THE USE OF EXPLICIT INSTRUCTIONAL TECHNIQUES TO IMPROVE STUDENT LITERACY IN THE SCIENCE CLASSROOM.

by

Joanna Chierici

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Joanna Chierici

July 2012

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ABSTRACT

In this investigation a number of literacy strategies were used in a science context to see if improvement occurred in students' development of reading skills and comprehension of scientific text and vocabulary. A number of activities were used within a physics topic over a period of ten weeks. The activities included reading techniques, discussion strategies and vocabulary activities. Results showed that after using these strategies, students' use of scientific vocabulary increased in both their oral and written work, their comprehension and use of the textbook improved and their test results reflected this positive improvement. When given the opportunity and time, students' literacy skills will improve if given the right tools for them to master and use in class.

INTRODUCTION AND BACKGROUND

The school that I have been teaching at for the last 10 years is Melvin H. Kreps Middle School in East Windsor, New Jersey. There are currently approximately 1300 students in the school in grades 6, 7 and 8. The East Windsor school district encompasses the towns of Hightstown and East Windsor. The towns are very diverse in population. Both East Windsor and Hightstown have large areas of middle class housing where the parents are often commuters to New York City. There are also pockets of low income housing mainly consisting of apartment complexes. In recent years, large numbers of Hispanic and Asian families have moved into the district, dramatically changing the demographics of the school.

The focus in my school district for this year was to improve reading across the curriculum. We had been given the opportunity to attend numerous workshops, literature to read and staff development time to incorporate some of the techniques we have been shown into our classrooms. The purpose of my action research study was to use instructional techniques such as, literature circles, read as you write activities using text, vocabulary analysis and journal entries to improve literacy of students within a science context.

The study took place during a regular eighth grade science class consisting of a wide range of skill abilities. It did not contain the highest ability students in science as they are placed in the advanced science group nor did it contain the lowest ability students as they are placed in a basic needs class. The class used for the study contained students who are at risk with reading, vocabulary and writing abilities, as identified by the New Jersey Assessment of Skills and Knowledge (NJASK) tests that were taken in

May 2010. The class contained 28 students. The gender mix of the class was 16 girls and 12 boys. The ethnicity of the class was 55% White, 21% Hispanic, 17% African American and 7% Asian (J. Blount, personal communication, January 23, 2012).

I used five instructional strategies from my research over a ten week period. With these activities, I wanted to cover skills relating to both reading and writing with the intention of improving these areas in my science classroom. I was also looking to see how the students reacted to an increase in the amount of literacy activities in the science classroom. Past experiences have indicated that the students are disengaged when the class instruction involves what they perceive to be language arts and not science. I wanted to address this during my study.

My primary question was how does the use of explicit instructional techniques to improve literacy impact student performance in the science classroom?

My sub questions included:

Which techniques produce the highest level of student motivation and engagement?

Which techniques prove to be successful in increasing the students' literacy skills?

CONCEPTUAL FRAMEWORK

In today's society it is important to have a scientifically literate population (Rupley, 2010). It is essential that students can think, analyze and act with knowledge and understanding on the issues society faces today. Scientists use language skills for communicating, reasoning, inquiring and explaining. It is imperative that teachers bridge the gap between the teaching and learning of science in the classroom (Fang & Wei, 2010). In 2005, only 59% of 8th graders were at or above basic level, and 29% of students were at or above proficient level in nationally normed examinations in science (National Assessment of Educational Progress, 2005). The evidence points towards schools producing students who are unable to achieve scientific literacy (Rupley, 2010). With the advent of No Child Left Behind, schools are putting an emphasis on language arts and math classes. Instructional time in science has been cut. The average of 90 minutes per day for language arts and 31 minutes per day for science in grade 4 to 6 shows this to be true. The integration of science and reading skills would allow both language arts and science teachers to make more of the time allotted to them on the schedule and cover common ground. This has been found to increase student achievement in class, as well as reading scores, compared to being taught separately (Royce & Wiley, 2005).

Another reason as to why students are not becoming science literate is they are uncomfortable with the language of science. Studies have shown that elementary grade children have very little exposure to expository reading and writing. The lack of interaction with this type of text could jeopardize the students' literacy development (Fang, Lamme, & Pringle, 2010).

When looking at the national curriculum learning standards for science and language arts, they contain common goals for the purpose of reading. Both content areas indicate reading as a way to acquire new information which can lead to using that knowledge to respond to their global and personal needs (Common Core State Standards, 2010). As well as common goals, both curricula outline similar skill sets, for example problem solving and sequencing (Royce & Wiley, 2005). Students studying science develop skills that follow logical processes, and these are necessary for effective content reading. Reading should be a productive experience, and in order for it to be effective, it should be made a critical skill regardless of grade or subject matter (Lemov, 2010).

Literacy in science can have many meanings. It can refer to the understanding of science text books, thinking and behaving like a scientist, knowing science for everyday life and as a form of inquiry (Pearson, Moje, & Greenleaf, 2010). The literature has shown two distinct areas of research. One area focuses on using literacy as a means of scientific inquiry and connecting it with concepts and principles. The other looks at how students read, write and make use of the science text in the classroom with the intent on improving their skills for lifelong use.

Science literacy should encourage reading and writing as a tool to be used. Avoiding literacy in the classroom encourages the student to become dependent on the teacher as a source of knowledge and designates the student to a passive role in the classroom rather than an active one (Pearson et al., 2010). A possible reason why reading may not be integrated into the content areas could be the willingness of teachers to teach literacy skills (Bigelow, 2007). There is no one better qualified than a science teacher to show students how to read a science textbook and help them understand the relevant

vocabulary. Teachers can also model the relevant skills required to be successful without much effort giving the students the tools to become independent readers (Bigelow, 2007). Students need to improve their literacy skills in all content areas. Subject teachers need to help students master their content, but all teachers have a secondary role to support literacy in their classroom. If teachers invest the time into making connections between literacy and science, it has been found that the students' knowledge and skills acquisition is accelerated (Their, 2010).

A student's reading education does not stop in elementary school. They need continuous development in their abilities to be able to deal with specialized texts in content areas (Fang & Wei, 2010). Many typical middle school science classrooms follow a similar pattern of including note taking, vocabulary definition, textbook reading and test taking (Rupley, 2010). This can be discouraging for the student if it is not their learning style. When oral language, reading, writing, a variety of text and science integrated in ways that are meaningful and appropriate to the learner, student achievement can be increased (Rupley, 2010; Sanacore & Palumbo, 2010; Creech & Hale, 2006). Middle school students have much to gain from a structured approach to reading. If they are given opportunities to read at school with instructional support, and it is then extended to at home reading, it has been found that not only will they begin to enjoy reading it also becomes a lifelong activity (Sanacore & Palumbo, 2010).

A series of interconnected strategies can create a framework within which students can develop lifelong literacy skills. There are three key areas to help achieve this:

- Performance expectations where students are provided with short reminders to focus them on the key skills of literacy.
- Explicit teaching strategies to help them become more adept readers and make reading more active.
- Student based metacognition strategies to encourage students' to become aware of their own thought processes (Their, 2010).

Combining these areas into activities in the classroom will create a powerful learning and literacy environment for the student.

One possible way of approaching the integration of literacy into the science classroom is with a long term project. There have been programs developed specifically to integrate reading and science instruction (Fang & Wei, 2010). One such model is Concept Oriented Reading Instruction (CORI) (Guthrie et al., 1998). CORI is a yearlong program designed to teach a variety of strategies including the use of questions, summaries and the use of graphic organizers to organize their work. It was found that students who received CORI were more likely to learn and use strategies for gaining knowledge from multiple texts than those students taught a more traditional curriculum (Fang & Wei, 2010). These students were also found to be more adept at performance assessments within science.

Another possible scenario is a succession of reading projects. A yearlong reading study on integrating literacy into the science classroom by giving the students a quarterly reading project is another example. Students were encouraged to take mental risks as they read and discussed their thought process, confusion and solutions. They were exposed to all types of texts, for example, books, labs, graphs and their own written work. All

students kept a metacognitive log to record their ideas and progress. The four projects were all non-textbook based and included current events, biography, nonfiction and fiction. The students became more capable and willing readers after following the program and it appeared that establishing a reading routine within the classroom improved the students' attitude towards reading and gave them the tools to become lifelong readers of science (Creech & Hale, 2006).

Not all science teachers are willing or able to devote such a large focus of time to reading in their classroom. Often they do not have the resources or support to do this effectively (Fang & Wei, 2010). Textbooks are a resource available to all students, whether it is in the classroom or in a library. It is possible to help students understand scientific texts by teaching them explicit strategies to process and comprehend them. Such strategies include predicting, thinking aloud, summarizing and questioning. Another way is to build on their background knowledge and vocabulary in order to provide comprehension and motivation to read (Fang & Wei, 2010). Giving students the skills to survey a chapter and help them activate their prior knowledge will help the student understand the importance of the reading assigned to them in the classroom (Manz, 2002).

Vocabulary is a very important part of science literacy. A wide ranging, varied vocabulary will allow the student to develop fluency and make connections when reading (Sanacore & Palumbo, 2010). Exposure to vocabulary can be implemented in a number of ways, either through conversation or direct instruction. Vocabulary instruction needs to be more than simple rote memorization. Students need multiple exposures to the terms for maximum retention. Teachers need to set aside time to actively teach important terms

and for students to practice using context clues. There should, however, be a balance between immersion and direct instruction. There are many strategies available for vocabulary instruction (Greenwood, 2010). For example:

- The Frayer model is a strategy that uses a graphic organizer for vocabulary building. This technique requires students to (1) define the target vocabulary words or concepts, and (2) apply this information by generating examples and non-examples. This information is placed on a chart that is divided into four sections to provide a visual representation for students (Frayer, Frederick, & Klausmeier, 1969).
- Concept circles allowing the student to classify and organize academic vocabulary.
- Graphic organizers such as semantic mapping.

Teachers should concentrate on learning a few techniques well and build a bank of word activities that work well for them in their own classrooms (Greenwood, 2010). Vocabulary instruction can be most effective when new words are related to existing knowledge. Active processing of the words contributes significantly to vocabulary growth, comprehension and continuous learning (Rupley, Logan, & Nichols, 1999).

