THINKING LOGS, CONCEPT MAPS AND REGULATORY CHECKLISTS:

THE EFFECT OF METACOGNITION ON SCIENCE LITERACY

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 the rules of the program.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

At St. John the Evangelist, students showed a disparity between how they perform and how they think they perform. In order to determine whether instruction of what learning is and metacognitive reading strategies would improve science literacy and confidence in science; students were given instruction in different learning styles and reading strategies for use in and out of the classroom. Learning logs during reading, concept maps to assess knowledge and regulatory checklists were used to determine if student learning improved. Reading comprehension was measured before and during treatment. Students did not show a marked increase in use of these strategies after the treatment; however reading comprehension and attitudes toward science improved.

INTRODUCTION AND BACKGROUND

I teach at a parochial Catholic school in Silver Spring, Maryland. Silver Spring is located two miles northwest outside of Washington, DC. Socio-economically, this area is predominantly middle to upper class. The population is about 50% Caucasian, 25% Hispanic and 20% African American (www.city-data.com).

St. John the Evangelist ranges from preschool aged to eighth grade. I teach sixth, seventh and eighth grade science. Most of the students are from two-parent households making middle class incomes. Parents are generally very involved in activities at the school such as lunch and recess duties, fundraisers and school programs. The focus of the school is on the whole child and there is not a heavy focus on academics. There is no honor roll, for instance, or academic awards of any kind. One of the bumper stickers for the school reads, "Every child is honored at St. John the Evangelist." My students are diverse in terms of academic ability, race and scientific interest.

Since our school accepts any student who wants to enroll for a Catholic education and we do not separate students based on ability in science class, teaching to every student can be a challenge and differentiation is a necessity. I have learning disabled students who receive notes from other students and testing accommodations while others excel with little teacher intervention.

One of my goals as an educator is to not just teach science content but to also teach critical thinking skills and academic skills. Many students coming into sixth grade do not have the adequate skills necessary to succeed in secondary education although they have been successful in elementary school. Middle school is a transitional period

where students need to learn how to learn effectively in the classroom setting. It seems

like every year, my sixth grade students struggle to adjust to the larger workload and six

different teachers' expectations.

Not only are students being asked to commit many more facts to memory than in

the past, but students are now being asked to analyze, synthesize, connect and apply

content. All of my students need help analyzing a text for the most important facts,

connecting those facts logically to one another and applying those facts to new situations.

I cannot assume that they come into my room knowing how to do these things.

In the past, I have struggled with how to go about teaching my students how to

learn. I know that simply presenting the material is not enough because I have students

fail assessments time and again. I offered quiz and test corrections as well as extra credit

to help students who are struggling. While I think it is valuable to offer these kinds of

things as additional learning opportunities, the problem of learning the material in the

first place persists. Additionally, students may do well on questions where they have

been asked to memorize a list of facts but fall short when they are asked to think

critically, especially on application questions.

A final clue about why my students consistently fall short when it comes to

traditional assessments and application questions was the typical reaction upon getting

back their quizzes and tests. Students who do not do well are shocked and dismayed

upon seeing how they performed. They had no idea they had not learned the material.

Upon further questioning, students who do not perform well think they understand what

they are doing. Therefore, they are not coming during lunch or recess for extra help –

they do not even know they need the extra help. Although students' preferred method of

studying is reading over notes and the textbook, their notes offer little insight into the material and many do not make meaningful connections to the textbook information.

The most important thing I can help my students learn is *how to learn*. In science class, this includes not only reading to learn but experimenting to learn. When asked what they learned from a lab we performed in class, students are able to tell me what concepts the lab covered, but they are not able to apply the concepts to real-world problems nor do they generate new questions that the lab may raise. In other words, even in guided or open inquiry labs my students are not engaged in the material.

Focus Question

Given the formal and informal observations and data from assessments, I concluded that my students were not really thinking about their learning in science class. They lack the metacognitive strategies needed to analyze whether they are learning and what to do if they are not.

My focus for this project was on the incorporation of metacognitive strategies. I wanted to know if implementing strategies like regulatory checklists, concept maps and learning logs would improve students' performance on assessments, labs and on questions that require higher level thinking skills. I also wanted to find out if these methods would improve students' perceptions of what science really is.

Question: Will student awareness and teacher implementation of metacognitive strategies improve reading comprehension and performance on assessments?

Sub-questions:

- Will the use of learning logs improve reading comprehension?

- Will student understanding of learning evolve as a result of explicit metacognitive instruction?

- Will metacognitive instruction improve student confidence in their own abilities to learn and use science?

CONCEPTUAL FRAMEWORK

Metacognition has been described as thinking about thinking. Flavell (1979, 1981) defined it as being aware of how we learn. However, metacognition as it is understood today is also about being aware of different learning strategies and knowing when to use them. Successful learners demonstrate a better awareness of how they learn, know about more learning strategies and understand when to use those strategies. Metacognition can be improved through classroom instruction. When teachers explicitly model metacognition, there are a number of benefits in the science classroom including improved science literacy and retention (Schraw, 1998).

Schraw, Crippen and Hartley (2006) described three types of metacognition, and all three can overlap during any given task. The first is knowledge about ourselves as learners and is called *declarative knowledge*. A student demonstrates this kind of metacognition when they realize that they learn best if they have heard it explained, seen a diagram or have gotten a chance to talk it over with someone. They know what kind of learner they are and how they learn best. Students show this level of metacognition when they become aware of prior conceptions they may have about a topic as well (Yuruk, Beeth & Anderson, 2008). Finally, declarative knowledge includes an understanding of

outside factors that help or hurt one's learning. For some, they need to study or learn in complete silence or a quiet classroom without distraction (Nordell & Shawn, 2009).

The second type of metacognition is called *procedural knowledge*. Procedural knowledge is knowledge about different strategies that are useful for learning (Schraw et al., 2006).   One example of this type of procedural knowledge is specifically related to the thinking behind strategies that scientists use for the process of inquiry, like formulating questions and making testable hypotheses (Ben-David & Zohar, 2009). Finally, *conditional knowledge* is understanding when to use a specific strategy and why that is the best one to use (Schraw et al, 2006-).

These three types of metacognition are often interrelated. For instance, one cannot have an adequate knowledge of the strategies that work best for them without knowledge of the strategies themselves. Research has found that low achieving students do not have adequate knowledge of these three types of metacognition (Liu, 2009; Nordell, 2009; Mokhtari, 2002). Higher achieving students seem to have a greater knowledge of what kinds of learners they are, about strategies they can use to help them learn and when to use them.

There are several benefits to explicitly teaching metacognition in the classroom. Many students do not have the knowledge they need to succeed in an academic setting. Low achieving students do not read actively or study efficiently. Students who do not use metacognitive strategies do not have an accurate picture of what they do and do not know. They are often surprised to find they have done poorly on tests and other assessments and their self-evaluations are often inaccurate. (Liu, 2009; Nordell, 2009; Mokhtari, 2002) Another benefit of using metacognition in the classroom is that it

improves retention of information for all students. In delayed transfer tests, students who practiced metacognition in the classroom remember the information that is taught better than those who were not (Ben-David, 2009; Mokhtari; Yuruk, 2008). This shows that students are not just memorizing a list of facts about a subject that will later be forgotten but are actively thinking about the information and fitting it into their existing schema.

