THE EFFECTS OF INCREASED LITERACY AND COMPREHENSION IN MIDDLE AND HIGH SCHOOL SCIENCE

by

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ABSTRACT

This Action Research project studied how building literacy skills in middle and high school classrooms can help students better understand science content. Students read different science related materials in and out of class, as well as worked on breaking down text and vocabulary to improve comprehension of units studied in class. As students read and understood the content, they applied what they learned into relatable situations in their lives and in the world around them. By becoming better readers, students were also able to improve their written communication skills. Basic improvements on spelling and grammar were realized and individual achievements varied across the board.
INTRODUCTION AND BACKGROUND

I teach 7-12 science at a small school in NE Montana. Reading (in class and for personal enjoyment) is not stressed with middle school students and high school students and their lack of reading habits was evident as I worked with them through the first weeks of the school year. Improving student literacy to help them understand their science work is the main purpose of this research project as well as stressing the importance of a lifetime habit of reading. I will be teaching these students throughout their secondary schooling and the data gathered through this project will help me develop curriculum geared towards individual learning and increased literacy in my classroom.

Comprehension of science data and terms, in my personal experience, is the stumbling block most students face during their mandatory high school science classes. If reading increases, then vocabulary increases along with sentence structures, contextual applications, and reasoning skills. Outside of English/Literature classes and possibly the social sciences, reading at my high school has not been a focus in other core education classes (and here I’m excluding textbook reading). Reinforced reading for comprehension in high school science and math must increase if we want to see students excel and perform to the best of their ability.

At our small school, the administration and teachers meet informally to discuss ways to improve our methods to benefit the students on an almost daily basis. Our relationship with parents is also critical and necessary to keep students on track with their studies. I have used both teachers and parents as part of the project to gain their collective insight on literacy and how it effects their classrooms and lives. My plan is to share the
information from this AR project with both peers and parents to gain their support in recognizing shortcomings in literacy and what can be done both in and out of school to enable every student to succeed in high school.

My main Action Research question is to assess the effects of increased literacy upon the comprehension and understanding of science in middle and high school students. With this topic, I have formed several questions I hope to answer through careful data collection and analysis.

- How does the type of literature read effect the process of increased literacy and comprehension in science?
- How does increased reading impact student learning, more than just the textbook and the usual worksheets used in class?
- How is student attitude towards personal reading goals changed due to an increased literacy in science?
- How will concentrating on literacy in the science classroom improve my development as a new science teacher

My support group consists of a small group of teachers of varying backgrounds. Dr. Leah Sledge is an English teacher and AVID instructor at Robert D. Edgren High School at Misawa AB, Japan. As a longtime friend and colleague, she agreed to be my editor. Kim Popham is a science teacher at Belgrade High School, Belgrade, Montana. She has been my mentor, cheerleader and friend for the past four years. Dr. Greg Francis, MSU Physics Professor, agreed to be my science reader. Dr. Walter Woolbaugh has been my
advisor throughout this entire process. I am greatly appreciative of all their collective help and feedback these past months.

Nashua K12 schools, located in Valley County, Montana is a Class C school with a student population of approximately 115 students, 46 of which are grade 7-12. As of the 2016 school year, 97% of students identified as Caucasian, 3% identified as Native American or other. Roughly 55% of middle and high school students are marked as living at or below poverty level. Nashua School has 53 students currently enrolled in the Federal Free and/or Reduced Lunch Program. I will also mention that of the 36 students I teach, roughly 34% are on either an Individualized Education Plan (IEP) or some sort of reading based specialized instruction to help boost their overall literacy.

Nashua High School requires a minimum of two credits of math and two credits of laboratory science for graduation. Students pursuing higher education are steered towards three or four rigorous math and science classes: Algebra 1 and 2, Geometry and Pre-Calculus are the high school mathematics courses offered; Physical Science and Biology are offered yearly with elective sciences offered every two years of Chemistry, Physics, Anatomy and Physiology, and Environmental Science. In 2016, ten students from Nashua took the ACT as juniors. The results of that test were an average composite score of 18.4; math scores averaged 17.1 and science 19.6. I would note that prior to the 2016-2017 school year, the students did not have fully qualified math and science teachers. The results of the ACT test showed that 50% of the students were college ready in reading, 20% for science and 10% for math (MontCAS , 2017).
CONCEPTUAL FRAMEWORK

Proficiency in literacy is essential for students to become productive adults in the future. However, it is common knowledge that millions of Americans function at a literacy rate below normal parameters. My action research project considered the relationship between increased reading and a better understanding of science concepts in a high school science classroom. My main question was whether an increased reading habit, both in and out of the classroom, can have a positive effect on science understanding and comprehension of concepts.

A study completed in 2014 looked at ways to embed multiple literacies into STEM curricula at a freshman college level. Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) are closely tied in the language development of students K-12 and K-16 respectively. A team of science faculty from California State University East Bay (CSUEB) collaborated in setting the goals for their incoming freshman science students. Overall, the team wanted their students to be able to read, research and write effectively (Inouye, et al., 2014).

With as many as 60% of first year college students failing their introductory science courses at CSUEB, the faculty had to overcome learning deficiencies in reading college level texts as well as being able to develop strategies to understand difficult texts. Writing to communicate information as well as writing to learn was another area of literacy the faculty wanted to address in their curriculum to enable their students to better understand what it is they are writing and why it is important for their understanding of science. Multiple strategies were used, however in every classroom the process of survey,
question, read, recite, review (SQ3R’s) as well as reading notebooks were implemented. The notebooks were used for the SQ3R’s, impromptu writing prompts, reading tutorials and discussions on readings done outside of class.

Laboratory notebooks were another component used in all the classes as an effective tool for writing to communicate. These notebooks allowed students to create lab write ups while developing their understanding of topics like methods, results, and conclusions. Individual research assignments were also used to develop writing skills in freshmen students. Part of their assignment was to work with writing tutors to help them improve their writing skills as well as peer reviews of rough drafts with a provided rubric to help students read and critique each other’s work (Inouye, et al., 2014).