Word walls have long been a regular feature of today's classrooms. They provide an excellent opportunity for teachers to expose students to new words (Yates, Cuthrell, & Rose, 2010). It is a resource available to the student attempting to analyze words, learning spellings or define new vocabulary. The wall allows for repeated exposure to the content vocabulary. Where possible, teachers from all content areas should articulate about their own subject vocabulary for joint reinforcement (Greenwood, 2010). Multi

content word walls can serve as a collection of vocabulary that a student needs throughout the school year (Yates, Cuthrell, & Rose, 2010). Such a wall in a commonplace, for example a hallway, can engage the student in learning and promote a greater understanding of the content. The establishment of an environment that promotes word consciousness is a key way to enhance students' vocabulary (Yopp & Yopp, 2007)

Another literacy strategy is the literature circle. Literature circles are common teaching tools in the language arts classroom. In a literature circle, the students are assigned various roles to guide the reading of a fiction book, discussion of their readings and presentation of their work to their peers. This approach can be extended to nonfiction books (Wilfong, 2009). Literature circles in content areas can bring together students to share their ideas on the text. The students can learn from each other, asking and answering questions while referring back to the text. It provides active engagement with the text rather than passive reading.

Word walls, vocabulary activities and literature circles are all methods that can be used to allow interaction between students and text (Sanacore & Palumbo, 2010). If students are given time to read text and taught useful strategies to help them understand and comprehend it, they will not only become more proficient readers but also learn science content more effectively (Fang & Wei, 2010). Literacy and reading should be an interactive process. This is not only essential for the learning process but it is also likely to increase the students' motivation and engagement in the content (Hanrahan, 2009). Part of the goal of science education is to produce science literate students. In order to do this, teachers must be proactive in the use of literacy practices to support their science teaching (Fang, Lamme, & Pringle, 2010).

METHODOLOGY

The students took part in the planned reading and vocabulary activities over the course of one topic from start to finish. Each topic took approximately ten weeks to complete. The study took place during the physics section of the eighth grade curriculum. This topic included types of waves, wave interaction, light and the electromagnetic spectrum. We used the Sound and Light book from Prentice Hall Science Explorer series (2009) as our textbook, which was a valuable resource if used to its full potential. This topic included a large amount of new vocabulary and concepts for the students. During this time, I introduced the students to a number of strategies to help them with their reading and writing skills. I used the strategies a number of times to help them grasp how they worked. 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.

Before I started the study, I asked the students to complete the Reading Motivation Questionnaire to see what their motivation level and strategies in terms of reading, vocabulary and writing strategies (Appendix A). The Reading Motivation Questionnaire was based on responses to set choices. This allowed for data analysis using statistical methods, for example the mode, as a way of looking at the data. Using the Likert Scale as a way to interpret the data, responses were coded with a numerical value. These were 4 = *a lot like me,* 3 = *a little like me,* 2 = *a little different from me* and 1 = *a lot different from me*. After the results were coded, the mode was used as a way to look for trends in the data. The number of responses were also tallied and used as a trend

indicator. I also surveyed the students using the Reading Strategies Questionnaire (Appendix B). The Reading Strategies Questionnaire used open ended questions as a way of self-reflection and to gather information. Where possible, common answers were collated and used to produce numerical data. Looking at each theme in turn, an analysis was done by using the number of responses in a particular category. The Reading Motivation Questionnaire and The Reading Strategies Questionnaire were administered by paper to the students in the study group. The information was collected as a pre survey before any literacy strategies were taught to the class (N=25).

I administered the Pre Knowledge Physics Assessment for the physics topic (Appendix C). The questions were based around the key vocabulary in the topic, and looked for prior knowledge and understanding of the terms. The test was scored out of 30 points. I also looked at the mean, median, range and standard deviation of the class scores.

My first activity was known as T.H.I.E.V.E.S. (Manz, 2002). This is an acronym for Title, Headings, Introduction, Every first sentence in a paragraph, Visual and Vocabulary, End of chapter questions and Summary. The students used the acronym as a guide to preview a chapter of given text without reading every word. It also drew on their prior knowledge so the students could make connections (Appendix D). Another method I used was for reading and comprehending small chunks of text of around one page in length (Creech & Hale, 2006). It was the Write as you Read activity and focused on the student reading and summarizing the passage into five bullet points which could then be used in class discussions or as part of their notes (Appendix E).

I also used a strategy called Seed Discussions. This was a type of literature circle for nonfiction text. During the discussion, the students took on roles in their small groups, and these roles guided them through conversations about facts they had collected during their reading (Appendix F) (Table 1).

Table 1
Student Roles in Seed Discussions

Role	Description
Leader	responsible for calling on each person to share his/her discussion seeds
Manager	ensures that everyone has all materials for the discussion (books, journals, seeds, etc.)
Checker	ensures that every group member has a chance to talk about his/her seed and that each group member comments on each seed before the next person presents a new seed for discussion
Communicator	the only person to leave the group; notifies the teacher when the discussion is complete

This activity was also used in conjunction with the Write as you Read activity. The use of a graphic organizer helped the students organize their facts. It allowed the students a different way to express their comprehension of the subject matter other than writing. The assessment took place as observation or, if necessary, using the Notebook Rubric to check any written work produced (Appendix G).

My last two activities focused on vocabulary. The first activity was word journaling. The use of a Word Journal allowed students to investigate unfamiliar words.

They determined their meanings through dictionaries, context and/or discussions. They then put the words into use by means of sentences, images and display in the form of a word wall or concept map (Appendix H). Ten Words Plus was an activity where students engaged in critical thinking by considering the relative importance of words and ideas in a text (Yopp &Yopp, 2007). The students read a selected text, preferably current events, and identified ten words they thought were important. The words were then plotted to create a graph to look at frequency, and the results were discussed. The final choices for the top ten were then used according to activity prompts and the class shared their ideas in small groups (Appendix I). A summary of the strategies is found below (Table 2).

Table 2
Possible Strategies for Reading and Writing in Science

Strategies	Description	Resources	Assessment
T.H.I.E.V.E.S	A reading strategy for previewing text.	THIEVES sheet for chapter studied (Appendix D)	Completion of task
Read as you write	A reading strategy suitable for small amounts of text.	Activity Sheet (Appendix E)	Observation of summary created.
Seeds Discussion groups	A type of literature circle where students discuss facts or “seeds”	Activity based on model. The use of a graphic organizer was used to organize facts. (Appendix F)	Teacher observation
Word Journaling	Word journal created and used as a display in classroom.	Journals created using word journal template (Appendix H)	Journal entries assessed using Notebook Rubric (Appendix G).
Vocabulary study – Ten Words Plus	Read, identify and use vocabulary	Graph created of top ten words; words used in activities (Appendix I).	Completion of task and teacher observation.

In order to evaluate the students' progress in these techniques, I used observation, rubrics and assessed their science notebooks for evidence. My observations were writte down in my own journal during and after class every day as necessary. I also randomly interviewed five to eight of the students using the Post Activity Interview Questions (Appendix K). By using all these methods of data collection, I gained a good idea of the students' progress and growth during the treatment period. My main priorities were to make sure the students were

- Making inferences and/or the application of content
- Extrapolating the main ideas and supporting from text
- Marking up text / previewing
- Using word organizers

At the end of the topic, the science department normally tests the students in some way. I created a Post Physics Assessment to include the relevant vocabulary words and question the students on the work targeted in the reading strategies (Appendix J). This was analyzed in the same way as the Pre Assessment the students completed at the beginning of the topic. I also used the Reading Strategies Post Questionnaire again as a survey to see if there were any changes in response (Appendix L). The questionnaire consisted of some of the same questions from the introductory questionnaires and some new questions to cover the strategies we had used in class. This allowed for data analysis using statistical methods, for example the mode, as a way of looking at the data concerning the students' perception of the methods used in the light and sound topic. Using the Likert Scale as a way to interpret the data, responses were coded with a numerical value. These were 4 = *it helped me a lot*, 3 = *It was helpful to me*, 2 = *It was a*

little helpful to me and 1 = *I didn't find this helpful at all*. After the results were coded, the mode was used as a way to look for trends in the data. The number of responses were also tallied and used as a trend indicator. The Reading Strategies Post Questionnaire also used open ended questions as a way of self-reflection and to gather information. Where possible, common answers were collated and used to produce numerical data. The Reading Strategies Post Questionnaire was administered by paper to the students in the study group. The information was collected as a post survey after the literacy strategies were taught to the class.

In order to check that all of my focus statement and questions were addressed during the research period, a data triangulation matrix was completed. A summary of my data collection techniques can be found below (Table 3).

Table 3
Triangulation Matrix of Methods

	Data Source 1	Data Source 2	Data Source 3
Prior knowledge of strategies	Surveys using reading questionnaires	Pre Knowledge Physics Assessment.	Standardized test results data
Level of motivation and engagement	Observation of activities by teacher	Science journal reflection of activities	Post activity interviews / questionnaire
Impact on student performance	Post study survey using reading questionnaires.	Pre test / Post test comparison	Interviews / observations

DATA AND ANALYSIS

The Reading Motivation Questionnaire and The Reading Strategies Questionnaire were given to students before the treatment began (*N*=25). After the study, the Post Survey Questionnaire was administered (*N*=25). There were three clear themes apparent from all the questionnaires when looking at the data. These were interest level, comprehension of text and confidence in their ability as a reader.

Interest in a topic was a big factor for reading motivation amongst the participants. From the pretreatment Reading Motivation Questionnaire (Appendix A), the students were asked the question, do they read more about a topic if a teacher discusses something interesting in class, 76% replied that it was a *little* or *a lot* like them (*n*=19, Figure1).

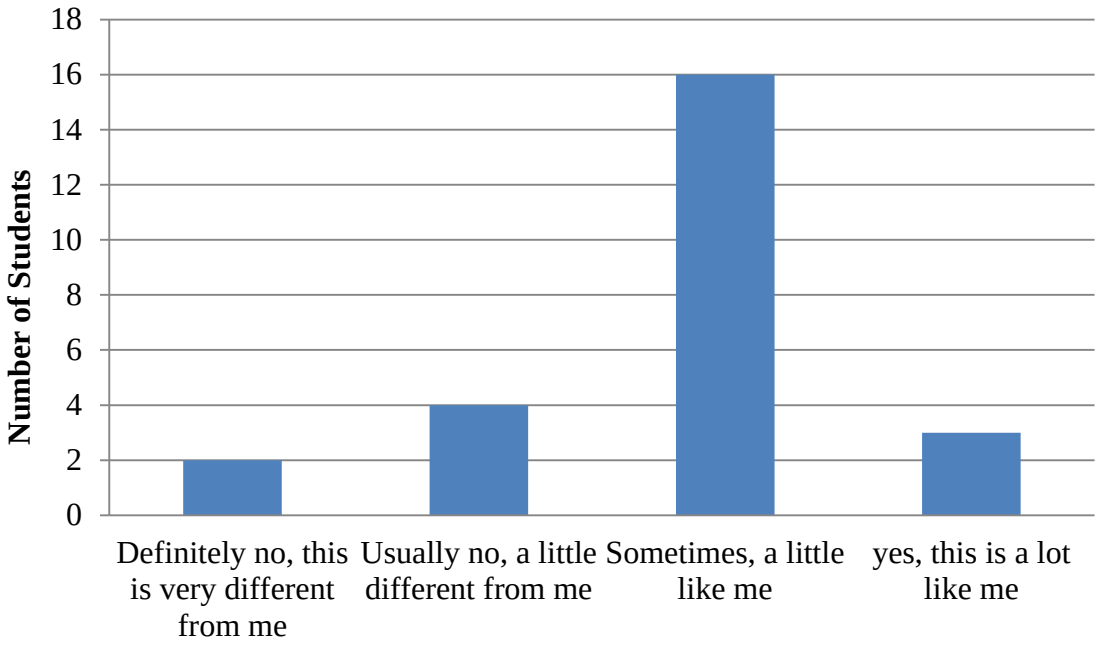

Figure 1. Pretreatment questionnaire - If the teacher discusses something interesting, I might read more about it, (*N*=25).