One way of assessing students' metacognitive thinking is by using concept maps. Concept maps are diagrams that show how concepts and terms are related to one another. They use linking words between propositions to show relationships between concepts (Novak, 1990). Student-constructed concept maps can show teachers how students are linking the knowledge together, instead of having students memorize facts in a linear way (Nordell, 2009).   Concept maps allow the students to connect concepts presented in labs, lectures and readings to their prior conceptions. They promote conceptual change, even in delayed transfer tests (Yuruk, 2008). They can be used to connect concepts together by showing relationships. They can increase the student's understanding of these relationships (Mok, Lung, Cheng, Cheung, & Ng, 2006). As students' familiarity and use of the concept maps increase, the complexity of the concept maps increase as well.

Concept maps can help assess not only scientific concepts but thinking strategies themselves (Ritchhart, Turner, & Hadar, 2009). In this way, you can ask students about strategies they are using and have them connect these to their thinking. Students can self-monitor these strategies and how helpful they are.

Another important tool for teaching metacognition is posing questions. Teachers should pose questions of the students which promote the skill of metacognition and allow students to ask their own questions (Kaberman & Dori, 2008). A *regulatory checklist* is a

list of questions students need to ask themselves during a problem solving task. This

helps the student plan, monitor and evaluate their own learning using a series of questions

(Schraw, 1998).

Finally, journals promote critical thinking and provide a tool for the teacher to

assess that thinking. Journaling about their thinking help students monitor their own

understanding by giving them the opportunity to question the content, summarize key

concepts, make predictions and connect it to prior learning (Steenson, 2006). They also

provide fodder for class discussion that goes beyond the content of the reading or lecture

(Carr, 2002).

With the incorporation of concept maps, regulatory checklists and journals,

teachers can improve the metacognitive thinking in their classrooms. In this way students

can take control of and monitor their own learning. Students can undergo greater

conceptual changes and retain the information longer.

METHODOLOGY

The goal of this study was to determine whether teaching metacognitive

techniques would improve student learning. This was done through the use of regulatory

checklists, learning logs and concept maps. The concept of metacognition was first

introduced to sixth and seventh grades beginning late in the 2nd quarter of school. 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.

Students were asked to create a concept map about learning at the beginning of the treatment and again after treatment. Students discussed what they thought learning was and methods for monitoring one's learning. As a class we categorized the things they put on their concept maps and created one for the entire class. At this time, I also taught them how to create a concept map. These two concept maps were compared using the Bloom's Taxonomy Checklist (Appendix A) to show growth in the understanding of students' beliefs about learning. These maps were used throughout the unit to assess student learning and thinking. Students generated words and concepts to incorporate in the maps and were asked to connect them logically. They then shared the maps with a partner or group and had to explain why they organized the concepts the way they did. They were then given time to create a new concept map as a group. Both concept maps, group and individual, were then analyzed for the accuracy and comprehensiveness of the connections. Over the course of the treatment, scores were kept and analyzed using the Concept Map Scoring Rubric (Appendix B) for growth both in concept map formation and better analysis on the content itself.

The next thing we did as a class was use two websites where students could assess what type of learner they were. They had to complete a Learning Styles Inventory (Appendix C). Next, I created a poster with a regulatory checklist on it to remind students of the metacognitive process (Regulatory Checklist, Appendix D). Throughout the treatment period, this questioning was reinforced and monitored by me.

For reading assignments during the treatment, students were given the Thinking Log (Appendix E), a guided learning log. In this way students got used to the process of analyzing their learning while they read. The questions on the Thinking Log were

designed to promote active reading and to get students to monitor their own learning. Students were given a Reading Comprehension and Retention Assessment (Appendix F) before and during treatment to assess the efficacy of the Thinking Log. Quizzes consisted of writing a summary of the main idea in the reading and providing three details about the main idea. Thinking Logs were also analyzed based on a Thinking Log Scoring Rubric (Appendix G). I recorded the number of statements or questions that corresponded to a fact the student was recalling and those that corresponded to a connection to something new. I also totaled the numbers for the entire class. I wanted to track both individual student and class growth. With that data, I looked at how the number of questions and connections correlated to quiz scores. During the treatment period, students were assigned two to three Thinking Logs.

For the last half of the quarter, students were given a Science Study Log (Appendix H) with a regulatory checklist asking them to plan, monitor and evaluate their studying. They were asked to study twice a week for fifteen minutes and log that time. They did this for three weeks. I collected the study logs and tallied the total amount of time per student as well as the average time per student in a class. I then looked at how this time correlated to quiz and test grades.

Students were given the Metacognition and Confidence Survey (Appendix I) to determine whether their self-questioning skills had improved over the course of the treatment period and to see if confidence in science had improved. The scores of surveys taken before and after were compared and analyzed for growth. They were also given a Student Evaluation of Techniques (Appendix J) where they were asked to rate each of the methods – learning style inventory, concept maps, thinking logs and study logs – on its

effectiveness at helping them learn science. They were able to add any comments about what they liked and what they would improve. These scores were analyzed for evidence of metacognition in the student.

Finally, I incorporated the Peterson Metacognition Interview (Appendix K) throughout the treatment to help clarify questions on the survey and results of the quizzes. These sources were designed to determine whether the incorporation of explicit instruction in metacognition affected students' performance in reading comprehension and in overall student achievement (Table 1).

Table 1
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
Primary Question: 1. Will student awareness and implementation of metacognitive strategies improve learning in middle school science classes?	Thinking Logs	Metacognition Survey	Student Interviews
Secondary Questions: 2. Do the use of concept maps and regulatory checklists improve concept retention and higher-level thinking?	Concept Maps	Quiz/Test scores	Metacognition Survey
3. Do learning logs improve reading comprehension?	Thinking Logs	Thinking Log Rubric	Student Interviews & Metacognition Survey
4. Will the implementation of metacognitive strategies improve student attitude toward learning and science content?	Student Interviews	Metacognition Survey	Student Evaluation of Techniques

DATA AND ANALYSIS

When analyzing student concept maps on learning a few interesting trends emerged. The first maps were created before the treatment and were almost exclusively school-related. They mentioned things like teachers, scholastic subjects, books and even the supplies one would need for learning (highlighters, pens, etc.). Only 34% of seventh grade mentioned any of the levels in Bloom's Taxonomy to define learning ($N=26$). Students also focused more on emotions associated with learning before the treatment (Figure 1). The words "stress" or "boredom" occurred on 46% of the first concept maps.
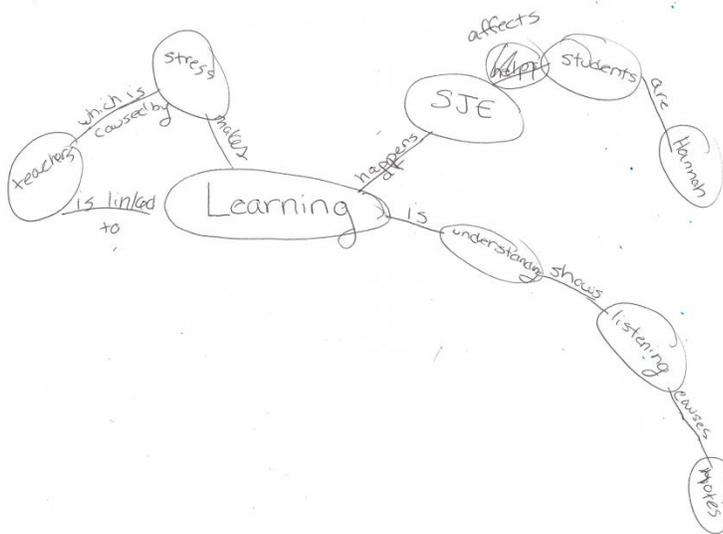
Figure 1. A seventh grade student's concept map about learning before the treatment.