Another article I read was the Adams and Pegg report (2012) which was the culmination of a two-year study of 26 science and math teachers from grades 6-12. The overall theme of the study was rehearsal, reorganization and transitional study enactments. Different literary strategies were used in each area to help students break down the information, understand its context and meaning, then reorganize the information with new understandings as a platform or foundation for learning activities. Transitional enactment occurred rarely in the classrooms studied, but the concept was for students to utilize what they have learned for data analysis and discussion.

Two literary strategies used were the Frayer Model and the Verbal Visual Word Association (VVWA). I was unfamiliar with both concepts which was one reason I was drawn to this study. Both are vocabulary learning strategies used to categorize words, concepts and meanings. The Frayer Model has students describing characteristics,
providing examples (and non-examples), and giving a definition in their own words. The VVWA approach is similar with concept definitions, students provide a visual representation of the word, and associate it with personal experience. Examples of both the Frayer Model and VVWA were included as visual guidelines for the reader.

In the conclusion of the article, the authors summarize the concepts and strategies used by the various classroom teachers, the successes achieved and areas for continual improvement for developing and implementing literacy into science and math lessons. In the final column, the authors provide a series of steps for any teacher to use for enhancing literacy within their classrooms. One of the highlights written by Adams and Pegg (2012) of this area is simply: do not do too much!

I have a goal to get students to read more, not only for my Action Research project, but every day as they continue to grow and learn how science impacts their daily life. Within that goal, I want to help students develop their skills to recognize the type of articles or books they read, author intent, any bias on the author’s part and how the language of a text influences our thinking of the information. An article from the Linguistics and Education Journal (O'Hallaron, Palinscar, & Shleppegrell, 2015) shows how often information non-fiction texts, such as a science textbook, can contain language which influences student thought about a topic and at the same time create a language so students (and often teachers) take the information as solid, unchanging fact. I was very surprised to realize that overall this is very true in that what we read in our science texts we believe it word for word without looking at the language style it is written in and forgetting that science is constantly changing.
The authors of this article spend a significant amount of time discussing critical language awareness and how to help students become aware of text, and author nuances that can sway our feelings or beliefs one way or the other. The emphasis of the article is critical literacy development in science. Whether textbooks, non-fiction materials, or science magazine articles, all are written to not only inform the reader but also persuade a reader. The authors believe that having discussions before and after readings with students can help them to distinguish the meaning of the text and persuasive words used by the text author.

The research demographics for the article consisted of four elementary and middle school classrooms in Michigan in which the students’ primary language was Arabic and nearly every student was classified as ELL. Two of the four teachers in the study also spoke Arabic. Not only were these students still learning grammar but now were being taught how to read informational texts and discuss the author’s attitude or purpose. Identifying and breaking down vocabulary was a consistent theme throughout the study and once students understood the article, they then began to pick out the words they thought influenced the writing (O'Hallaron, Palinscar, & Shleppegrell, 2015).

Another article from an NSTA magazine was written to help teachers with reluctant readers (anyone who does not show interest in reading) at the high school level. McCormick and Segal point out that many teachers who have reluctant readers often remove the text from daily lesson plans. Instead, material is discussed in class, experiments conducted, demonstrations given and videos watched. While all of this does work and inquiry-driven lessons are productive to learning, removing the text completely
denies students the chance to read, understand and interpret the written material. Reading a science text is much different than, say, a graphic novel and it is up to the educator to decide how best to approach a reluctant reader.

Many reluctant readers have valid reasons for avoiding reading texts. Background knowledge of student abilities, restrictions, differentiation needs and accomplishments need to be looked at to determine where to start with a reluctant reader. Vocabulary is key in a science classroom. Vital terms should be taught first, along with the skills to recall prior knowledge to enable reluctant readers to be more confident in their skills.

Two ways that were established in the article to help students was for educators to modify the text to make it easier to read. While this process is time consuming, it could be an ongoing file for future use, with adjustments made for reading levels of students. By starting small, identifying key terms and ideas that are necessary for learning, educators can create a word document that is easier for students to read and understand while still having them read. Modifying the text clarifies confusing sentences, deletes unnecessary details and guides the students to the point of comprehension of material while gaining confidence in their reading.

According to McCormick and Segal, another way to modify text is to box the text into smaller, more compact sections again by editing out information that is not needed. Examples of this idea were given to collaborative groups, so students could work on this concept in class with their peers and together they study the sections, break them down and organize them for easier understanding. One point for this exercise is to make sure each student has an active role to play (reader, note taker, question asker, etc) so all
students are included and the reluctant reader plays an active role (McCormick & Segal, 2016).

One of the additional articles for my AR project was a research study conducted in Norway in 2013 that looked at texts in a primary science classroom, how the different texts were used, the way the students reacted to the texts and, if literacy in science could change student learning and perception of scientific concepts. Video and audio data was collected from different classrooms and lessons to be analyzed for their content and significance to the study. Literacy events were singled out and categorized into topics such as reading, communication, writing, etc.

The reading events were divided into different sections depending on the type of materials the students were reading. Some examples would be informational texts, internet text, orienting text like concept walls or work plans, and graphs, models and figures, as well as student writing among others. By analyzing the different types of text students used, the researchers were then able to code the data to determine student attitudes, feelings, social relationships and values towards science and science topics in general. Basically, the researchers were trying to determine what students did with the text they were given (Blikstad-Balas, Odegaard, & Ove Sorvik, 2014).

The conclusion alluded to students engaging more in literacy when the information was meaningful and fun to read. Part of my AR project was to have students develop a reading habit of any type and I encouraged various types of reading outside the classroom as well as inside it. Newspapers, magazine articles, science fiction as well as scholarly literature and informational text was read in the classroom. This study was good
for me in that it showed the types of text students responded most positively to. Even though they were elementary students, I imagine the same can hold true for older students too.

My biggest obstacle for this project was to find a reliable science reading assessment that I could use with all my classes (grades 7-12), as not every grade participates in a standardized reading test each year. After many searches, I came across ReadWorks.org, a website dedicated to articles for students K-12 (ReadWorks.org, 2017). Each article is marked according to a Lexile score that allows educators to customize reading for students, especially those that need differentiation. With a variety of topics to choose from, teachers can incorporate the articles into their curriculum, no matter the subject. For science, ReadWorks.org breaks down their topics into the following categories: Life Sciences, Physical Science, and Earth and Space Science. Each article comes with a set of multiple choice and free answer essay questions to gauge student comprehension.

