______ I record an unfamiliar word that I can't figure out.

_______ I read the captions under and above photographs, charts, and graphs.

_______ I raise questions and read for answers.

Strategies I Use After Reading:

_______ I speak, draw and /or write reactions.

_______ I think about why I liked or didn't like certain parts.

_______ I picture characters, places, and ideas.

_______ I predict what might happen about the details of the article.