After the treatment students were again asked to create a concept map about what they associated with learning. The same methods were used to create the maps. This time 89% of the maps had ideas related to Bloom's Taxonomy ($N=27$). In addition, students included things that were not on any of the first maps like learning style and

experiences outside of school where they believed learning occurred. Sports, television shows, and life experiences were more likely to be included in the second concept map (Figure 2).
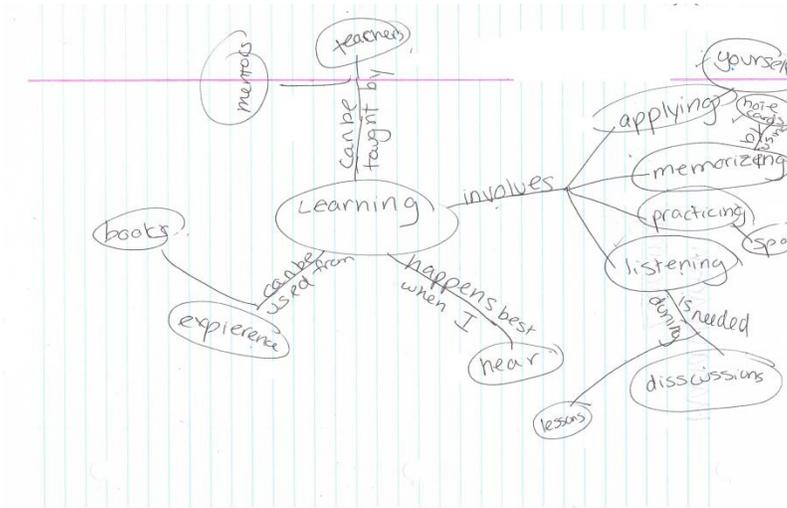
Figure 2. The same student's concept map after the treatment period.

According to the results of the Metacognition and Confidence Survey, students used metacognitive skills more often when they were testing than when they were in class or performing a lab before the treatment period. For instance, before the treatment only 15% of students *disagreed* or *strongly disagreed* with the statement, "After I take a test I have a pretty good idea of what grade I got," (Figure 3). They were confident when it came to evaluating their performance on a test or a quiz. In contrast, when asked whether they evaluate their learning after a lab, 43% of students *disagreed* or *strongly disagreed* (Figure 4).
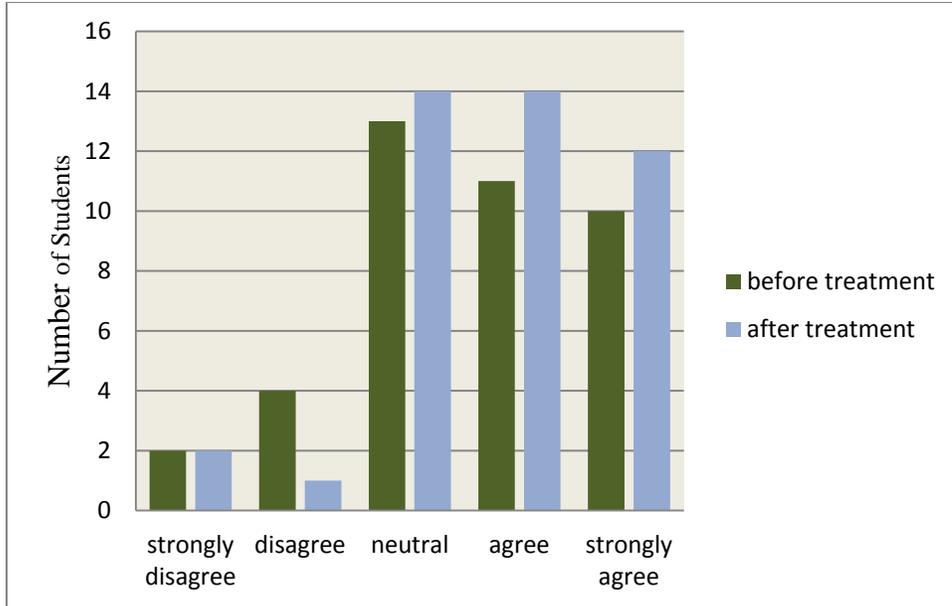
Figure 3. Number of students who responded to the statement, "After a test I have a pretty good idea of what I got," (*N* pretreatment = 40, *N* post treatment = 43).
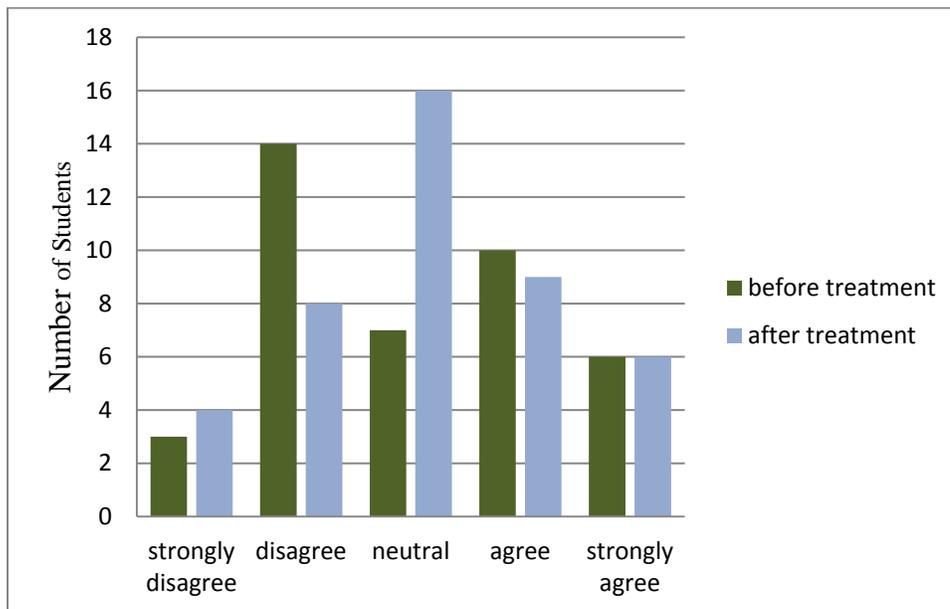
Figure 4. Student responses to "After I do a lab I find myself evaluating what I did and what I learned," (*N* pretreatment = 40, *N* post treatment = 43).