The study of literacy and science is not a new concept. Connecting the Next Generation Science Standards (NGSS) and the Common Core State Standards for English Language Arts (CCSS for ELA) is a new way of intersecting language, communication and science. In December 2013, the National Research Council (NRC) brought together a gathering of science, language and education experts for a workshop. The evidence of that workshop is the book Literacy for Science: Exploring the Intersection of the Next Generation Science Standards and the Common Core for ELA Standards (Feder & Rhodes, 2014).
The goals of the workshop were to study the relationship of NGSS and CCSS for ELA as they stood with the NRC’s *A Framework for K-12 Science Education*. One goal was to develop an active literacy platform in science that involves “gathering, evaluating and communicating information” as it relates to science education. Another goal considered the relationship between English teachers and science teachers and how they could complement each other in reaching goals in literacy for their students. Curriculum alignment options were discussed, with an emphasis on student support in reading comprehension and communication. Finally, the roles of school administration for implementing practices according to state standards was discussed in the workshop.

The book itself reads more as a series of guidelines for educators to help them steer science classroom instruction towards one that promotes literacy through actively engaging in exercises beyond just reading. The authors discuss how educators can incorporate effective communication skills while students are grasping science concepts. NGSS goals lead students from a pattern of read, memorize, regurgitate, and forget to a system of observing, analyzing and communicating evidence through the “doing” of science. The process of argumentation is one that has been gaining support in science classrooms and allows students to present and argue findings after collecting evidence.

The NRC workbook includes examples from classrooms across the United States that applied different literacy strategies to their science instruction to better help students comprehend science knowledge while also learning how to communicate their findings. In the final summary chapter, the chair of the workshop planning committee, David Pearson summarized each day’s theme. Questions, student engagement and coherence
were just some of the main ideas throughout the workshop. The more students are involved in problem-solving science, with a hands-on approach, the better their reading, writing and oral communication skills become which leads to a deeper understanding of the subject.

*The Role of Identity in Reading Comprehension Development*, a study by Leigh A. Hall in 2014 (Hall, 2014) brought student attitudes about reading to the forefront of comprehension in reading. The author studied an 8th grade middle school Language Arts classroom for an entire school year, making observations, gathering data and administering surveys to students to gain insight on their understanding and personal goals in reading. The study findings were similar to my own in many aspects as attitude was my biggest obstacle throughout the entire AR project, and to be honest, the school year in general.

According to the author, students at this particular school were under the impression that their teacher was in charge of their reading ability. The class began to set personal goals in reading and vocabulary to help boost not only their confidence in communicating but also their state standardized test scores. Throughout the school year, students began to identify that they were in control of what they learned, how much they learned and what they did with that information. Attitude effects learning and can be both positive and negative on any given day. By the end of the study, students had a better understanding of their own reading abilities and the means to improve their skills as they desired.
METHODOLOGY

Treatment

I collected data using treatment and non-treatment weeks in which I alternated using different instruments. During the treatment phase of my project, I placed an emphasis on reading both in and out of the classroom. The materials read in class related to the topic of discussion and included: science textbook, reading guides provided by textbook publishers, guided notes, internet research and web quests, magazine articles and excerpts from various books. Students practiced their oral reading skills as well as comprehension by taking the information read and applying it into practical situations. Students were given access to a free online library website for personal reading using their Chrome book. Free reading time was encouraged with various materials available in both the classroom and the library.

I printed off guided reading packets for each student that followed their science text books with a condensed and simplified text, as provided by the publishers. The guides broke vocabulary words down into their root words as well as defined academic vocabulary. I worked with students as we read through the text highlighting key points, deciphered what was important and should be marked and what text was ok to leave alone. We then used these guides along with the guided notes to show how the two packets complemented each other. Students then used both packets to complete any worksheets or cooperative learning activities during the unit to help reinforce learning. Lastly, I worked through ways students should use the guided reading/notes packets to
study for assessments. I mentioned almost daily that students should read through their packets multiple times to help with comprehension of the material.

The project covered a large percentage of the first semester of the school year, roughly 14 weeks (see Appendix A). On average, treatment sessions ran two weeks, non-treatment weeks about the same. The timeline gave me enough school days to alternate treatment weeks with units in all my classes. Our school utilizes a four-day school week and with holidays and teacher in-service training, not all treatment weeks were evenly distributed.

For grades 7-10 I used curriculum resources such as reading guides and vocabulary lists to help students simplify text, break down root words and highlight key points. As the readings were done aloud in class, an emphasis was placed on vocabulary to help build context skills. I found myself asking students “what does this word mean” and together we began to build their academic vocabulary. In my upper level classes, I utilized the same process as it became apparent that this was not an encouraged practice in previous years.

Table 1

<table>
<thead>
<tr>
<th>Non-Treatment instruction</th>
<th>Treatment Instruction</th>
</tr>
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<tbody>
<tr>
<td>Guided Notes</td>
<td>Guided Notes with Read-Before summaries to break down large amounts of text into smaller bites</td>
</tr>
<tr>
<td>Class discussion</td>
<td>Administer CAT assessments muddiest point; minute paper; self-assessment; reflective entries</td>
</tr>
<tr>
<td>Worksheets or online instructional homework</td>
<td>Worksheets/online instructional homework</td>
</tr>
<tr>
<td>Practical/Inquiry labs and demonstrations</td>
<td></td>
</tr>
<tr>
<td>Quizzes/end of chapter assessment</td>
<td></td>
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</table>
During non-treatment weeks, students were given a packet of guided notes for the chapter. They were to read through the chapter and fill in the notes prior to the beginning of discussions, normally this assignment fell over the weekend. Students participated in class discussion and learning was reinforced with worksheets or assessed with a short quiz. I tried to include a hands-on lab instruction for each unit of study. Most students enjoyed the lab activities and it helped reinforce ideas from the unit and made for a starting board to questions that allowed us to look in to a topic more thoroughly. As we have four-day instruction weeks, I tried to break non-treatment and treatment weeks equally, roughly 10 to 12 days of instruction.