From analyzing the responses on the Reading Strategies Questionnaire in the pre treatment, one participant noted “The types of reading I find easiest to understand are the ones I am interested in.” Another student said “I like the science magazines you give us to read because they are interesting and short to read.” Fifty six percent of the students said they preferred magazine articles and short sections of text over textbooks and similar materials. In the post survey, 96% of Students replied was a *little* or *a lot* like them (Figure 2).

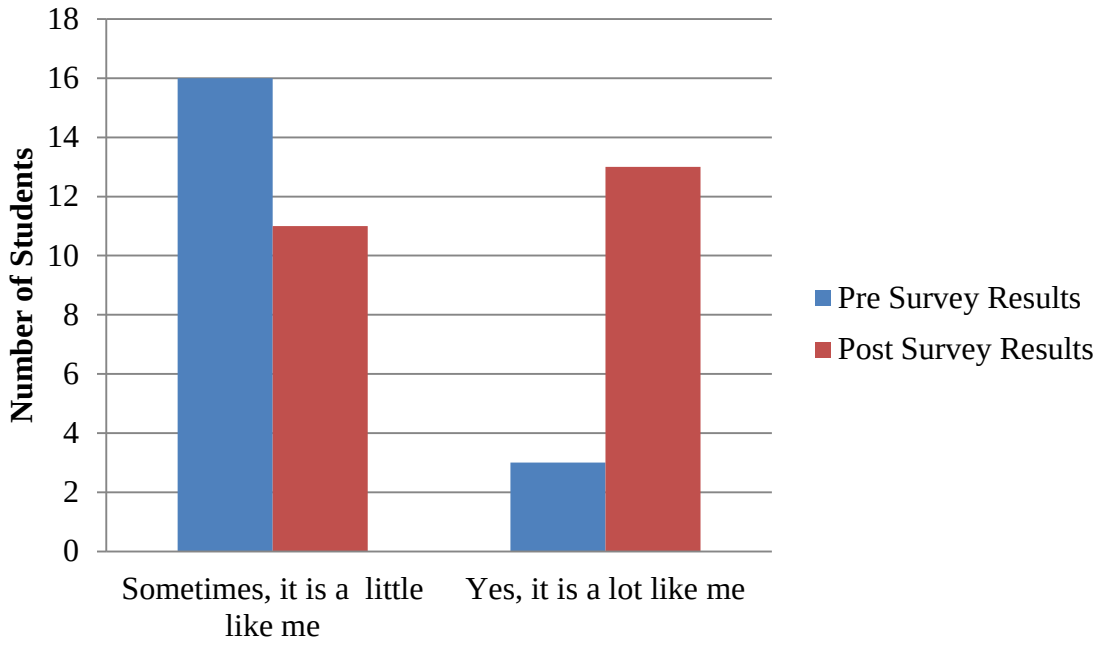

Figure 2. Pre and Post survey comparison - If the teacher discusses something interesting, I might read more about it, (*N*=25).

From analyzing the responses about reading materials on the post survey, one participant noted “I find the text book easier to understand now I know how to read it.” Another student wrote “Is it possible for us to read science fiction books? I like Science and I like fiction!” When collating the open ended responses in the post survey, 76% of the students said they preferred science magazine articles and textbooks compared to

56% in the pre study surveys. A student commented “The magazine articles make it real for us.”

It was also noted that when the students were interested in the reading, they lost track of time. From the data, 72% of the participants replied that it was a *little* or *a lot* like them as their response. This rose to 80% in the post survey results (Figure 3).

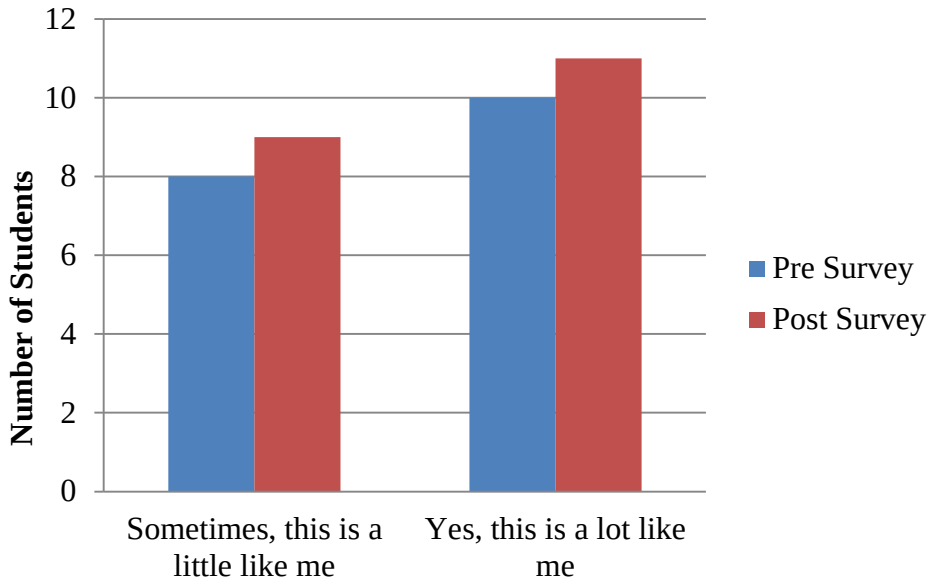

Figure 3. Pre and Post survey comparison - If I am reading about an interesting topic, I sometimes lose track of time, (*N*=25).

When asked what might stop them from reading, 44% said noise or distraction in the class room. It was noted by 36% of the students that if the reading was boring, they might stop or give up on it. It was a similar trend in the post survey. Thirty six percent said if the reading was boring or there was a distraction, this would stop them reading. A further 28% said it could be due to the comprehension of the text. One student said “If it is hard or boring, I always start daydreaming.” This was a typical response for this question (Figure 4).

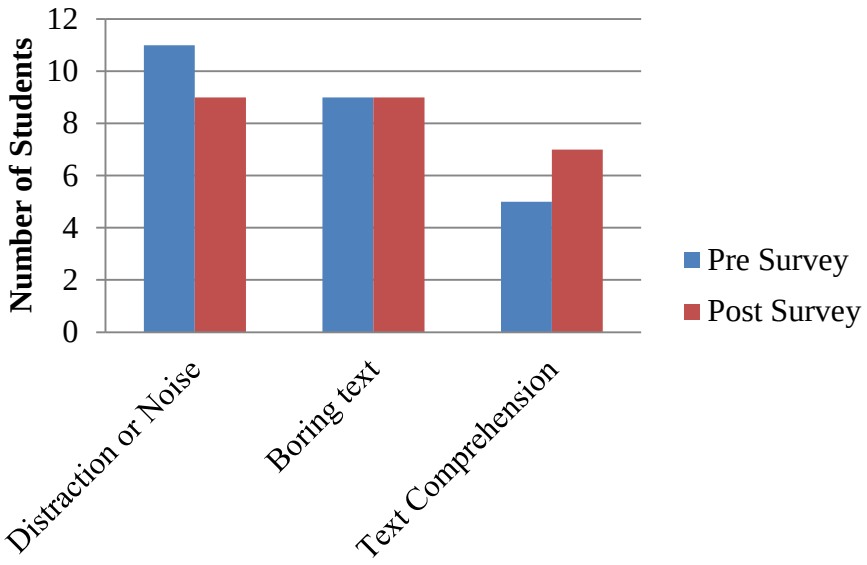

Figure 4. Pre and Post survey comparison - What might stop you when you are reading, (*N*=25).

The comprehension and the vocabulary used in the text were also a big factor for the students. A student stated "What causes me difficulty is actually comprehending what a book or a text book is saying." When asked what caused them the greatest difficulty when reading, 84% of the students listed factors including vocabulary and comprehension (Figure 5).

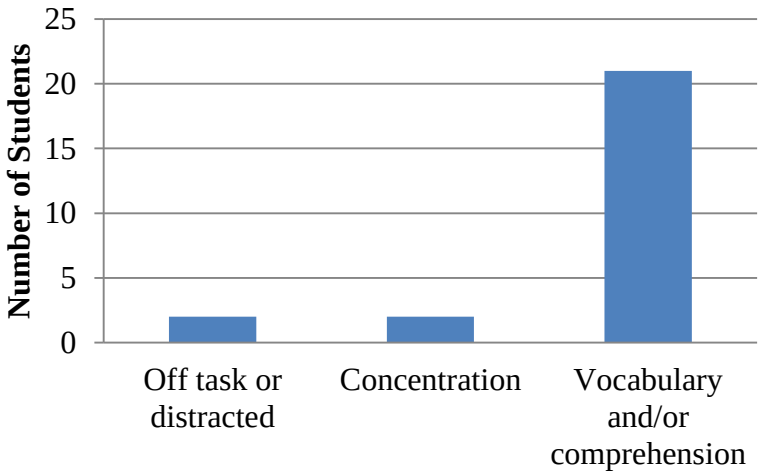

Figure 5. Pre Survey - What causes you greatest difficulty when reading? (*N*=25).

When students came across a difficult word they did not understand, 68% said they would look it up or use context clues. It was noted by a student that “I try to figure it out by the context clues first and if that doesn't work, I look it up.” From the responses, 20% said they would ignore the word. One student stated “When I come across a word I absolutely don't know, I skip it.” Only 12%, however, said that they would ask for help (Figure 6).