This trend continued after the treatment as well. In fact, students claimed to do less monitoring of their learning after the treatment. Before treatment, 15% of students *disagreed* with the statement "During class I monitor my learning to make sure I understand what's going on," while after treatment 23% of students *disagreed* or *strongly disagreed* (Figure 5). Students who were interviewed however, explained that they took notes and asked themselves questions to monitor their learning. None of the students in the interviews claimed they did not monitor their learning during class.
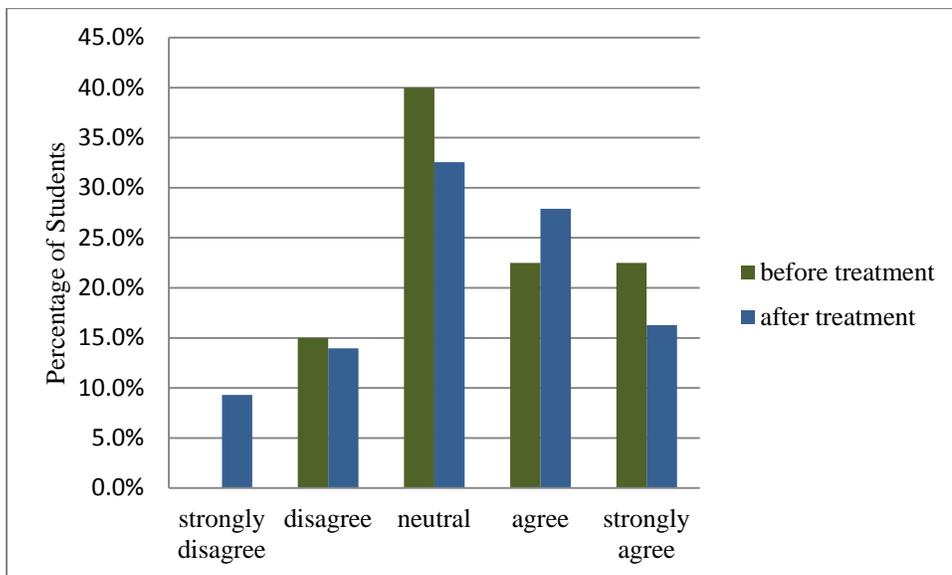
Figure 5. Percent of students who responded to the statement "During class I monitor what I'm thinking to make sure I know what's going on," (*N* pretreatment = 40, *N* post treatment = 43).

Before and after treatment, students were confident in their ability to learn (Figure 6). When given the statement, "I am in control of my own learning," most students *agreed*. Of all the students who completed a survey both before and after the treatment, only four students lost confidence in the ability to control their learning. Some students only completed one survey, either before or after the treatment.
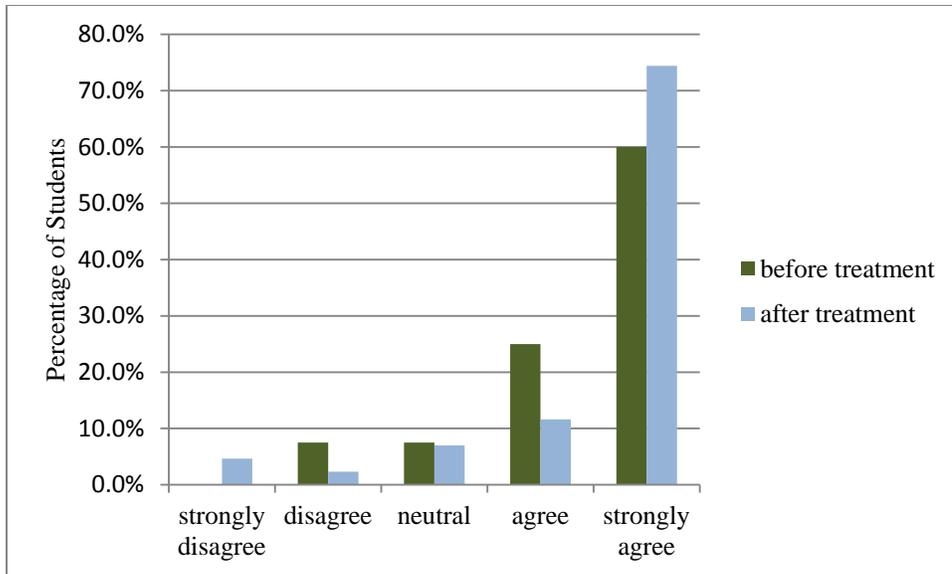
Figure 6. Percent of student responses before and after treatment to the statement "I am in control of my own learning," (*N* pretreatment = 40, *N* post treatment = 43).

Reading comprehension quizzes were calculated using the Reading Comprehension and Retention Assessment (Appendix F) before and after treatment. Before treatment, students either read the text aloud as a class, in peer reading or at home for a home assignment. They were then asked to answer the section review questions. At that time, they were given the assessment. The maximum score a student could receive is four points, one point for an accurate summary and one point for each detail that supported the summary.

During the treatment students' reading comprehension scores went up during the treatment both in sixth and seventh grades with the use of Thinking Logs (Figure 7). The number of students in seventh grade who were able to write an accurate and complete summary did not change significantly. In sixth grade, however, the average percentage

of students who received full credit for their summary went from 29% to 55%.
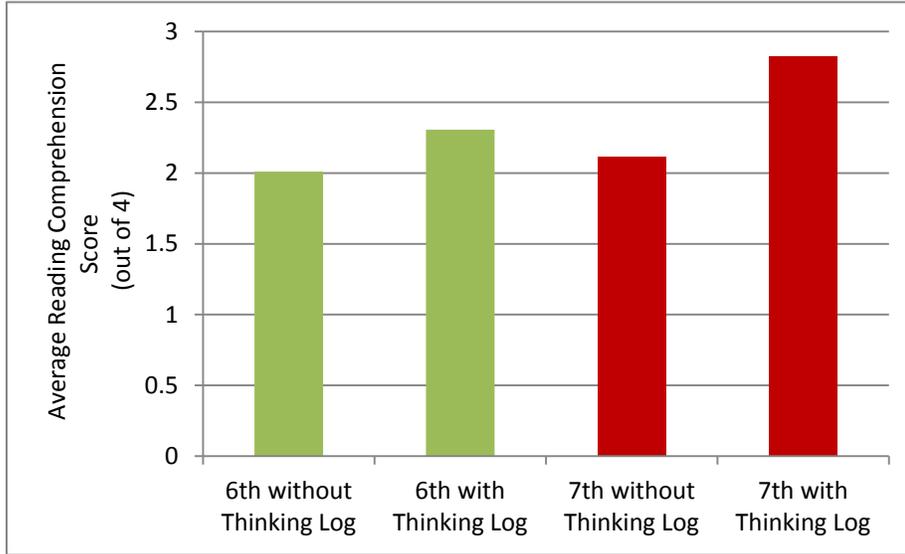
Figure 7. Average Reading Comprehension Scores with and without Thinking Logs. Scores ranged from 0-4.

There was a small correlation between the number of connections and questions tallied on the Thinking Logs and the quiz averages during treatment (Figure 8). However, when Thinking Logs themselves were analyzed for growth, I did not see any evidence indicating significant growth in the quality or the number of connections and questions written on the Thinking Logs.
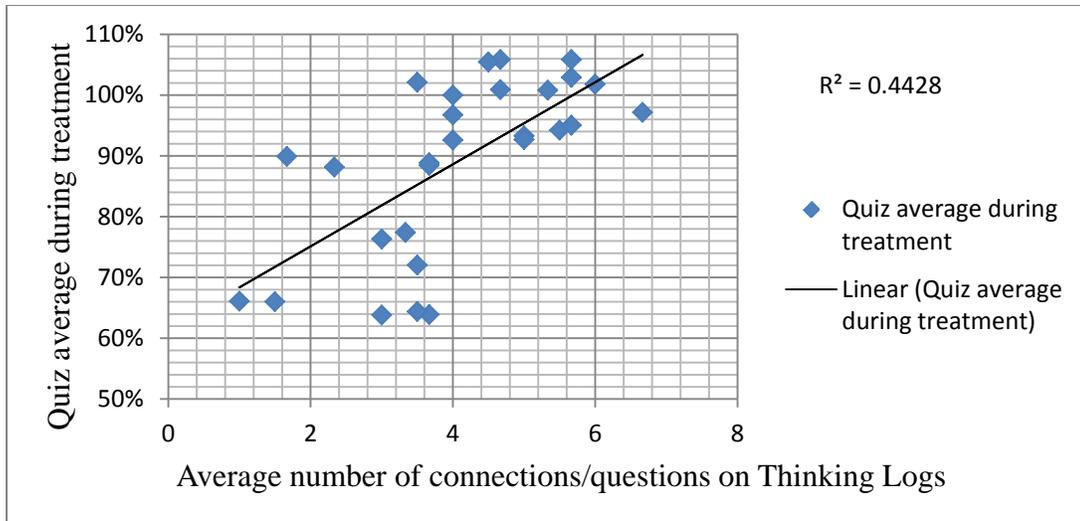
Figure 8. The correlation between quiz averages and the number of connections and questions tallied on the Thinking Logs.