For my treatment weeks, students received the guided notes packet as well as a packet of guided reading. The textbook material was condensed down into the relative and needed information; these packets also reinforced vocabulary within the unit as well as academic vocabulary students may or may not have been familiar with. During treatment weeks, we also focused on current event news in science through reading

<table>
<thead>
<tr>
<th>Non-Treatment Instruction</th>
<th>Treatment Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical/Inquiry labs and demonstrations</td>
<td></td>
</tr>
<tr>
<td>Root word vocabulary/academic vocabulary</td>
<td></td>
</tr>
<tr>
<td>Reading articles/book chapters to gain understanding of topic in real life situations; assess reading comprehension through short summaries, discussions and/or questions</td>
<td></td>
</tr>
<tr>
<td>Quizzes/end of chapter assessment</td>
<td></td>
</tr>
</tbody>
</table>
magazine or internet articles and focusing on the pertinent information and how it applies to regular people. Another activity during treatment weeks was the use of short personal assessments that allowed both myself and the students to critique what they are learning or if they are having issues with certain topics or concepts.

**Instrumentation**

The students took a reading comprehension pretest for use as a baseline assessment of their abilities in reading science information and answering questions related to the article. Throughout the following weeks, I alternated units with treatment and non-treatment methods (see Table 1). Student surveys (pre- and post-project), as well as selected student interviews were used to gauge student attitude towards reading and to self-assess their own habits and any change as the project progressed. A post-treatment assessment of the same type as the pretest was administered at the end of the AR project to provide evidence of individual student literacy improvement.

I administered a pre- and post-survey to the students to gauge an understanding of their attitudes on reading in general and within science. We were still getting to know each other and the information gathered during this time served a dual purpose for me. The surveys allowed me to gather information on their ideas and attitudes towards school, learning through reading and how they felt about science. I was then able to use that information to engage them in the learning process while overcoming personal bias and negative attitudes, to some success.

I also conducted a lunch time interview with a selected number of students to try and get a different perspective on thoughts and ideas about literacy, obstacles with
reading, and ways to improve these important skills. I asked students to come by if they wanted to participate, making this a sample of convenience. As my classes are small, I did not specifically choose students and it worked out that I had a nice range of students from both middle and high school. The questions in the survey were similar to the pre-treatment survey that was administered in class. Answers were more open to discussion and allowed me to steer towards a deeper self-understanding of student attitude towards reading.

Our small school is very informal and parents often drop by just to say hello or to ask questions and voice any concerns they have with their student’s performance. Conversations at the beginning of the year ended up talking about my research which gave me some needed insight on what the parents thought of literacy and how their students needed with improvement reading in general. I wanted to gain a collection of parent attitude surveys for use in this project but was unsuccessful after several repeated attempts. It seemed that talking about it was good but answering questions to it was not. I did get a limited response which I will use later in analysis.

Table 2
*Data Triangulation Matrix*

<table>
<thead>
<tr>
<th>DATA COLLECTION MATRIX</th>
<th>Data Collection Methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAIN TOPIC</td>
<td>SURVEYS</td>
</tr>
<tr>
<td>What are the effects of increased literacy upon the comprehension and understanding of science in middle and high school students</td>
<td>1, 5</td>
</tr>
</tbody>
</table>
Research Questions

<table>
<thead>
<tr>
<th>Sub question #1</th>
<th>How does the type of literature read effect the process of increased literacy and comprehension in science?</th>
<th>1,5</th>
<th>1,2,5</th>
<th>3</th>
<th>4,5</th>
<th>1</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub question #2</td>
<td>How does increasing literacy impact student learning, more than just the textbook and usual worksheets used in class?</td>
<td>1,5</td>
<td>1,2,5</td>
<td>1</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub question #3</td>
<td>How is student attitude towards personal reading goals changed due to an increased literacy in science?</td>
<td>1,5</td>
<td>1,5</td>
<td>4,5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub question #4</td>
<td>How will concentrating on literacy in the science classroom improve my development as a new science teacher?</td>
<td>1,5</td>
<td>1,2,5</td>
<td>3</td>
<td>4,5</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

Key for Table 3: Data Collection Matrix
1. Will give qualitative data to include opinions on literacy and understanding, student self-evaluations and teaching methods
2. Will give student opinions on specific questions regarding literacy
3. Data will provide a baseline of student literacy (prior to treatment)
4. Data will show progress during the treatment
5. Data will provide qualitative value of the treatments
6. Data will show literacy and comprehension posttreatment

The pre-assessment and pre-treatment survey were administered on the same day in early October. We had not yet been through any treatment weeks and the non-treatment schedule (as in the table above) was the norm as we settled in to the school year. The lunch time interview occurred a couple weeks after that first survey was completed. We had begun treatment and I wanted to get a better understanding of how students felt about reading and how it is relative to both their schoolwork and their lives in general. The post-assessment and post treatment survey were given in mid-December.
to gauge any changes in reading comprehension and any change in attitude towards reading. I was hoping to see more evidence of understanding, and in a few students, this was the case. As the year progressed though, I began to see that reading in the middle and high school is truly an issue of student attitude and it is that which needs to be overcome before any real improvement or development can occur.

When I found the reading assessments I wanted to use, I sent them to our English teacher and Special Education teacher as they became reliable sounding boards for the validity of my instruments. It was important that the readings be science related and the questions cover not just content but also require students to think about what they read and how to apply the information. The survey questions were developed before the AR project began. Several of my peers worked with me as I created questions that dealt with student attitude towards their own learning. Both instruments gave reliable answers and insight on my students before, during and after the AR project.

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. See Appendix F for IRB exemption.

DATA ANALYSIS

As the only science teacher at my school, I have six different science classes each day. My middle school classes consist of six 7th graders and ten 8th graders. Of these students, ten are male and six are female. The high school classes consist of six 9th graders in Physical Science, five 10th graders in Biology, eight Physics students (six are 12th grade and two are 11th), and three Anatomy and Physiology students (1 junior and 2
seniors). One of the seniors takes two classes so her information is only entered once. At the high school level 14 students are male and seven students are female.