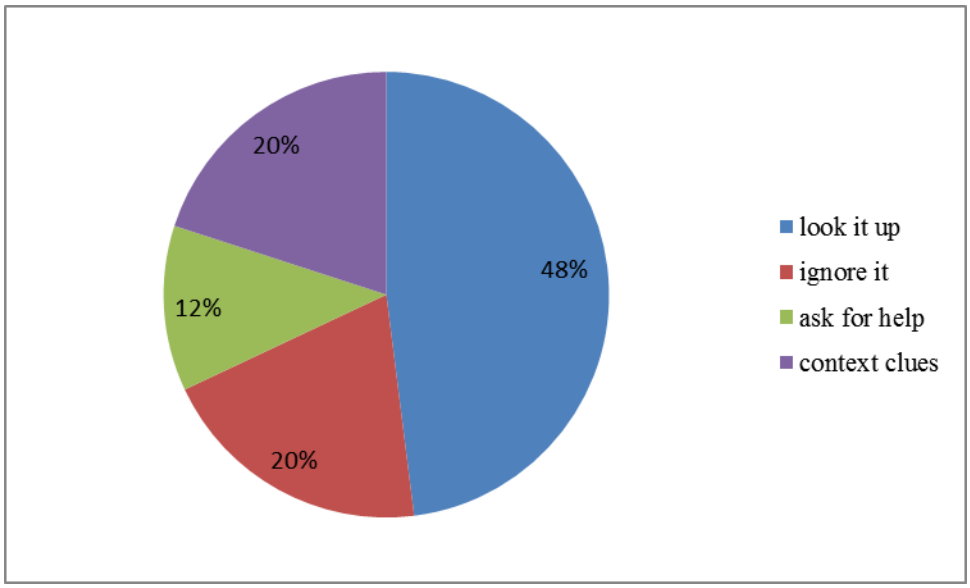

Figure 6. Pre Treatment - What do you do when you come across a word you don't understand? (*N*=25).

The responses in the open ended questions also reflected this trend. Re-reading the text to improve comprehension was mentioned by 76% of the students on the Reading Strategies Questionnaire. Other strategies mentioned included the use of graphic organizers, breaking down text into smaller parts, use of prefixes and suffixes and creating summaries. A number of students, 16%, said that they would ask themselves questions about the text or put it into their own words. One student noted “When I need to understand the text better, I use context clues, the glossary or think about it. Sometimes

I write things down." This type of list response was common amongst the students (Figure 7).

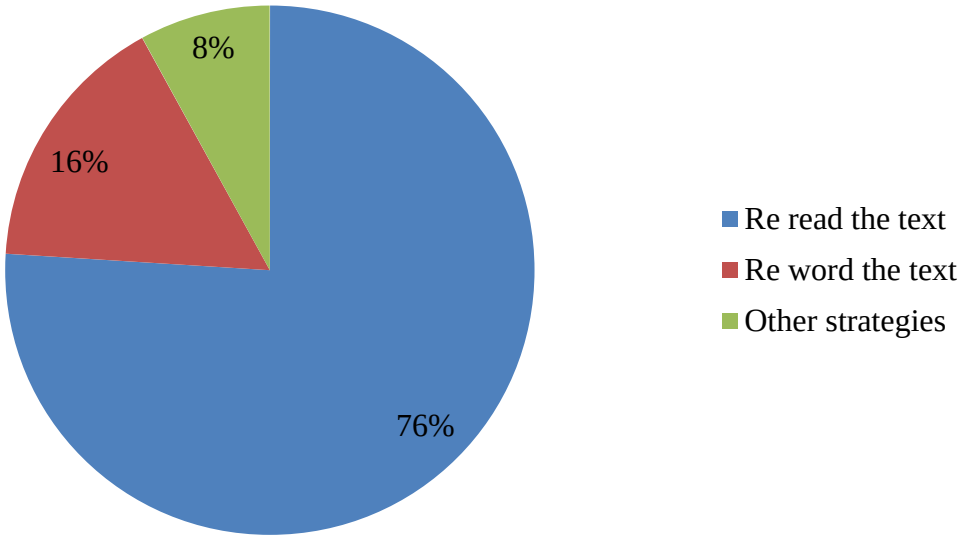

Figure 7. Pre treatment - What could you do to be better at understanding what you read, (*N*=25).

In the post survey, vocabulary and comprehension was still the biggest stumbling block with 84% listing this as their problem. When a student was asked what they did when they came across a difficult word they did not understand, 100% said they would look it up or use context clues compared to 68% in the pre study survey (Figure 8). No one responded with the choice of ignoring the word. From the responses, one student said "I would use the glossary in the back of the textbook or the science dictionaries in the classroom." Another said "use a dictionary or ask an adult to explain it to me."

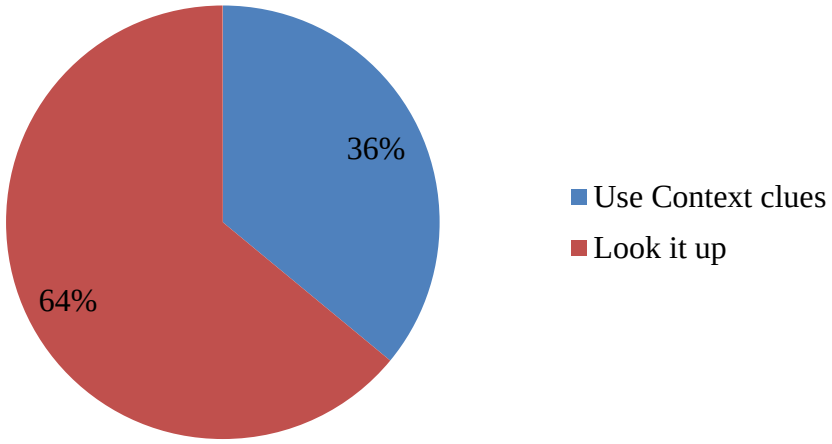

Figure 8. Post Treatment - What do you do when you come across a word you don't understand? (*N*=25).

The responses in the open ended questions also reflected this trend. In the post survey, when asked what they could do to better understand what they are reading, all 25 responses mentioned at least 1 of the reading techniques from the study rather than merely re-reading the text again (Figure 9).

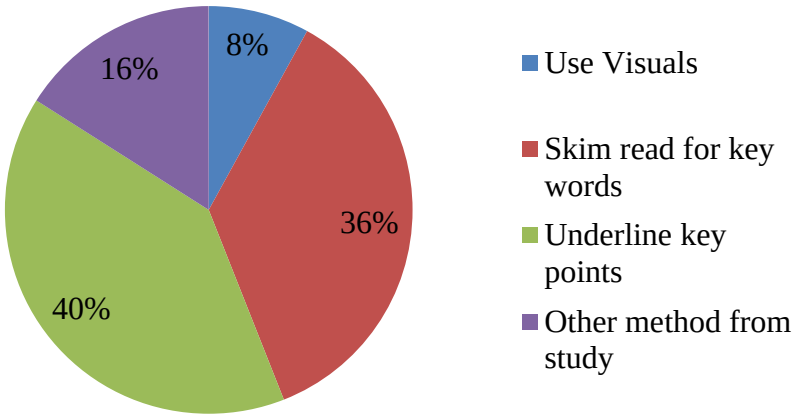

Figure 9. Post treatment - What could you do to be better at understanding what you read, (*N*=25).

When asked if they enjoyed vocabulary questions about the text they were reading and other related vocabulary work, 52% of the participants did not like this type of activity. The post survey did not show much change in the students' response. The total participants who did not like this type of activity went down to 48% (Figure 10).

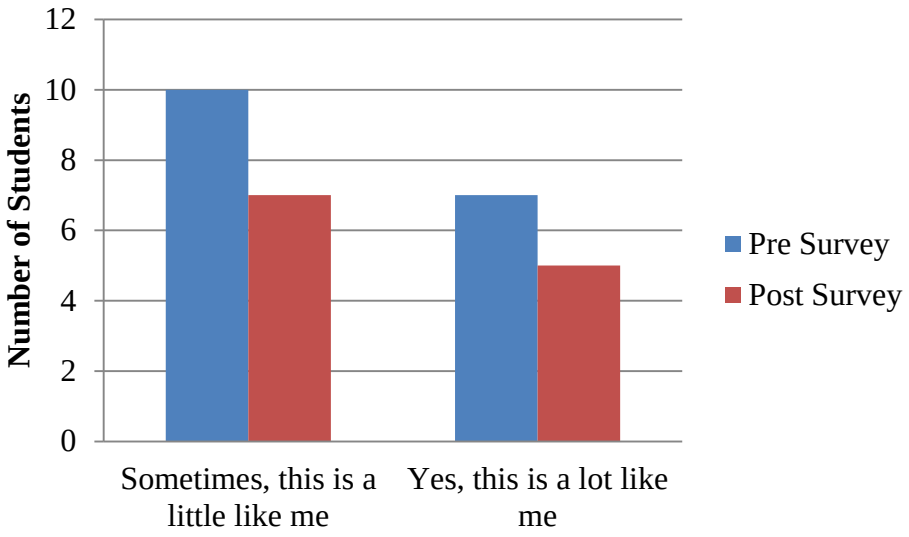

Figure 10. Pre and Post survey comparison - I don't like vocabulary questions, (*N*=25).

In terms of using strategies to help them succeed, the students were asked if they visualized what they were reading as they were reading the text. The data showed that 100% of the students said it was a *little* or *a lot* like them as their response compared with 88% in the pre study survey. No one in the post survey answered that is was a *little different* or *very different* from them (Figure 11).

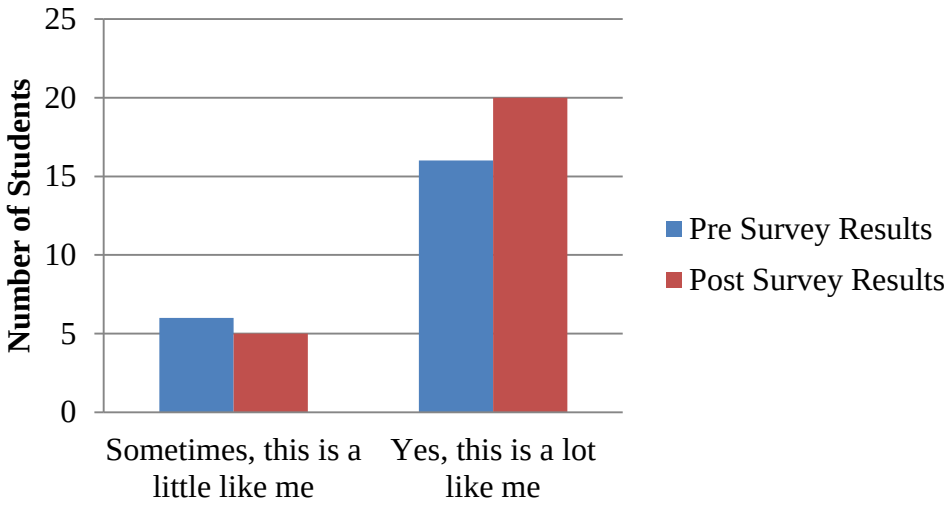

Figure 11. Pre and Post survey comparison - I make pictures in my mind when I read, (*N*=25).