When asked to evaluate Thinking Logs (Appendix E) in terms of their usefulness, students were overwhelmingly positive (Figure 9). Many students claimed that Thinking Logs forced them to think about the reading material. Others said it helped them remember what they were reading. One student claimed, "I was able to efficiently monitor my thoughts and keep focused on the material." Another said "It made me think about what I was reading." And another, "It forced me to pause and process what I was learning rather than read through it all but not understand a single thing in the end."
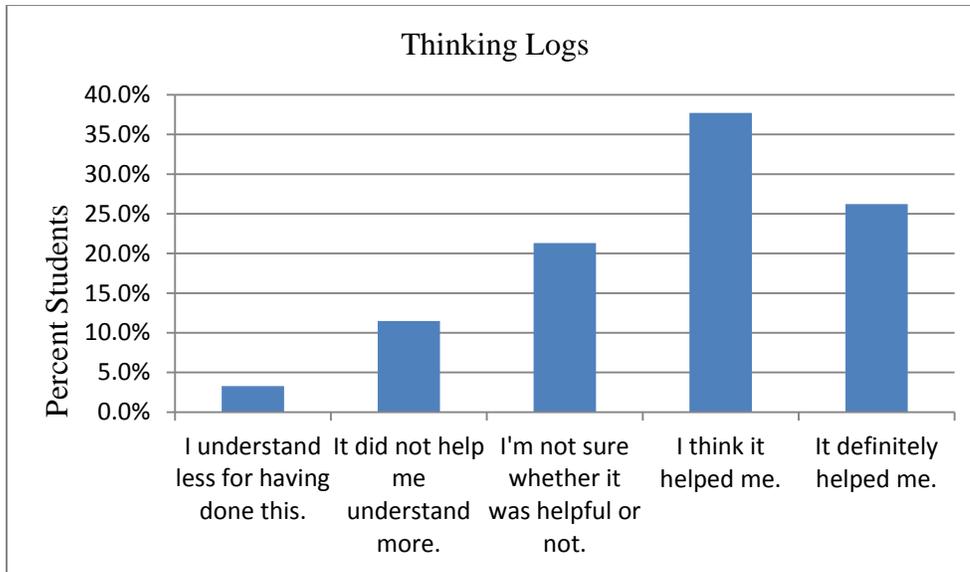
Thinking Logs

Figure 9. Student evaluation of Thinking Logs, (*N* = 61).

In general, the kinds of connections and questions students wrote on their Thinking Logs did not evolve in quality nor did the number of connections and questions increase. Some students found it tedious to record what they were thinking and others simply found the task distracted from the content.   Most students who disliked Thinking Logs suggested focusing on the facts and vocab from the section instead of on making connections and asking questions.   There was positive growth in student confidence in science. In response to "I am good at science," 20% of students *disagreed* or *strongly disagreed* before the treatment and no one strongly agreed (Figure 10). After the treatment, only 4.6% of students *disagreed* or *strongly disagreed* with that statement. Only two students who took the survey before and after treatment changed their answers in a negative way.
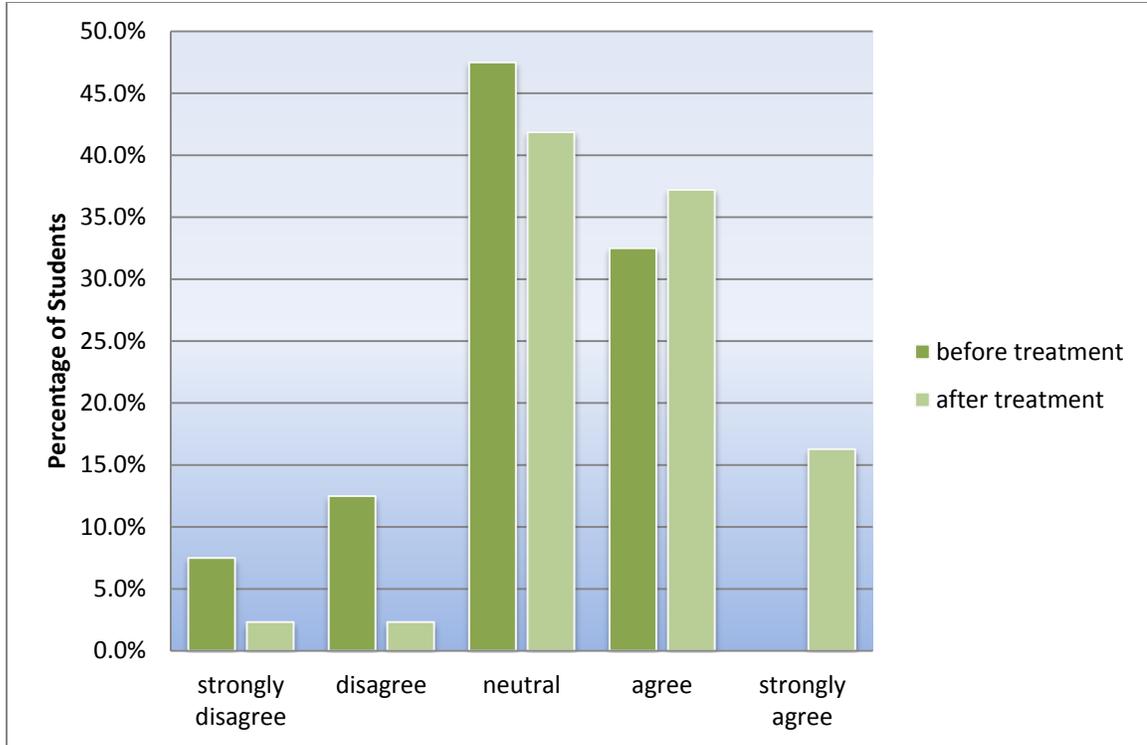
Figure 10. Student responses to "I am good at science," before and after treatment, (*N* pretreatment = 40, *N* post treatment = 43).