The first treatment item I used to gather information was an online survey given pretreatment at the beginning of October. I created it using a free survey site so students could access it using their Chromebooks and the internet which is available in the classroom. Nashua K12 schools is a one to one school, every student is issued a Chromebook for use both at school and at home if internet is available. The attitude survey contained 10 questions which were a mixture of Likert items, multiple answer responses and open-ended questions.

As I teach both middle and high school students, I felt it would be good to see a comparison sample of the survey questions. The following four questions were intended for me to gain an understanding on what my students think about school, how often they read on their own, if they are reading their science assignments and if there are any problems with reading their textbooks. This is my first year working with this group of students, and except for the seniors, I will be working with them each year they take a science class.

The survey question asking students if they read any books in the first couple weeks of school covers all three sub questions regarding literacy and student attitude. And while the graph and the evidence from the survey point towards students being unwilling or not wanting to read, I have worked with them long enough to know that many of them are reading, they simply do not realize they are doing it. It may not be in the form of a novel but most of the students do an active amount of reading each day. My
part now as their teacher is to help them realize how much they are reading and ways to increase it to benefit their lives and increase their overall literacy.

The assigned reading question and the text comprehension question I intentionally put back to back so students were thinking about their science book and how much they access it on their own. While opinion based, (and I’m hoping honest as well), the question had students do a self-evaluation without realizing it. These questions would also return in future surveys as a reminder that reading assignments are given for a reason. I expect my students to be able to be responsible with their reading and it is a habit that is undergoing development. As a new teacher, it is crucial for me to know if there are problems with the text material. If I notice trends from the text content, such as many in the class not understanding a topic of discussion, it is up to me to be able to break that information down for them into pieces that are relevant and reasonable.

Survey Question 1: How much do you like school most days (scale of 1-5 with 1 as least and 5 as most)

![Bar chart showing survey results for high school and middle school students.](image)

*Figure 1.* How well do you like school most days, (N= 36).
A slight majority of students (36%) in both age groups fall in the middle of the graph as expected. The middle school graph reads with a median average of 3.0 and a mode of 3 as well. The high school student graph reads with a median average of 2.9 and the mode rests somewhere near 2.5. I found this information interesting to me, as I expected my upper level high school students (juniors and seniors) to answer more favorable with their attitude towards school. The same number of students (27%) either really like school, or not so much.

Survey Question #3: How many books have you read since the beginning of the school year?

![Pie chart showing book reading habits]

Figure 2. Number of books read from August to October, (N=36).

Twelve middle school students and 15 high school students confessed to reading two or fewer books since the school year started. Last year as my research topic began to take shape, I was helping a science teacher at a larger high school in Montana. I noticed an alarming apathy towards reading in general from high school students. Now at a much smaller school, teaching 36 students grades seven through twelve, I thought perhaps the negative attitude towards reading would not be as prevalent. As they say, the numbers do
not lie. As treatment cycles progressed and students had to read and analyze text more closely, it was a struggle at times to engage students in active reading, even when it was required.

Of the students surveyed, it was my observation that two of my 36 students regularly came to class with a library book. Their books became an enjoyable topic of discussion as many of the books they read are ones that I have also enjoyed reading. I asked one of the students (an 11th grader) if he thought his prolific reading helped him in school, particularly in Anatomy, which is the science class he was taking. He said, “I think it helps me more in English class but I do understand the text and work in science so maybe it does help some. There is just more new vocabulary than I’m used to.”

Survey Question #9: How often do you read the chapter of science assigned by your teacher?

Table 3
Assigned Reading in Science

<table>
<thead>
<tr>
<th>Category</th>
<th>Middle School (N=16)</th>
<th>High School (N=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>6.25%</td>
<td>18.75%</td>
</tr>
<tr>
<td>I skim as I do the notes but don’t read the chapter completely</td>
<td>12.5%</td>
<td>31.25%</td>
</tr>
<tr>
<td>Read chapter only as I do the notes</td>
<td>62.5%</td>
<td>50%</td>
</tr>
<tr>
<td>Read chapter more than once</td>
<td>18.75%</td>
<td>18.75%</td>
</tr>
<tr>
<td>Other</td>
<td>0%</td>
<td>6.25%</td>
</tr>
</tbody>
</table>

Four of the six classes I teach have guided notes for each unit that requires the students to go through the chapter for vocabulary, critical thinking questions,
summarizing information and graphs or equations as needed. The only classes that do not have these notes are Physics and Anatomy, which are my upper classes of 11th and 12th graders. They are required to read and take notes on each section prior to discussing it in class. The majority of these upper classmen fall into the ‘never’ or ‘skim only’ categories (6/8 that answered within those 2 categories are upper classmen). That attitude is one I covered with them throughout the year as their lack of effort became evident during discussions, homework assignments and inquiry labs.

Most middle school students fall into the category I expected, which is for them to read the chapter as they do the notes. In working with these students for the past few year, I began to learn their work habits and can honestly say that seemed to be the case. The few students that said they either do not read the chapter or simply skim it are also the ones that are very consistent with unfinished or ‘lost’ notes on a regular basis.

Survey Question #10: How would you describe the text in your science book?

Table 4
Assessment of Science Texts

<table>
<thead>
<tr>
<th>Category</th>
<th>Middle School (N=16)</th>
<th>High School (N=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too hard for me to understand</td>
<td>2 (12.5%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Sometimes difficult to understand but I do ok with reading</td>
<td>4 (25%)</td>
<td>7 (43.75%)</td>
</tr>
<tr>
<td>Neither difficult nor easy to read</td>
<td>2 (12.5%)</td>
<td>6 (37.5%)</td>
</tr>
<tr>
<td>Sometimes easy to read with little difficulty to understand</td>
<td>6 (37.5%)</td>
<td>5 (31.25%)</td>
</tr>
<tr>
<td>Very easy to read and understand</td>
<td>2 (12.5%)</td>
<td>2 (12.5%)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>2 (12.5%)</td>
</tr>
</tbody>
</table>
Academic reading and an emphasis on academic vocabulary are two focal points during my treatment cycles for my students, especially at the high school level. I have introduced college texts to juniors and seniors to show them exactly what college books look like for entry level classes. Many were surprised with ‘all the words’ and the complexity of the language and graphics in the text books. The Physics students especially struggled with the new text this year as it required them to read on a level many are unused to. For the past 3-4 years, the core subjects of math, science and English have not been as demanding as they were this past year with a change in school administration and the hiring of qualified teachers. The school also did not have any pre-requisites for Physics (mainly a minimal C average passing grade in Algebra II and Chemistry) and students were unaware and unprepared of the depth of math required for the class.