The last theme looked at the students' confidence level in reading. Fifty-two percent of the students replied they were not the type to read hard, challenging books. This was also reflected in the open ended responses by a small number of students. One student stated “I know nothing about science, so when I read I don't really understand what I read.” Another student said “The best things for me to read are things I have previously learned because as I reread, I playback all the information I know and it is easy.” A number of students went on to say that reading textbooks was not their favorite reading material because they were hard for them to understand. When asked in the post survey, this figure dropped to 36% of students said they were not the type to read hard, challenging books (Figure 12).

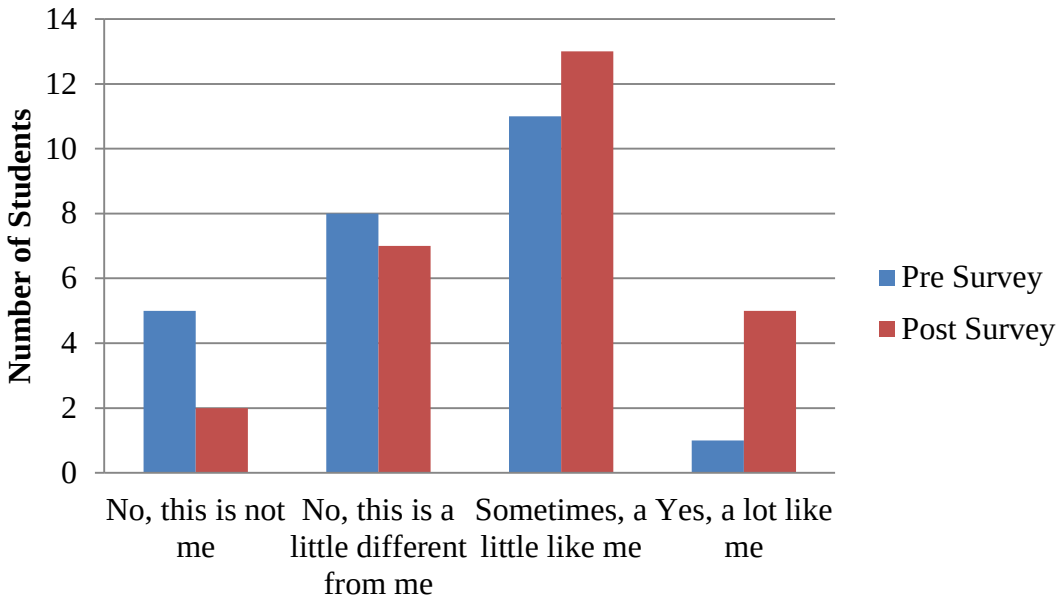

Figure 12. Pre and Post survey comparison - I like hard challenging books, (*N*=25).

For the rest of the questions in this theme, again, a general positive trend was shown by the data (Table 4).

Table 4
Summary of Results concerning the students' feelings towards reading (N=25)

		Very different from me	a little different from me	A little like me	A lot like me	Av. mode
Mode Value		4	3	2	1	
I am a good reader	Pre	4%	8%	28%	60%	4
	Post	0%	16%	32%	60%	4
I read to learn new information about topics that interest me	Pre	12%	24%	24%	40%	4
	Post	12%	20%	32%	40%	4
I like knowing an answer in something we read	Pre	4%	12%	36%	48%	4
	Post	0%	4%	28%	68%	4
I am happy when someone recognizes my reading	Pre	4%	20%	36%	40%	4
	Post	4%	24%	20%	48%	4
I like to read about new things	Pre	12%	24%	48%	16%	3
	Post	4%	12%	40%	48%	4

When asked if they thought they were a good reader, 82% in the post survey compared to 60% in the pre survey agreed it was *a lot* like them. It was also shown that 80% compared to 64% of the students in the pre survey were willing to read in order to learn new information. This was further confirmed in the post survey where 88% of students liked to read about new things compared to 64% in the pre survey, increasing the modal value from 3 to 4. Lastly, when it came to praise, an increase of 8% from 76% in the pre survey to 84% of the respondents wanted to be recognized for their reading.

The second part of the post survey questionnaire asked the students about the reading methods they had used during the study (*N*=25). When asked about THIEVES, 68% of the students responded that this method was a *little helpful to them* or *didn't find it helpful at all*. In the student interviews, one student said "I found THIEVES unhelpful because I didn't really learn anything and was too busy trying to complete it." Another student mentioned "THIEVES is least useful because even though I am reading and skimming through the section, it is the vocabulary work that makes me understand more." Many students also commented that the task was too long and boring to complete. Students' feelings towards the strategies used in the treatment varied with some being more popular than others (Table 5).

Table 5
Summary of Results concerning the students' feelings towards using various reading activities (N=25)

	It helped me a lot	It was helpful to me	It was a little helpful to me	I didn't find this helpful at all	Average mode
Mode Value	4	3	2	1	
THIEVES	12%	20%	48%	20%	2
Read as you write	12%	44%	32%	12%	3
Top ten words	68%	24%	0%	8%	4
Vocabulary Journal sheets	20%	40%	36%	4%	3
Writing with key vocabulary	28%	60%	16%	0%	3
Word Wall	48%	24%	12%	16%	4
Seed Discussion and graphic organizers	68%	24%	8%	0%	4

The word wall helped 84% of the students. During interviews, one student said "Seeing the words on the wall is the most useful because it gives me a clear image of what the vocabulary word means." Another student commented "Seeing the word with a picture on the wall quickly reminds me what it is." Many students commented on the fact they enjoyed creating the word wall as part of the Top Ten Words activity. "I enjoyed putting my work up on the word wall because I am not good with vocab and being able to glance up helps me remember." was mentioned by one student. The journal entry sheets and the graphic organizers scored 60% and 92% respectively in popularity amongst the students. One reason mentioned time and time again in interviews was the organizational aspect. A student said "I love being able to fill out sheets and studying from them. It makes me feel prepared and it is easier because I know what to specifically study."

Another successful method was Top Ten Words with 92% of students finding this helpful. One student mentioned in their interview “I like the Top Ten Words activity because you get to choose what to do and I pick what I find helpful.” Within the Top Ten Words activity there are a number of options to choose from. The students were asked which options they found most helpful (Table 6).

Table 6
Summary of Results concerning the students’ feelings towards Top Ten word activity options (N=25)

Favorite option to complete	
Vocabulary journal sheet	20%
Concept Map	16%
Drawings	24%
Skit / poem / rap	0%
Flashcards	24%
PowerPoint Presentation including research	8%
No preference	8%

Representing the words visually proved popular with the students and gained 84% of the vote. The options not including a drawing aspect did not gain much of the vote with only 8% of the students choosing these options. To assess the growth within the topic, in terms of the students’ content knowledge and use of vocabulary, one pre topic and one post topic test was given. The average score on the post test was 78% compared with 34% in the pretest (Figure 13).

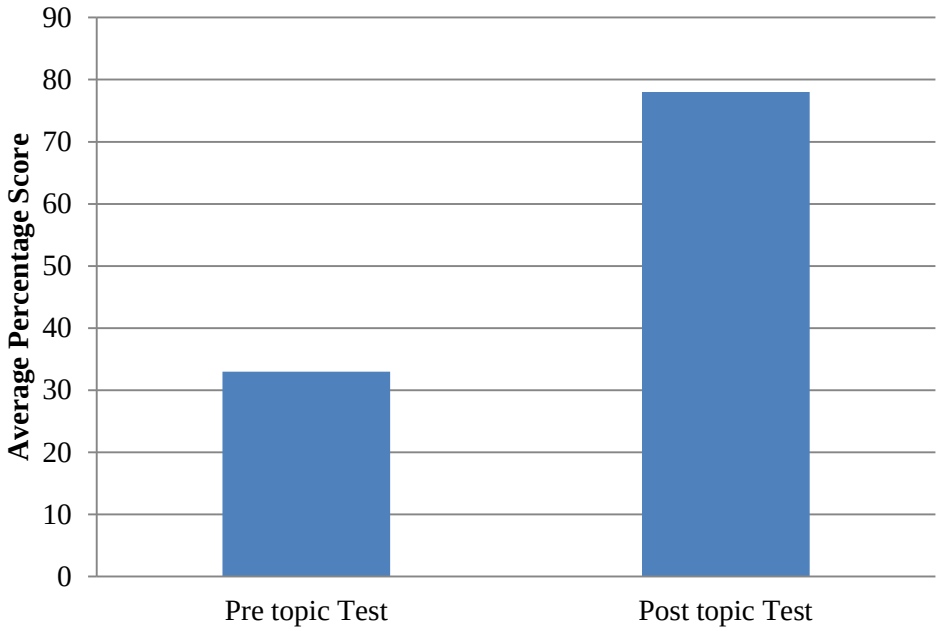

Figure 13. Average percentage score on topic testing, (*N*=25).

The median score in the post test was 79% compared with 37% in the pretest. The standard deviation was 13% in the posttest compared with 20% in the pretest. Ninety six percent of the students increased their score from pre to post test by at least five percentage points. When the students were tested on their quarterly benchmarks by the school district, 68% of the students either maintained or improved their proficiency on the benchmark following the study timeframe compared with the benchmark taken before the study began.

INTERPRETATION AND CONCLUSION

The study on different literacy strategies turned out to be a very successful experience in my classroom. Each of these students came to my class with different backgrounds in science, reading levels and literacy skill. They were also all new students to me this year. I needed to find out where their skills were in terms of both reading achievement and use of literacy skills within a science setting. This study helped me find this out and go on to raise their achievement. The strategies were fairly simple to set up for the students and after modeling the technique or activity, the majority of students were able to master the skills fairly quickly and needed little input from me.

One of my focus statements was which techniques produce the highest level of student motivation and engagement? Data gained from the post study questionnaires and interviews, clearly showed that the many of students did not gain any useful knowledge from or enjoy the THIEVES activity. During my interviews, students generally felt that the THIEVES activity took too long, and it concentrated on just rewriting headings or finding key words without looking up their meaning. When I asked students to compare THIEVES with the Write as You Read activity, the majority preferred the latter. One student stated “I prefer Write as You Read. When you markup the text, you are comprehending it better.” Another student said “With the Write as You Read method you are actually reading the text rather than skimming it.”

I also found that the students really enjoyed the Top Ten Words activity immensely. One student said “I really like Top Ten Words because I like to see if my words are as important to others as they are to me.” The graphing of the word choices by each student gave a good visual for the class. I was often asked what if we choose the

wrong words. The graphing element solved this problem. The words the students listed were the words I listed as most important too. The options available for them to choose how they study the words were a big hit. The more creative drawing options were the most chosen. Almost all the flashcards, pictures and concept maps became the word wall for the topic, and the students were proud that their efforts were on display and served as the word wall for all my classes (Figure 14).

Figure 14. Flashcards used as word wall display.