Student Evaluations of Techniques (Appendix J) were analyzed for evidence that students were evaluating their own learning. I also wanted to determine if students found the treatment helpful. Most students found the Learning Styles Inventory helpful (Appendix C). Many students said they learned something about themselves by doing this activity and would use this information to help them study (Figure 11). In addition, according to the Metacognition and Confidence Survey, students' knowledge of what type of learner they were increased after they completed the Learning Styles Inventory (Figure 12). Sixty percent of students agreed or strongly agreed before the Learning Styles Inventory, compared to 74.4% after the Learning Styles Inventory.
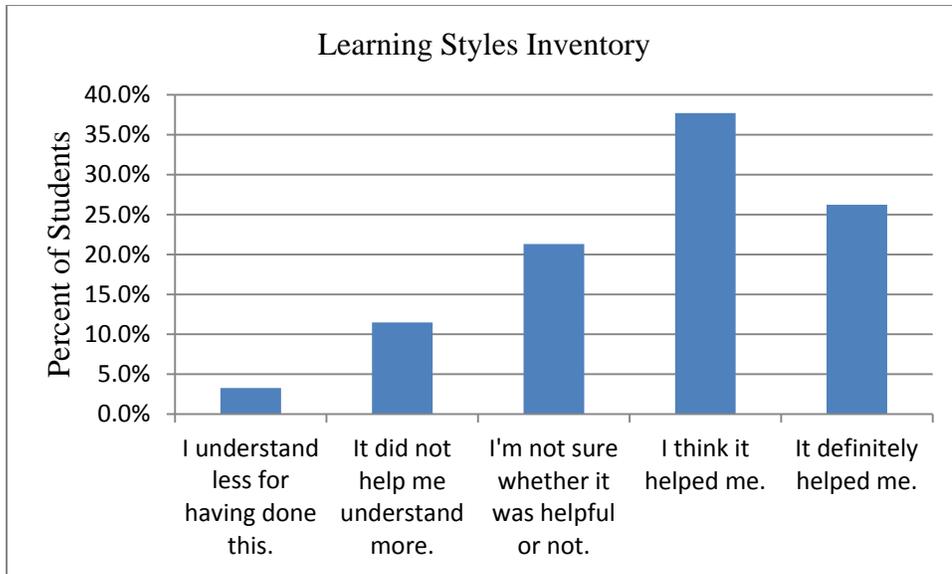
Figure 11. Student evaluation of the Learning Styles Inventory (Appendix C) on how helpful they were to them, ($N = 54$).
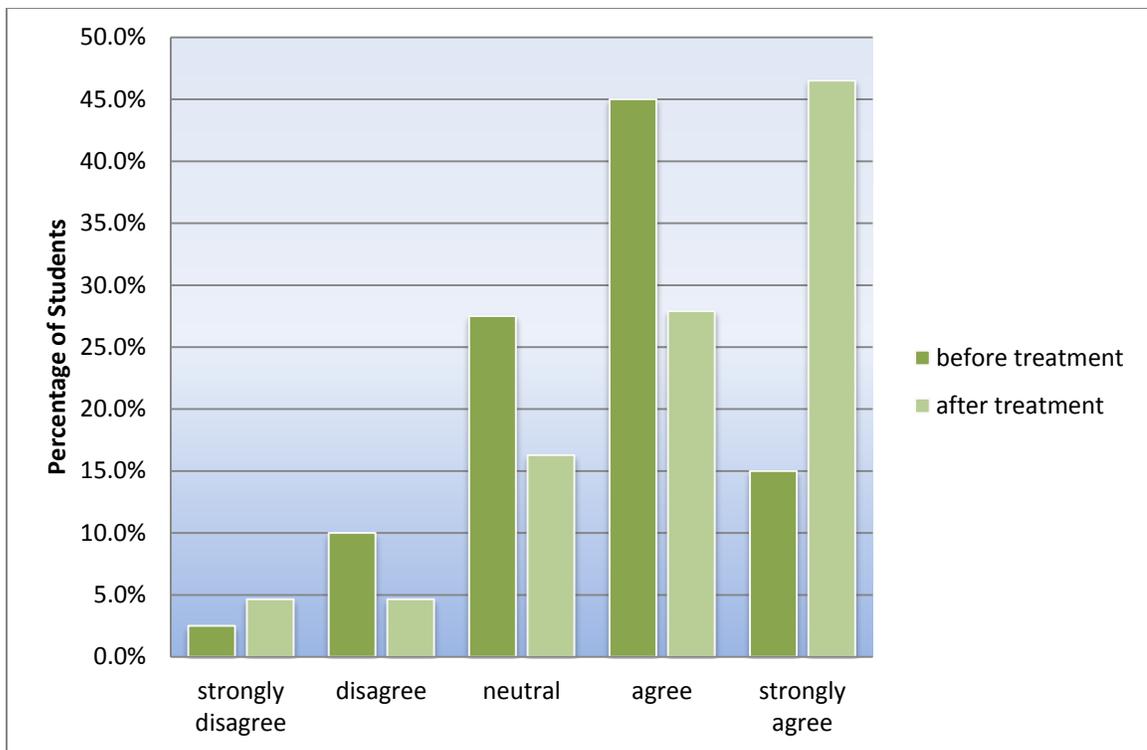
Figure 12. Student answers to the statement "I know what type of learner I am," (N pretreatment $= 40$, N post treatment $= 43$).

Students also had positive things to say about the use of concept maps (Figure 13). One student said, "[Concept maps] helped me understand how the things I was learning all worked together." Another said, "It was easier for me to learn because I saw how minor things connected to the main idea." Many students initially resisted the use of concept maps, but admitted in the evaluations that they were helpful. Ten percent of students said they knew less because of the use of concept maps or that they were not helpful.
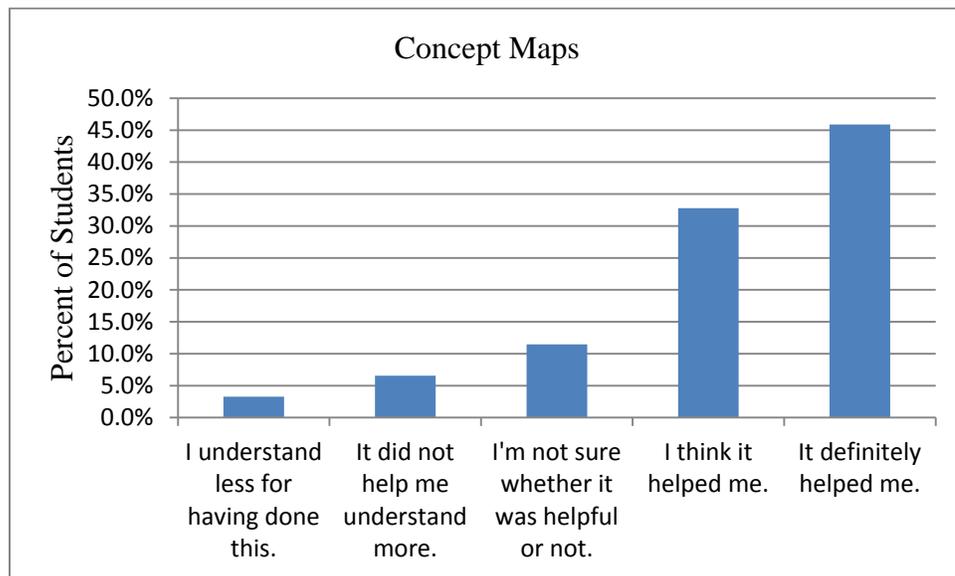
Figure 13. Student evaluation of usefulness of concept maps, ($N = 61$).