With the middle school students, I expected the responses to be all over as these students are spread over the reading spectrum, five of them receiving services for reading. Reading was practiced in class and expected outside of class. Information was summarized and often students had put it into their own words which was a new concept for many of them. As I will work the longest with these students over the next five or six years, I look forward to seeing (and helping) their literacy levels increase so that by the time they are nearing 12th grade, the college texts will not be a surprise or a burden. The ‘other’ category had two students providing the following statements: “Pretty easy to read but boring” and “easy to read but hard to understand some parts of it”. While these could
have fit within the confines of one of the given choices, I opted to keep them as given outliers for this study.

The attitude survey questions served several purposes with regards to my AR project. The students gave their opinion of school, how much they like it, based on a scale of one to five, with one being the lowest rating and five being the highest rating. By self-evaluating their attitude towards school, students set a tone or perception per their own point of view. This point of view may or may not be an everyday reality. During any week, I could ask this same question to the students and get different answers each time.

The literature pre- and post-assessment was administered to all students based upon their grade level. The site used had several science related articles per grade level broken down by Lexile reading level numbers. As my main AR question is based on improving science understanding through literacy, I chose reading articles for my students based on their level as a class or individually. For my students that receive services, the Special Education teacher advised me to go ahead and give the students the same tests as their classmates.

The reading assessments for each level followed basically the same format: an article to read followed by a series of seven multiple choice questions and three short answer essay questions. As the new kid in the room, I had no idea what the reading levels for the students truly were nor did I know their depth of prior knowledge on any subject. I chose the articles by what looked interesting, each grade increasing in Lexile scores. When it came time to choose the post-treatment assessments, I did my best to keep the Lexile scores are close to the pre-test as possible.
Table 5
7th Grade Reading Assessment (Possible 10 Points)

<table>
<thead>
<tr>
<th>7th Grade Students</th>
<th>Pretreatment MC Scores</th>
<th>Pretreatment Essay Scores</th>
<th>Posttreatment MC Scores</th>
<th>Posttreatment Essay Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6/7</td>
<td>3/3</td>
<td>5/7</td>
<td>3/3</td>
</tr>
<tr>
<td>2</td>
<td>2/7</td>
<td>2/3</td>
<td>5/7</td>
<td>1/3</td>
</tr>
<tr>
<td>3*</td>
<td>5/7</td>
<td>0/3</td>
<td>1/7</td>
<td>0/3</td>
</tr>
<tr>
<td>4*</td>
<td>6/7</td>
<td>0/3**</td>
<td>3/7</td>
<td>2/3</td>
</tr>
<tr>
<td>5</td>
<td>7/7</td>
<td>2/3</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4/7</td>
<td>2/3</td>
<td>***</td>
<td></td>
</tr>
</tbody>
</table>

* Denotes student on an IEP
** Student did not answer the essay questions
*** Student was not available to take the post-treatment assessment

My 7th grade class consists of six students, two of which are on IEP’s and receive services for reading. Student 3 reads well in class but has a very difficult time understanding what she reads. Often, we go over information several times one on one to help her connect the dots of what she read to her assignments. What frustrates me with this student is she identifies the need to practice both vocabulary and reading as it will help her with her school work; she just does not like to read on her own. Student 4 reads on an early elementary level and his written communication skills are the same. However, his oral skills and understanding of topics is on par with the whole class. His mother and I discussed his progress at several meetings this year and when I told her that he was much more intelligent than I was led to believe, she thanked me as most of his past teachers did not hold him accountable for work due to his learning disabilities. His
reading and writing skills have improved this year, even though the assessment scores do not show that progression.

Table 6

<table>
<thead>
<tr>
<th>8th Grade Students</th>
<th>Pretreatment MC Scores</th>
<th>Pretreatment Essay Scores</th>
<th>Posttreatment MC Scores</th>
<th>Posttreatment Essay Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6/7</td>
<td>0/3**</td>
<td>6/7</td>
<td>3/3</td>
</tr>
<tr>
<td>2*</td>
<td>3/7</td>
<td>0/3**</td>
<td>5/7</td>
<td>0/3**</td>
</tr>
<tr>
<td>3*</td>
<td>3/7</td>
<td>0/3**</td>
<td>3/7</td>
<td>2/3**</td>
</tr>
<tr>
<td>4*</td>
<td>2/7</td>
<td>2/3</td>
<td>5/7</td>
<td>2/3</td>
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<tr>
<td>5</td>
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<td>3/3</td>
<td>5/7</td>
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<tr>
<td>6</td>
<td>3/7</td>
<td>1/3</td>
<td>4/7</td>
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<td>3/3</td>
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<tr>
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<td>3/3</td>
<td>5/7</td>
<td>2/3</td>
</tr>
<tr>
<td>9</td>
<td>6/7</td>
<td>2/3</td>
<td>5/7</td>
<td>1/3**</td>
</tr>
<tr>
<td>10</td>
<td>5/7</td>
<td>2/3</td>
<td>7/7</td>
<td>3/3</td>
</tr>
</tbody>
</table>

* Denotes student on an IEP

** Student did not answer the essay questions

The 8th grade students received their pre-treatment assessment on the same day they completed their first survey. I did write in my teaching journal after the class ended and observed that it took nearly half the class period for the students to settle down long enough to complete the task and next time, do not do one of these on a Monday! Several students complained during the computer survey and the written assessment. That day
there was also an issue with students logging on to the internet (forgotten passwords). Do any of these factors account for some of the above scores? Absolutely! The unanswered essay questions in the 8\textsuperscript{th} grade class may be attributed to rushing through without checking the back of the packet. Considering the students in question, this was a very reasonable answer as it was a pattern I saw often during the school year.