The Seed Discussion activity was a different approach as it involved the students working as a group rather than individuals. The students took the roles assigned to them very seriously and from my observations of the groups, they were very motivated to stay on task so they would have the information needed to share with others about the different types of telescopes and their uses. I added a graphic organizer to this activity as

my students sometimes need that extra assistance in collecting their information. With these strategies, the students were able to hold more informed and structured discussions about the topic. Again during my interviews with the students, a number of them mentioned how much they enjoyed this activity and how much they learned from it. This was reinforced for me when the students took the quarterly benchmark assessment administered by the district a month after the ten week period. There was an open ended question about telescopes for them to complete. Many of my students scored highly on this question. When I asked them about it, one student stated “I felt that I really knew the topic because we did all the research and discussed it with each other. I could picture what I wrote on my graphic organizer when we did that.”

One of the biggest concerns of my students was the type of text that they were reading. A number of participants in the surveys mentioned that if the text was boring or hard for them to read, it turned them off. It was also noted that 56% of the students enjoyed the science magazines that are in my classroom. In the past I have not really utilized these publications in my lessons but in light of these results, I plan to include them as part of my reading strategies. I also plan to use suitable websites and current events to spark interest. It is important to check the reading level of the piece before exposing it to the students. There are websites available to do this that I can use in my lesson preparation. These measures will help to alleviate some of the problems that the students were encountering.

From these observations and the comments from my students, I feel I now know which of my activities were both successful and enjoyable and which were not. If I were to do these activities again, I would make sure I model the activities carefully and have

some examples to share with them of both what to do and what not to do so the students have a clearer understanding of what is required from them. I would also have some scaffolding in place for the Seeds discussion as a number of students needed extra help in terms of what websites and resources to use and how to find them. Some students did the research without any prompting, but other students would benefit in the future from some guidance in this area. I would also try to restructure the THIEVES activity so it is less time consuming and more interesting for the students to complete. I still feel it is a worthwhile skill to be able to skim through text but the activity needs reworking as it stands.

I will definitely use these activities in class and will incorporate them into my program of study for next year. The more practice students have, the better their skills will become. I would like to incorporate more literacy skills into an inquiry or lab activity so the students feel that it is more science and not language arts class. I was very pleased to see that not one student asked me “Why are we doing this?” or “This is language arts not science.” during the ten week period. The vocabulary part of the study was very successful. My students were still pointing out vocabulary words from the topic three months later. To me, this is why we need literacy skills in all classrooms. It has been very encouraging to see the rate of reading about science increase in my class as well as the increased recognition and use of scientific terms in both their written work and oral participation.

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VALUE

As we progress in the 21st century with advances in technology in the classroom and in the workplace, the need for literacy skills is more important than ever if the student is to use the wealth of information available to their advantage. Giving students the skills to read, understand and use this knowledge from all of the available resources allows them to be successful in their studies and later in their careers. These skills have motivated my students to read more, research successfully and use scientific vocabulary correctly.

The experience of researching, developing and conducting the capstone project has led me to make some changes in my teaching methods. I have come to appreciate the value of data. We always had the traditional forms of data, for example test scores, but I now value the data I have gathered from my own surveys and interviews. I will continue to survey the students to check for the usefulness of teaching strategies and improvements in their skills. From conducting the capstone, I have gained a number of teaching strategies to use to incorporate reading in the classroom. I also have a number that were not included in the capstone that I would like to try out. I will continue to research the literature and keep up to date with new ideas and strategies in the future. My future professional plans include further research into literacy and its place in the science classroom by pursuing a reading specialist / science supervisor certification.

Success in science has motivated students in other areas of their schooling. Other teachers in the eighth grade have expressed an interest in the strategies used during this study for use in their classrooms. If we take the time to develop these strategies across content areas, less time would be needed to model procedures as the students would be

familiar with the techniques. This allows for more time to be used for content, inquiry activities and lab work.

With the emphasis put on test scores and student achievement by administrators, a common set of strategies used across the grade level would ensure every student has the literacy skills they need for success. The introduction of the Common Core State Standards (2010) helps schools with this initiative. The Common Core Standards state "…the Standards also lay out a vision of what it means to be a literate person in the twenty-first century. Indeed, the skills and understandings students are expected to demonstrate have wide applicability outside the classroom or workplace…They habitually perform the critical reading necessary to pick carefully through the staggering amount of information available today in print and digitally. They actively seek the wide, deep, and thoughtful engagement with high-quality literary and informational texts that builds knowledge, enlarges experience, and broadens worldviews." By adopting strategies outlined in this study, we, as teachers, help our students on this path.

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APPENDICES

APPENDIX A

READING MOTIVATION QUESTIONNAIRE

Reading Motivation Questionnaire

Participation in this research is voluntary and participation or non-participation will not affect your grades or class standing in any way.

Read each sentence and decide whether it describes a person who is like you or different from you. There are no right or wrong answers.

	Very different from me	A little different from me	A little like me	A lot like me
I like hard, challenging books.				
If the teacher discusses something interesting, I might read more about it.				
I read because I have to				
If I am reading about an interesting topic, I sometimes lose track of time.				
I talk to my friends about what I am reading.				
I don't like reading something when the words are too difficult.				
I don't like vocabulary questions.				
I like it when the questions in books make me think				
I am a good reader.				
I read to learn new information about topics that interest me.				
I like knowing an answer in something we read.				
I learn more from reading than most students in the class.				
I am happy when someone recognizes my reading.				
I like to read about new things.				
I make pictures in my mind when I read.				
I usually learn difficult things by reading				

APPENDIX B

READING STRATEGIES QUESTIONNAIRE

Reading Strategies Questionnaire

Participation in this research is voluntary and participation or non-participation will not affect your grades or class standing in any way.

1. What causes you the greatest difficulty when you try to understand what you read?

2. What could you do to be better at understanding what you read?

3. What do you do when you come to a word that you do not understand?

4. What types of reading materials are easiest for you to understand?

5. What might stop you when you are reading?

6. When you are reading and you have difficulty:

a) Do you ever repeat what you are reading in your own words?

___ Yes ___ No

b) Do you ever reread something that does not make sense?

___ Yes ___ No

c) Do you ever ask yourself questions as you read? ___ Yes ___ No

APPENDIX C

PRE KNOWLEDGE WAVES AND LIGHT ASSESSMENT

Pre Knowledge Waves and Light Assessment

____ 1. A disturbance that transfers energy from place to place is called a
a. wave. b. medium. c. vibration. d. compression.

____ 2. The highest parts of a transverse wave are called
a. troughs. b. crests. c. nodes. d. wavelengths.

____ 3. Waves that move the particles of the medium parallel to the direction in which the waves are traveling are called
a. longitudinal waves. b. transverse waves. c. surface waves. d. combination waves.

____ 4. The maximum distance that the particles of a medium move from the rest position is the
a. amplitude of the wave. b. wavelength of the wave. c. frequency of the wave.
d. speed of the wave.

____ 5. The distance between two corresponding parts of a wave is the wave's
a. amplitude. b. wavelength. c. frequency. d. speed.

____ 6. The speed of a wave is its wavelength multiplied by its
a. amplitude. b. vibration. c. frequency. d. reflection.

____ 7. The bending of waves due to a change in speed is called
a. reflection. b. refraction. c. diffraction. d. interference.

____ 8. The bending of waves around the edge of a barrier is known as
a. reflection. b. refraction. c. diffraction. d. interference.

____ 9. The interaction between two waves that meet is called
a. reflection. b. refraction. c. diffraction. d. interference.

____ 10. What occurs when vibrations traveling through an object match the object's natural frequency?
a. reflection b. refraction c. diffraction d. resonance

____ 11. A wave travels through a medium because

a. the medium's particles are carried along with the wave. b. the wave's energy passes from particle to particle. c. the medium transfers electromagnetic energy. d. the wave increases the potential energy of its medium.

____ 12. Frequency is measured in units called
a. amps. b. hertz. c. nodes. d. antinodes.

____ 13. A material that reflects or absorbs any light that strikes it is
a. opaque. b. transparent. c. translucent. d. concave.

____ 14. Frosted glass and wax paper are
a. transparent. b. translucent. c. clear. d. opaque.

____ 15. What happens when parallel rays of light hit a smooth surface?
a. diffuse reflection b. diffraction c. refraction d. regular reflection

____ 16. What happens when light passes from air into water?
a. The light speeds up. b. The light continues at the same speed. c. The light slows down. d. The light forms a mirage.

____ 17. A curved piece of glass or other transparent material that is used to refract light is called a(n)
a. mirror. b. lens. c. reflector. d. optical fiber.

____ 18. Because the light rays never meet, a concave lens can produce
a. no image. b. both real and virtual images. c. only a real image. d. only a virtual image.

____ 19. How would a tomato look under blue light?
a. The tomato would seem to disappear. b. The tomato would still appear red. c. The tomato would appear black. d. The tomato would appear white.

____ 20. The primary colors of light are
a. red, yellow, and blue. b. yellow, cyan, and magenta. c. red, green, and blue. d. red, orange, yellow, green, blue, and violet.

____ 21. What instruments use lenses or mirrors to collect and focus light from distant objects?
a. microscopes b. optical fibers c. telescopes d. lasers

____ 22. Clear glass, water, and air are examples of what kind of material?
a. opaque b. fluid c. translucent d. transparent

____ 23. What occurs when parallel rays of light hit a rough or bumpy surface?
a. regular reflection b. diffuse reflection c. refraction d. diffraction

____ 24. Which waves have some electrical properties and some magnetic properties?
a. longitudinal waves b. transverse waves c. mechanical waves d. electromagnetic waves

____ 25. Electromagnetic waves can transfer energy without a(n)
a. medium. b. electric field. c. magnetic field. d. change in either a magnetic or an electric field.

____ 26. The range of electromagnetic waves placed in a certain order is called the
a. electromagnetic spectrum. b. electromagnetic wavelength. c. electromagnetic frequency. d. electromagnetic field.

____ 27. When a police officer uses radar for speed control, the officer is using what kind of electromagnetic waves?
a. radio waves b. gamma rays c. ultraviolet rays d. X-rays

____ 28. Visible light can be separated into various colors to form a(n)
a. spectrum. b. thermogram. c. MRI. d. X-ray picture.

____ 29. What kind of waves do cellular telephones use to transmit and receive signals?
a. gamma rays b. microwaves c. ultraviolet rays d. infrared rays

____ 30. Which of the following is true of ultraviolet rays?
a. They are visible. b. They carry information to televisions and radios. c. They help your body produce vitamin D. d. They provide the energy that makes your morning toast.