Finally, traditional quiz and test averages went up (Figure 14). Before treatment, the average quiz and test percentage for sixth grade was 85% and during treatment, that average went up to 89%. For seventh grade it was 86% before treatment and 89% during treatment.
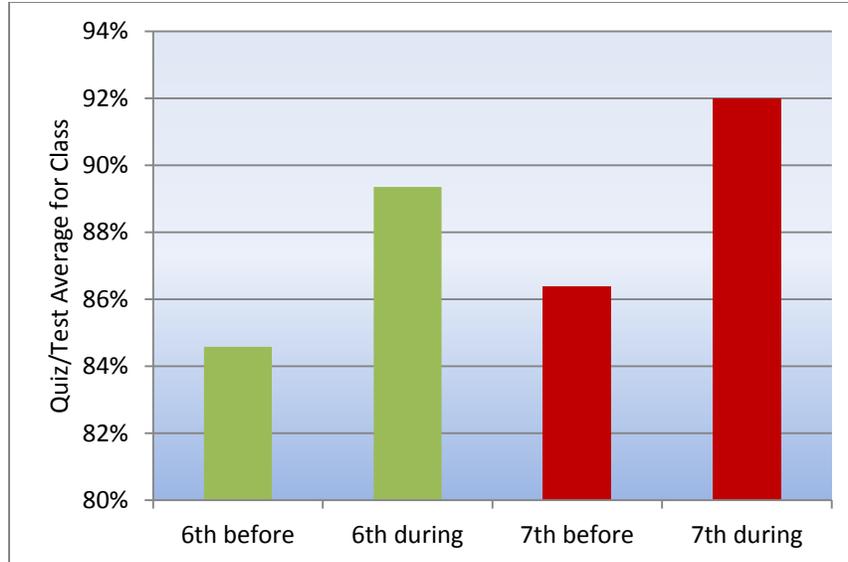
Figure 14. Average class scores for quizzes and tests before and during treatment. A total of ten assessments were averaged for 6th grade before treatment and three assessments were averaged during treatment. In 7th grade, there were 12 assessments averaged before and three during treatment.

Overall, student understanding of learning was broader at the end of the treatment and their test and quiz scores improved. Students showed an ability to evaluate their learning through their feedback of the different methods I employed as well as on their Thinking Logs. They also gained a greater understanding of what kind of learner they were. However, when analyzing metacognitive skills themselves on Thinking Logs and through the Metacognition Survey, students did not show an overall improvement in their metacognitive skills during the course of the treatment.

INTERPRETATION AND CONCLUSION

Reading comprehension seemed to improve during the treatment. Quiz scores and the number of accurate summaries increased. Whether this improvement was due to increased metacognitive strategies or not is unclear. Students who tend to do well are

skilled at monitoring and evaluating their learning already. This was clear when reading their Thinking Logs and asking them about their strategies for learning. Students who excel academically had insightful answers about what they think when they read and how they monitor their learning in class. Students who do not do as well, had trouble with these questions and had low quality connections and questions on the Thinking Logs.

To score the Thinking Logs, I tallied the number of connections and questions without regard to the quality. The lack of growth in the quality of the Thinking Logs and the decrease in agreement of students that they are monitoring their learning and asking themselves questions leads me to conclude that students did not, in general, learn metacognitive strategies during this treatment. I think this is because I did not make the value of these strategies transparent to students. They, in turn, were not motivated to adopt them into their everyday lives.

Student understanding of learning did evolve. I think this is mainly due to the Learning Styles Inventory. This activity helped a lot of students determine what type of learner they were and made them think about how this could help them at school. Many students were not even aware that people learn differently. The difference between this activity and the Thinking Logs were that students could see a connection between their learning style and success.

I saw a difference in the confidence of my students during the treatment. Both sixth and seventh showed growth in their answers to "I am good at science." Again, I cannot conclude whether this improved because of metacognitive strategies or not. My students are still more focused on grades, but their concept maps after the treatment prove they see learning as something that can happen outside of a classroom.

In conclusion, I do not believe my methods led to an increase in metacognition among the students who were not already monitoring their own learning. I feel this is because students did not see the value of the activities we were doing and therefore did not actively engage in them. However, I believe an overall shift in the emphasis toward what learning is and how it happens improved the confidence of my students.

VALUE

The big question for me is, why didn't my students' metacognitive strategies improve? I think the answer hinges on motivation. If students do not see the value in a subject or activity, they will not do well. Most of us are the same way. As a teacher I have always found the motivation for a grade demeaning. I wanted my students to strive for more than a grade. I hated hearing the questions "Is this graded?" or "How many points is this worth?" I struggle on some occasions to get students to take risks with their thinking.

What this exercise has taught me is that many of my students are still concrete learners who are externally motivated. They are capable of these strategies but they need to be shown the value of them. I am forced to admit that I, myself, am motivated by external factors all the time. Why should my students be any different?

Thinking Logs and concept maps required more than just skimming the text for an answer to a question or memorizing a fact. Students did not like completing these at the time we were doing them and it was more effort than the usual reading assignments. Most students admitted that they were valuable in helping them think about what they were learning – but many decided not to do it anyway.

I see two solutions. First, the most important lesson I learned during my time with Montana State was that every assessment I use with my students should be presented to the students for evaluation. This is called "closing the loop." I did not do as good a job as I should have at analyzing data as I went and presenting it to the class. This would have helped students see how it affected their learning. Second, I should have graded students on the effort they put into the concept maps and Thinking Logs by analyzing the statements for quality.

Focusing on learning is effective overall in improving student confidence. However, if you are going to ask students to do something more difficult than normal, you must be prepared to motivate them.

Finally, as a teacher I have learned to constantly monitor my teaching and the learning of my students in order to improve. Everyday provides an opportunity for revision. This project helped give me confidence as a teacher who can solve problems with regard to their classroom. I talk with my students about their learning a lot more than I did in the past. Students are used to me asking questions about what they are learning. When I give an informal assessment, students expect to hear what the results were. We all look forward to discussing them. My students and I feel more involved and empowered in our own learning and in the instruction process.

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APPENDICES

<u>APPENDIX A</u>

BLOOM'S TAXONOMY CHECKLIST

Appendix A: Bloom's Taxonomy Checklist
Used to asses concept maps about learning

Date: _____

Name									
Knowledge/ Remember									
Comprehension/ Understand									
Application									
Analysis									
Synthesis/ Create									
Evaluate									

APPENDIX B

CONCEPT MAP SCORING RUBRIC

Appendix B: Concept Map Scoring Rubric

Name: _____

Number of accurate connections made in 1st concept map: _____

Number of accurate connections made in 2nd concept map: _____

Difference between 1st and 2nd map (2nd - 1st) = _____ (A)

Comprehensive Score

3 – Included all concepts and was accurate in terms of hierarchy and relatedness.

2 – Included most of the major concepts but missed minor concepts.

1 – Did not understand the hierarchy of the concepts and missed many of the concepts.

APPENDIX C

LEARNING STYLES INVENTORY

Appendix C: Learning Styles Inventory

Directions: Go to www.educationplanner.org and answer the twenty questions about your

learning style. There are no right or wrong answers. If two answers apply to you, pick

the answer that is MOST like you. Record the results below.

Auditory	Visual	Tactile

1. What type of learner are you? What are some of the suggestions about helping you

learn?

2. Do you agree with this information? Why or why not?

Now you're going to learn about something a little different. This next quiz will teach

you about something called multiple intelligences. Go to the website www.edutopia.org

and click the link at the top that says "Learning Styles Quiz." Record your results below.