Eighth grade student 2 is currently on an IEP and receives extra instruction for reading. He has been diagnosed with dyslexia and struggles to read words but learns what they mean very well. He has an older sister (Grade 12, student 5) that also has been diagnosed with dyslexia. She will be attending community college in the fall which is a great success for her (and we hope a role model for her younger brother). Grade 12 student 3 is also a sibling who happens to read very well with satisfactory comprehension. It has been interesting to me as their teacher to learn how the family dynamics plays a part in their attitude towards learning, their proficiency in reading and their work ethic when it comes to school.

Table 7
\textit{High School Pre-Treatment Assessment (Possible 10 Points)}

<table>
<thead>
<tr>
<th>Student #</th>
<th>Grade 9</th>
<th></th>
<th>Grade 10</th>
<th></th>
<th>Grade 11</th>
<th></th>
<th>Grade 12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC</td>
<td>EQ</td>
<td>MC</td>
<td>EQ</td>
<td>MC</td>
<td>EQ</td>
<td>MC</td>
</tr>
<tr>
<td>1</td>
<td>6/7</td>
<td>3/3</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
</tr>
<tr>
<td>2</td>
<td>1/7*</td>
<td>1/3*</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
<td>1/3</td>
<td>7/7</td>
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<tr>
<td>3</td>
<td>6/7</td>
<td>3/3</td>
<td>5/7</td>
<td>2/3</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
</tr>
<tr>
<td>4</td>
<td>5/7</td>
<td>1/3</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
<td>3/3</td>
<td>7/7</td>
</tr>
<tr>
<td>5</td>
<td>5/7*</td>
<td>2/3*</td>
<td>6/7</td>
<td>3/3</td>
<td>5/7*</td>
<td>1/3*</td>
<td></td>
</tr>
<tr>
<td>Student #</td>
<td>9 MC</td>
<td>9 EQ</td>
<td>10 MC</td>
<td>10 EQ</td>
<td>11 MC</td>
<td>11 EQ</td>
<td>12 MC</td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5/7*</td>
<td>3/3*</td>
<td></td>
<td></td>
<td>7/7</td>
<td>3/3</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7/7</td>
<td>3/3</td>
<td></td>
</tr>
<tr>
<td>8</td>
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<td></td>
</tr>
</tbody>
</table>

* Student receives services for reading (IEP, 504)

Table 8

**High School Post-Treatment Assessment (Possible 10 Points)**

<table>
<thead>
<tr>
<th>Student #</th>
<th>Grade 9</th>
<th>Grade 10</th>
<th>Grade 11</th>
<th>Grade 12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MC</td>
<td>EQ</td>
<td>MC</td>
<td>EQ</td>
</tr>
<tr>
<td>1</td>
<td>4/7</td>
<td>3/3</td>
<td>5/7</td>
<td>3/3</td>
</tr>
<tr>
<td>2</td>
<td>2/7*</td>
<td>1/3*</td>
<td>7/7</td>
<td>3/3</td>
</tr>
<tr>
<td>3</td>
<td>7/7</td>
<td>3/3</td>
<td>5/7</td>
<td>3/3</td>
</tr>
<tr>
<td>4</td>
<td>3/7</td>
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<td>3/7*</td>
<td>2/3*</td>
<td>4/7</td>
<td>3/3</td>
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<tr>
<td>6</td>
<td>***</td>
<td>***</td>
<td>7/7</td>
<td>3/3</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>7/7</td>
<td>1/3**</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* Denotes a student on IEP
** Student did not answer one or more of the essay questions
*** Student was not available to take the post assessment

In the 9th grade, student 2 normally goes to the resource room to have his tests read to him. Discussing the dynamics of the research, the assessments and what I was hoping to get out of it, the Special Ed teacher felt he would be fine to stay in class and
complete the test himself. I had my doubts and after looking at his scores, I feel like he may have scored better if the article had been read to him. His vocabulary sight word level is currently around a 5th grade level. This student also is given extra time to complete homework assignments as needed. He does need to be reminded to turn things in and one of his best excuses is leaving work at home. Again, attitude towards the importance of learning.

The high school students performed well overall on the pre-treatment assessment. Looking back through the journal, I do not see any behavior issues when administering the tests either. Having worked with these students for a little over a month before the test, I feel like this was an adequate representation of their abilities. The issues with these students lies not with the normal everyday type of language but a comprehension of more scientific language and graphics. As mentioned before, the upper classmen also tend to take the easy route to accomplish their assignments when it comes to reading their texts.

The post-treatment assessment tests were given near the beginning of the Christmas holidays. The students had completed several chapters and different units, coursing their way through topics they had some or nearly no knowledge of before we progressed through them. My hope for the post-assessment was that 1) all the questions would be answered 2) the students would take this assessment seriously and 3) a definite change or show of improvement would be evident from the test scores. Near success with the first goal, the only exception was one of my best senior students just did not finish answering the essay questions. I feel the students did take this post-test more seriously than the pre-test and the differences in scores may attribute to that attitude change.
I had a difficult time finding the literacy tests. I wanted to use something that would have the students read and answer questions for a pretest baseline assessment as well as for a post treatment assessment with my students. Not every grade in the middle and high school has standardized testing, which was going to be my first choice. However, I feel that these simple literacy tests provided me with needed data on individual improvement throughout the year.

After a round of treatment, I asked several students to come to my classroom during lunch to participate in a group discussion that would be recorded. The survey group was random, they came to my room if they wanted too (sample of convenience). There was a good mixture of students from each grade level. The interview itself took about 15 minutes to complete. At first, the students were not very forthcoming with their thoughts, opinions or answers in general to the questions I asked. I felt like I had to feed or lead them into narrower paths to get answers.

Most students agreed that reading is an important aspect of their lives though why it is important was less understood. Reading during elementary school seemed to be more fun and exciting than it is now as a middle/high school student. When asked why, one student answered because it was new, something they had not done before. The students also stated they had more time when they were younger to read for fun. As my research centers on reading for science comprehension, I asked students to connect reading to understanding science. The few students that answered revealed that a larger vocabulary gained through reading can help with all their classes, science included.
Students were then asked what steps they could take to increase how much they read outside of school each day. Several good ideas were brought forward. One of my 7th graders said, “have a book on you throughout the day so if free time came up, you can read a little bit.” Another student (a 9th grader) said, “in the evenings, set an alarm for 20 minutes as a time set aside specifically for reading.” I asked my seniors that participated in the interview ways in which they could improve their textbook reading. One of them answered it may be better to read smaller portions more often and to re-read the text more than once to better understand what was being said.