Waves Pre Test
Answer Section

MULTIPLE CHOICE

1. ANS: A PTS: 1 DIF: L1 REF: p. O-7
   OBJ: O.1.1.1 Explain what causes mechanical waves. STA: 5.7.B.2
   BLM: knowledge
2. ANS: B PTS: 1 DIF: L1 REF: p. O-8
   OBJ: O.1.1.2 Describe two types of waves and how they can be represented.
   STA: 5.7.B.2 | 5.3.B.1 BLM: knowledge
3. ANS: A PTS: 1 DIF: L1 REF: p. O-9
   OBJ: O.1.1.2 Describe two types of waves and how they can be represented.
   STA: 5.7.B.2 BLM: knowledge
4. ANS: A PTS: 1 DIF: L1 REF: p. O-12
   OBJ: O.1.2.1 Describe the basic properties of waves. STA: 5.7.B.2
   BLM: knowledge
5. ANS: B PTS: 1 DIF: L1 REF: p. O-13
   OBJ: O.1.2.1 Describe the basic properties of waves. STA: 5.7.B.2
   BLM: knowledge
6. ANS: C PTS: 1 DIF: L2 REF: p. O-14
   OBJ: O.1.2.2 Explain how a wave's speed is related to its wavelength and frequency.
   STA: 5.7.B.2 BLM: comprehension
7. ANS: B PTS: 1 DIF: L2 REF: p. O-19
   OBJ: O.1.3.1 Describe how reflection, refraction, and diffraction change a wave's direction.
   STA: 5.7.B.2 | 5.7.B.4 | 5.1.B.3 BLM: comprehension
8. ANS: C PTS: 1 DIF: L2 REF: p. O-20
   OBJ: O.1.3.1 Describe how reflection, refraction, and diffraction change a wave's direction.
   STA: 5.7.B.2 | 5.7.B.4 BLM: comprehension
9. ANS: D PTS: 1 DIF: L1 REF: p. O-20
   OBJ: O.1.3.2 State the different types of interference. STA: 5.7.B.2 | 5.7.B.4
   BLM: knowledge
10. ANS: D PTS: 1 DIF: L2 REF: p. O-23
    OBJ: O.1.3.3 Explain how standing waves form. STA: 5.7.B.2 | 5.7.B.4
    BLM: comprehension
11. ANS: B PTS: 1 DIF: L2 REF: p. O-7
    OBJ: O.1.1.1 Explain what causes mechanical waves. STA: 5.7.B.2
    BLM: application NOT: application
12. ANS: B PTS: 1 DIF: L1 REF: p. O-13
    OBJ: O.1.2.1 Describe the basic properties of waves. STA: 5.7.B.2
    BLM: knowledge NOT: knowledge
13. ANS: A PTS: 1 DIF: L1 REF: p. O-107

OBJ: O.4.1.1 State what happens to the light that strikes an object.
STA: 5.7.B.4 BLM: knowledge

14. ANS: B PTS: 1 DIF: L2 REF: p. O-107
OBJ: O.4.1.1 State what happens to the light that strikes an object.
STA: 5.7.B.4 BLM: comprehension

15. ANS: D PTS: 1 DIF: L1 REF: p. O-114
OBJ: O.4.2.1 Identify the kinds of reflection. STA: 5.7.B.4
BLM: knowledge

16. ANS: C PTS: 1 DIF: L2 REF: p. O-120
OBJ: O.4.3.1 Explain why light rays bend when they enter a medium at an angle.
STA: 5.3.D.1.b | 5.7.B.4 BLM: comprehension

17. ANS: B PTS: 1 DIF: L1 REF: p. O-122
OBJ: O.4.3.2 Identify what determines the types of images formed by convex and concave lenses.
STA: 5.7.B.4 BLM: knowledge

18. ANS: D PTS: 1 DIF: L1 REF: p. O-123
OBJ: O.4.3.2 Identify what determines the types of images formed by convex and concave lenses.
STA: 5.7.B.4 BLM: knowledge

19. ANS: C PTS: 1 DIF: L2 REF: p. O-108
OBJ: O.4.1.2 Describe what determines the color of an opaque, transparent, or translucent object.
STA: 5.7.B.4 BLM: application

20. ANS: C PTS: 1 DIF: L2 REF: p. O-110
OBJ: O.4.1.3 Explain how mixing pigments is different from mixing colors of light.
STA: 5.7.B.4 BLM: comprehension

21. ANS: C PTS: 1 DIF: L1 REF: p. O-130
OBJ: O.4.5.1 Describe how lenses are used in telescopes, microscopes, and cameras.
STA: 5.2.B.2 | 5.7.B.4 | 5.8.D.2 BLM: knowledge

22. ANS: D PTS: 1 DIF: L2 REF: p. O-107
OBJ: O.4.1.1 State what happens to the light that strikes an object.
STA: 5.7.B.4 BLM: comprehension

23. ANS: B PTS: 1 DIF: L1 REF: p. O-114
OBJ: O.4.2.1 Identify the kinds of reflection. STA: 5.7.B.4
BLM: knowledge

24. ANS: D PTS: 1 DIF: L2 REF: p. O-71
OBJ: O.3.1.1 State what an electromagnetic wave consists of. STA: 5.7.B.2
BLM: comprehension

25. ANS: A PTS: 1 DIF: L2 REF: p. O-71
OBJ: O.3.1.1 State what an electromagnetic wave consists of. STA: 5.7.B.2
BLM: comprehension

26. ANS: A PTS: 1 DIF: L1 REF: p. O-75
OBJ: O.3.2.2 Name the waves that make up the electromagnetic spectrum.
STA: 5.7.B.2 | 5.7.B.4 BLM: knowledge

27. ANS: A PTS: 1 DIF: L2 REF: p. O-76

OBJ: O.3.2.2 Name the waves that make up the electromagnetic spectrum.
STA: 5.7.B.2 | 5.1.B.3 | 5.1.A.3 BLM: comprehension

28. ANS: A PTS: 1 DIF: L2 REF: p. O-78
OBJ: O.3.2.2 Name the waves that make up the electromagnetic spectrum.
STA: 5.7.B.2 | 5.7.B.4 | 5.3.A.1.c BLM: comprehension

29. ANS: B PTS: 1 DIF: L1 REF: p. O-93
OBJ: O.3.4.2 Describe how cellular phones work. STA: 5.8.D.1 | 5.2.B.1 | 5.2.B.2
BLM: knowledge

30. ANS: C PTS: 1 DIF: L2 REF: p. O-78
OBJ: O.3.2.2 Name the waves that make up the electromagnetic spectrum.
STA: 5.7.B.2 | 5.7.B.4 | 5.3.A.1.c BLM: comprehension

APPENDIX D

INFORMATION ON T.H.I.E.V.E.S. STRATEGY

T.H.I.E.V.E.S.

Here is a great strategy to preview chapters of any textbook. It is known as T.H.I.E.V.E.S., an acronym for the steps of the strategy. After a few times of practice, you will find this strategy easy, and very effective in improving your comprehension of what you read.

T……. TITLE

- What is the title?
- What do I already know about this topic?
- What does this topic have to do with the preceding chapter?
- Does the title express a point of view?
- What do I think I will be reading about?

H……HEADINGS/SUBHEADINGS

- What does this heading tell me I will be reading about?
- What is the topic of the paragraph beneath it?
- How can I turn this heading into a question that is likely to be answered in the text?

I……INTRODUCTION

- Is there an opening paragraph, perhaps italicized?
- Does the first paragraph introduce the chapter?
- What does the introduction tell me I will be reading about?

E……EVERY FIRST SENTENCE IN A PARAGRAPH

- What do I think this chapter is going to be about, based on the first sentence in each paragraph?

V ……VISUALS AND VOCABULARY

- Does the chapter include photographs, drawings, maps, charts, or graphs?

- What can I learn from the visuals in a chapter?
- How do captions help me better understand the meaning?
- Is there a list of key vocabulary terms and definitions?
- Are there important words in boldface type throughout the chapter?
- Do I know what the bold-faced words mean?
- Can I tell the meaning of the boldfaced words from the sentences in which they are embedded?

E……END-OF-CHAPTER QUESTIONS

- What do the questions ask?
- What information do I learn from the questions?
- Let me keep in mind the end-of-chapter questions so that I may annotate my text where pertinent information is located.

S……SUMMARY

- What do I understand and recall about the topics covered in the summary?

APPENDIX E

WRITE AS YOU READ ACTIVITY

Write as you Read

1. What is the main topic of this section?

Read the text.
Underline the parts you think are important.
Circle any parts you don't understand
Highlight anything you think is interesting

2. List the vocabulary that is important to know in order to understand this section?

3. What do the images show you?

4. Write down two questions about the things you don't understand

5. Write down one fact you find interesting

6. Using the underlined sections write 5 bullet points to summarize the important facts.

1	
2	
3	
4	
5	

APPENDIX F

INFORMATION ON SEEDS DISCUSSIONS STRATEGY

Steps to Seed Discussions:

- Explain the dynamics of a seed discussion. Focus specifically on the four roles played by students.

Roles

Leader	The leader is responsible for calling on each person to share his discussion seeds.
Manager	The manager makes sure that everyone has all of their materials for their discussion (books, journals, cards, etc.).
Checker	The checker makes sure that every team member has a chance to talk about his/her seeds. Everyone in the group comments on the seed before the next person presents his seed for discussion.
Communicator	The communicator is the only person to leave the group. The communicator lets the teacher know when the discussion is complete.

- Provide a series of questions about a reading selection that will assist students to identify possible "seeds" for discussion.
  - What new information does the reading selection provide?
  - What did you find interesting or surprising about the selection?
  - What did you not understand in the selection?
- Allow students time to write and refine their "seeds."
- Have students initiate discussion by presenting their "seeds." Wait for at least four comments about a "seed" before moving on to the next.
- At the end of the discussion, have students evaluate the strongest and weakest "seeds." Ask them to describe criteria for determining quality "seed" ideas.