Linguistic	Logical-Mathematical	Visual-Spatial	Intrapersonal	Interpersonal	Musical	Bodily-Kinesthetic	Naturalistic

3. Do these results make sense to you? Why or why not?

4. Name some suggestions you think you might use to help you study.

APPENDIX D

REGULATORY CHECKLIST

Appendix D: Regulatory Checklist[1]

Inquiry Lab Checklist

Please go through these questions with your lab group orally. Check them off when you have answered them. **You do not need to write the answers down but you may want to jot down notes on the left side of your lab notebook.**

- **Planning Questions (To be done before you begin)**

    1. What is the nature of the task Mrs. Peterson is asking us to perform? (What skill is being emphasized here?)
    2. What is my goal?
    3. What kind of information and strategies do I need?
    4. How much time and resources will I need?

- **Monitoring Questions (Stop and ask these during the lab)**

    1. Do I have a clear understanding of what I am doing?
    2. Does the task make sense?
    3. Am I reaching my goals?
    4. Do I need to make changes?

- **Evaluating Questions (after lab)**

    1. Have I reached my goal?
    2. What worked?
    3. What didn't work?
    4. Would I do things differently next time?

---

[1] Adapted from Schraw, 1998

APPENDIX E

THINKING LOG

Appendix E: Thinking Log

Reading Assignment: _____

Name: _____ Date: _____

Thinking Log Directions: While you are reading and after you are finished reading, *please fill out something for each of the following.*

BEFORE READING

1. Preview the headings, pictures and diagrams. In one sentence, explain what you think

the main idea of this reading assignment will be.

_____

_____

2. Before you read, write at least one experience or connection you can make to this

content. (A movie you've seen, something you've already learned, something you've

heard before, etc.) Be as specific as possible.

_____

_____

_____

WHILE READING

Fill in the following areas as you read. You need to write something under each area.

Stop after each section and fill these in.

Connections to my personal experiences and observations:

Reactions to the reading:

<u>Questions I have about the content:</u>

<u>Predictions about what I'm going to read next:</u> (STOP every so often to fill this in.)

AFTER READING

1. In one sentence summarize the main idea of this reading.

_____

_____

2. What surprised you the most?

_____

_____

3. What would you like to know more about?

_____

_____

APPENDIX F

READING COMPREHENSION & RETENTION ASSESSMENT

Appendix F: Reading Comprehension & Retention Assessment

What was the main idea of the reading? (1 pt)

_____

_____

_____

_____

_____

_____

What are three details you remember about the reading? (3pts)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

APPENDIX G

THINKING LOG SCORING RUBRIC

Appendix G: Thinking Log Scoring Rubric

Date of Thinking Log: _____

Topic: _____

Name:									
No. of connections made									
No. of questions asked									
Summary									

Name:									
No. of connections made									
No. of questions asked									
Summary									

APPENDIX H

SCIENCE STUDY LOG

Appendix H: Science Study Log

*The purpose of this sheet is to log study hours in science. You will receive one homework grade a week for completing this study sheet checklist. **You need to study at least fifteen minutes two nights a week.***
Please go through this checklist before you study. You do NOT need to write down the answers to these questions. This checklist is to get you thinking about what you need to study and how you should study it.
1. **REVIEW:** What am I learning in science class right now?
2. **QUESTION:** What are some questions I have about what I'm learning? What do I need to review? What do I not understand?
3. **PLAN:** What can I do to make sure I learn what I need to? How am I going to study this material? (review notes, make flashcards of the vocabulary, re-read the textbook, talk about the material with my parents or a sibling, etc.)
4. **EVALUATE:** How will I know if I've learned what I need to learn?
5. **PREPARE:** What can I do to prepare myself for my next science class?

Study Log

Date	Time	Went through checklist	Parent initials
1/31/12	3:45 – 4:00	Yes	

APPENDIX I

METACOGNITION & CONFIDENCE SURVEY

Appendix I: Metacognition & Confidence Survey

Metacognition & Confidence Survey

Please rate the questions based on the following scale:

1	2	3	4	5
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

	1	2	3	4	5
I know what type of learner I am.	1	2	3	4	5
I use my learning style to help me study.	1	2	3	4	5
I am good at science.	1	2	3	4	5
After I take a test, I have a pretty good idea of the grade I got before I get it back.	1	2	3	4	5
When I read a question on a quiz or test or lab, I know what the question is asking most of the time and how to answer it.	1	2	3	4	5
I find myself thinking about what I will need to know to answer a question before I answer it.	1	2	3	4	5
I make predictions about what I will be learning in science next.	1	2	3	4	5
I ask myself a lot of questions during science class.	1	2	3	4	5
Most of the time, I understand what I am supposed to be learning during lab.	1	2	3	4	5
I usually think I got a much better grade than I did on science tests and am surprised when I get my test back and see the grade.	1	2	3	4	5
I feel confident that I can find the answers to questions that arise during science class.	1	2	3	4	5
I understand the process of inquiry and how the labs are related to this process.	1	2	3	4	5
During class I monitor what I am thinking to make sure that I understand what is going on.	1	2	3	4	5
I understand how to write a conclusion after doing a lab.	1	2	3	4	5
After I do a lab I find myself evaluating what I did and what I learned.	1	2	3	4	5
I like when I have a procedure to follow during lab.	1	2	3	4	5
I like being given a question during lab and figuring out what to do on my own.	1	2	3	4	5

In order to be good at science, you must be able to memorize a list of facts.	1	2	3	4	5
Science is a process of problem solving	1	2	3	4	5
I am in control of my own learning	1	2	3	4	5

Please add any comments regarding the confidence (or lack thereof) in your ability to

understand science.

What kinds of things can a student do to improve their learning in science class?

Please add any comments regarding your ability to monitor your own learning during

class, during lab or while reading science texts.

<u>APPENDIX J</u>

STUDENT EVALUATION OF TECHNIQUES

Appendix J: Student Evaluation of Techniques

Please rate the following on how effective they were in your understanding of science concepts **and** the nature of science in general.

1- I understand less because I did this. (Very unhelpful)
2- It did not help me understand more.
3- I'm not sure whether it was helpful or not.
4- I think it helped me understand science.
5- It definitely helped me learn science.

1. Learning Styles Inventory
Science content: _____   Nature of science:_____   Learning in general:_____

What was useful about this activity? What did you learn?

_____
___

_____
___

_____
___

What did you find unnecessary? What would you improve?

_____
___

_____
___

_____
___

2. Thinking logs
Science content: _____   Nature of science:_____   Learning in general:_____

What was the most valuable aspect of the thinking logs?

_____
___

_____
___

_____

___

What did you find unnecessary? What would you improve about these to help you learn as you read?

_____

___

_____

___

_____

___

3. Study logs
Science content: _____   **Nature of science:_____**   **Learning in general:_____**

What did you like about using the study logs? What was helpful for you?

_____

___

_____

___

_____

___

What did you find unnecessary? What would you improve?

_____

___

_____

___

_____

___

4. Concept Maps
Science content: _____   **Nature of science:_____**   **Learning in general:_____**

What aspects of using concept maps were helpful?

_____

___

_____

___

_____

___

How would you improve the use of concept maps? What didn't you like?

_____

___

_____

___

_____

___

APPENDIX K

PETERSON METACOGNITIVE INTERVIEW

Appendix K: Peterson Metacognitive Interview

1. What kinds of things do you do to plan for learning in science class?

2. How do you monitor your learning during science class?

3. In what ways do you evaluate what you learned after class is over?

4. What kinds of things do you do before you read your science text?

5. In what ways do you monitor what you're learning while you're reading your science text?

6. After you read, how do you evaluate what you've learned?

7. Can you give me an example of how lab activities have helped you learn something in science?

8. Can you give me an example of something that was confusing during lab class, that you were not able to connect with what we were learning in class?