APPENDIX G

NOTEBOOK RUBRIC

Quick Check Notebook Rubric

5 Points - (a WOW product)

- all of the requirements are evident and EXCEEDED expectation including use of appropriate scientific vocabulary
- the product is VERY neatly done and EXTREMELY well organized and shows LOTS of creativity and is colorfully illustrated, completed on time

4 Points - (What is EXPECTED)

- all of the requirements are evident and met expectation including use of appropriate scientific vocabulary
- the product is VERY neatly done and EXTREMELY well organized and the product shows of creativity and is colorfully illustrated, completed on time

3 Points – (Almost What is EXPECTED)

- the requirements are evident (maybe 1 or 2 are missing) including some use of appropriate scientific vocabulary
- the product is neatly done and organized and shows some creativity and is illustrated, completed on time

2 Points – (Not Quite What is EXPECTED)

- the requirements are evident (maybe 3 or 4 are missing) including some use of appropriate scientific vocabulary
- the product is done and sort of organized and shows little creativity and is illustrated, completed on time

1 Point – (Two or More parts is missing)

- MANY of the requirements are NOT PRESENT expectation including use of appropriate scientific vocabulary
- the product is VERY POORLY done and POORLY organized.
- the product shows little or NO creativity and THE illustrations IS POORLYDONE..it is hard to use for understanding. not completed on time

0 Points - (Does not meet Standards)
Unscorable or no product

APPENDIX H

WORD JOURNAL

WORD JOURNAL

Vocabulary Journal for……. Topic

Word	Drawing
Textbook Definition	
My definition	
References in book or in class	

Word	Drawing
Textbook Definition	
My definition	
References in book or in class	

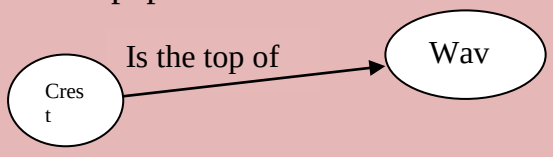
APPENDIX I

TEN WORDS PLUS ACTIVITY

TEN WORDS PLUS ACTIVITY

Choose from this list of words as voted by you

Diffraction, refraction, amplitude, transverse wave, reflection, wave, electromagnetic spectrum, medium, trough, wavelength

Yellow	Use a dictionary and one other source to find the meanings of at least 6 words. Complete A Vocabulary Journal sheet for each of these words
Blue	Share connections between these words and examples in real life, where might you expect to see or hear these words(pictures can be used) – at least 6 words - present as a PowerPoint of no more than 7 slides (title + 6 words)
pink	Create a concept map using "Wave" as the center starting point. Show how these words relate to Waves – at least 6 words. Use Construction paper and Markers Ex. 
green	Create a drawing showing at least 6 of these words interacting together – use color. Can be a cartoon. It should be clear from the drawing what the words mean.
orange	Create a song, poem, rap or skit containing at least 6 of these words. Can be done as a pair
Purple	Create a set of flash cards for at least 6 words showing the word and the definition in one sketch. (see Examples)

APPENDIX J

POST PHYSICS ASSESSMENT

POST PHYSICS ASSESSMENT
Multiple Choice

____ 1. A disturbance that transfers energy from place to place is called a
a. wave. b. medium. c. vibration. d. compression.

____ 2. The highest parts of a transverse wave are called
a. troughs. b. crests. c. nodes. d. wavelengths.

____ 3. Waves that move the particles of the medium parallel to the direction in which the waves are traveling are called
a. longitudinal waves. b. transverse waves. c. surface waves. d. combination waves.

____ 4. The maximum distance that the particles of a medium move from the rest position is the
a. amplitude of the wave. b. wavelength of the wave. c. frequency of the wave.
d. speed of the wave.

____ 5. The distance between two corresponding parts of a wave is the wave's
a. amplitude. b. wavelength. c. frequency. d. speed.

____ 6. The bending of waves due to a change in speed is called
a. reflection. b. refraction. c. diffraction. d. interference.

____ 7. The bending of waves around the edge of a barrier is known as
a. reflection. b. refraction. c. diffraction. d. interference.

____ 8. What occurs when vibrations traveling through an object match the object's natural frequency?
a. reflection b. refraction c. diffraction d. resonance

____ 9. A wave travels through a medium because

a. the medium's particles are carried along with the wave. b. the wave's energy passes from particle to particle. c. the medium transfers electromagnetic energy. d. the wave increases the potential energy of its medium.

____ 10. Frequency is measured in units called
a. amps. b. hertz. c. nodes. d. antinodes.

____ 11. A material that reflects or absorbs any light that strikes it is
a. opaque. b. transparent. c. translucent. d. concave.

____ 12. Frosted glass and wax paper are
a. transparent. b. translucent. c. clear. d. opaque.

____ 13. What happens when parallel rays of light hit a smooth surface?
a. diffuse reflection b. diffraction c. refraction d. regular reflection

____ 14. What happens when light passes from air into water?
a. The light speeds up. b. The light continues at the same speed. c. The light slows down. d. The light forms a mirage.

____ 15. A curved piece of glass or other transparent material that is used to refract light is called a(n)
a. mirror. b. lens. c. reflector. d. optical fiber.

____ 16. How would a tomato look under blue light?
a. The tomato would seem to disappear. b. The tomato would still appear red. c. The tomato would appear black. d. The tomato would appear white.

____ 17. The primary colors of light are
a. red, yellow, and blue. b. yellow, cyan, and magenta. c. red, green, and blue. d. red, orange, yellow, green, blue, and violet.

____ 18. What instruments use lenses or mirrors to collect and focus light from distant objects?

a. microscopes b. optical fibers c. telescopes d. lasers

____ 19. Clear glass, water, and air are examples of what kind of material?
a. opaque b. fluid c. translucent d. transparent

____ 20. What occurs when parallel rays of light hit a rough or bumpy surface?
a. regular reflection b. diffuse reflection c. refraction d. diffraction

____ 21. Which waves have some electrical properties and some magnetic properties?
a. longitudinal waves b. transverse waves c. mechanical waves d. electromagnetic waves

____ 22. Electromagnetic waves can transfer energy without a(n)
a. medium. b. electric field. c. magnetic field. d. change in either a magnetic or an electric field.

____ 23. The range of electromagnetic waves placed in a certain order is called the
a. electromagnetic spectrum. b. electromagnetic wavelength. c. electromagnetic frequency. d. electromagnetic field.

____ 24. Visible light can be separated into various colors to form a(n)
a. spectrum. b. thermogram. c. MRI. d. X-ray picture.

____ 25. What kind of waves do cellular telephones use to transmit and receive signals?
a. gamma rays b. microwaves c. ultraviolet rays d. infrared rays

____ 26. Which of the following is true of ultraviolet rays?
a. They are visible. b. They carry information to televisions and radios. c. They help your body produce vitamin D. d. They provide the energy that makes your morning toast.

____ 27. When the surface of a mirror curves inward, like the inside of a bowl, it is called a
a. plane mirror. b. convex mirror. c. concave mirror. d. diffuse mirror.

____ 28. An image of a distant object caused by refraction of light is called a
a. prism. b. mirage. c. rainbow. d. hologram.

____ 29. What do some bats use to locate food and to navigate?
a. dissonance b. echolocation c. infrasound d. acoustics

____ 30. You can hear sounds from around corners because of
a. refraction. b. reflection. c. diffraction. d. elasticity.

Answer Section **MULTIPLE CHOICE**

1.	ANS: A	PTS: 1	DIF: L1	STA: 5.7.B.2
2.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.2 | 5.3.B.1
3.	ANS: A	PTS: 1	DIF: L1	STA: 5.7.B.2
4.	ANS: A	PTS: 1	DIF: L1	STA: 5.7.B.2
5.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.2
6.	ANS: B	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.7.B.4 | 5.1.B.3
7.	ANS: C	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.7.B.4
8.	ANS: D	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.7.B.4
9.	ANS: B	PTS: 1	DIF: L2	STA: 5.7.B.2
10.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.2
11.	ANS: A	PTS: 1	DIF: L1	STA: 5.7.B.4
12.	ANS: B	PTS: 1	DIF: L2	STA: 5.7.B.4
13.	ANS: D	PTS: 1	DIF: L1	STA: 5.7.B.4
14.	ANS: C	PTS: 1	DIF: L2	STA: 5.3.D.1.b | 5.7.B.4
15.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.4
16.	ANS: C	PTS: 1	DIF: L2	STA: 5.7.B.4
17.	ANS: C	PTS: 1	DIF: L2	STA: 5.7.B.4
18.	ANS: C	PTS: 1	DIF: L1	STA: 5.2.B.2 | 5.7.B.4 | 5.8.D.2
19.	ANS: D	PTS: 1	DIF: L2	STA: 5.7.B.4
20.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.4
21.	ANS: D	PTS: 1	DIF: L2	STA: 5.7.B.2
22.	ANS: A	PTS: 1	DIF: L2	STA: 5.7.B.2
23.	ANS: A	PTS: 1	DIF: L1	STA: 5.7.B.2 | 5.7.B.4
24.	ANS: A	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.7.B.4 | 5.3.A.1.c
25.	ANS: B	PTS: 1	DIF: L1	STA: 5.8.D.1 | 5.2.B.1 | 5.2.B.2
26.	ANS: C	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.7.B.4 | 5.3.A.1.c
27.	ANS: C	PTS: 1	DIF: L1	STA: 5.7.B.4
28.	ANS: B	PTS: 1	DIF: L1	STA: 5.7.B.4
29.	ANS: B	PTS: 1	DIF: L2	STA: 5.7.B.2 | 5.4.A.1
30.	ANS: C	PTS: 1	DIF: L2	STA: 5.7.B.2

APPENDIX K

POST ACTIVITY INTERVIEW QUESTIONS

POST ACTIVITY INTERVIEW QUESTIONS

I will ask a number of questions after each literacy activity. I will chose 5 to 8 students from my classes to participate.

1. Why do you think reading and writing is important in science?
2. Can you give me an example to show this?
3. What did you learn from today's activity?
4. How did the activity help your reading and writing skills?
5. Is there anything you could improve about your participation in the activity?
6. When do you think you could do this activity again in science?
7. Is there anything you would like to tell me?

APPENDIX L

POST ACTIVITY READING STRATEGIES QUESTIONNAIRE

Post Reading Strategies Questionnaire

Participation in this research is voluntary and participation or non-participation will not affect your grades or class standing in any way.

Read each sentence and decide whether it describes a person who is like you or different from you. There are no right or wrong answers.

	Very different from me	A little different from me	A little like me	A lot like me
I like hard, challenging books.				
If the teacher discusses something interesting, I might read more about it.				
I read because I have to				
If I am reading about an interesting topic, I sometimes lose track of time.				
I talk to my friends about what I am reading.				
I don't like reading something when the words are too difficult.				
I don't like vocabulary questions.				
I like it when the questions in books make me think				
I am a good reader.				
I read to learn new information about topics that interest me.				
I like knowing an answer in something we read.				
I learn more from reading than most students in the class.				
I am happy when someone recognizes my reading.				
I like to read about new things.				
I make pictures in my mind when I read.				
I usually learn difficult things by reading				

In our light and waves topic we have used a number of activities to improve our reading and vocabulary skills.

Check the option you feel most about each activity

Activity	It helped me a lot	It was helpful to me	It was a little helpful to me	I didn't find this helpful at all
THIEVES				
Write as you read				
Top ten words				
Vocabulary journal sheets				
Writing with key vocab				
Seeing the words on the wall				
Telescope research chart				

1. What causes you the greatest difficulty when you try to understand what you read?
2. What could you do to be better at understanding what you read?
3. What do you do when you come to a word that you do not understand?
4. What types of reading materials are easiest for you to understand?
5. Choose one option you found helpful and tell me why, Choose one option you found unhelpful and tell me why?
6. In the top ten words activity you were given a choice of ways to present your vocabulary. Which methods did you prefer and why?