After many weeks of treatment and non-treatment, the students were given another survey and reading assessment. The survey this time was on paper and consisted of 15 Likert style questions with three questions asking students to give more information explaining why they felt that way (See Appendix C). In the table in Appendix C, I chose to give the class average for each question. The post-treatment assessments were from the same website and corresponded again with student grade levels. As before, students had to read an article and answer a series of seven multiple choice questions and three essay type questions.

The post treatment survey was a collection of questions scaled from 1-10 with 1 being the least important and 10 being the most important or strongest feeling. The questions asked students their opinions on reading, how important they feel it is in their lives, their comfort levels in reading different types of text and their thoughts on some of the instruments used during the project. I think a couple of answers from one of my 8th grade students summed up the whole point of this project. When asked how important
reading is overall, his opinion was a 5/10 and his explanation was “because I do not like reading.” And yet another question asks if students feel they need to improve their reading skills as they go through middle/high school. He gave the question an answer of 9/10, recognizing that he needs improvement again “because he doesn’t like to read.”

My first sub question dealt with the types of literature read and their effect on science literacy. In my pre-assessment survey, students were asked to provide their thoughts on their science textbook as well as give me an idea of what they like to read for enjoyment (see Table 4 and Appendix B). I had already planned on finding science articles outside of the text to use and was going to use the information to cater student preferences. After the survey, it was apparent that most students have no preference except to not read. It was then that I decided to use both magazine articles and online news articles for students to read and apply to real life situations. They enjoyed these articles and I will be utilizing this type of instrument more next year. Did the types of articles read effect their comprehension of science? To some degree, I think it did. We tended to discuss the articles deeper and the students connected the information to their own lives.

The parent interviews were disappointing as I only had two parents respond to the survey, after many repeated attempts. Of the two parents that responded, both had students in 7th grade. It was interesting in that my best performer and one of my students that struggles with reading had parents respond (see Table 5 above, students 1 and 2). Both parents felt reading is an important skill for their students to learn but that to this
point, neither of their students has developed a habit of reading for enjoyment. One parent felt that while her student was taught to read, she was not taught to love reading.

The impact of this project for me was great. It helped me not only get to know my students better, but as their science teacher I learned how they felt about learning in general as well as their feelings towards science. My more mature students understand the importance of reading, school work and the real world while my middle school students do not yet see the correlation between attitude and aptitude and applying them to succeeding both in the classroom and out of it.

One of the more difficult tasks for me was to prepare five days of lessons to give in four days for six different science classes and on top of that include my treatments, observations, interviews and journal writings. As my own family stayed behind in our home town, I spent much of my ‘off’ time in my classroom researching and preparing the lessons, putting in full work days on Friday even though there is no school as well as staying late many nights. The amount of preparation time surprised me, though it began to ease as the year progressed.

The results of the project and really of the whole school year have changed how I will approach next school year. I feel my students need to write more, practice their communication skills more in science, as well as continue to read and develop a deeper understanding of the world around them through science. I was able to cover nearly all the units I wanted to at the beginning of the year which was also a bit of a surprise. I often felt like I was falling behind.
I admit when I picked this topic to study it was not only because I recognized a particular problem within the mindset of young people in school, but really because I love to read. I have had a wonderful relationship with the written word since the age of four when I discovered Dr. Seuss. Reading is the one area I was encouraged to pursue at a young age by my teachers (it kept me from talking to other students)! Growing up I had friends who did not read for fun like I did and I did not understand why. As an adult, and more specifically as a parent and an educator, I know just how important it is for students to continually develop a habit of reading throughout their teens. I still have a difficult time understanding why people do not actively read for pleasure, and so I work with reluctant readers in my science classroom.

If students increase their own reading, does it positively affect their understanding in science? I believe it does but I also know that attitude plays a key role in the development of that skill in middle and high school students. At the beginning of the project which was roughly six weeks in to the school year, 28% of my students admitted to reading three or more books since the school year had started (see Fig 2), which left 72% having read two or fewer books. Reading outside of school is based on attitude whether positive or negative, it is a choice. I spoke to one of my colleagues about the overall reading habits of the students in the middle school and high school and she was very open to say that student attitude towards reading at our school is a direct result of how they were taught to read in elementary school, and a lack of emphasis on reading for enjoyment. Reading skills were taught and mastered for testing purposes, not necessarily
for building the habit of reading and how it can encompass self-esteem issues and create a positive overall attitude towards learning and education by the students.

In response to my first sub-question, does it matter the types of materials students read on a regular basis? How can reading fiction or comic books help students understand electricity or genetics? Yes, I think it is important that students read both in and out of class. Reading that interests and captivates a mind and the imagination is just as important as reading for knowledge as both builds vocabulary and needed literacy skills. In this project, I exposed students to different types of science reading material to help them not only learn subject material but to engage them in critical thinking by tying in what they were learning in the classroom to the outside world around them.

An example of this was right before Christmas break, my middle and high school students spent their class time reading to elementary students. My classes chose books from a wide variety available from our school library and then spent roughly 40 minutes reading to different students. What really surprised me was not only how much my most reluctant readers enjoyed this exercise but also the reciprocal reading that occurred as new readers thought it would be fun to read to the big kids! It was a lesson that was brought up by the students long afterward.

In my second sub-question, I asked if increased reading impacts student learning. When this project started, we were roughly six weeks in to the school year. I picked up on student habits fairly quickly. I noticed I had two students that came to class regularly with a reading book from the library. Two students out of nearly forty. I knew I had my work cut out for me to get my students to not only read, but read independently. I made
note several times throughout the project that students complained when they were asked to read (significantly higher in the 7th and 8th grade classes). As we worked through the information, focused on vocabulary and reinforced learning through discussion and worksheets, students’ homework, quiz and test scores improved. More importantly, their understanding of the topic and how it relates to their lives improved as they increased their work levels and understanding of what it was they were reading.

When the students took the pre-assessment, I had no idea what the results were going to look like. I knew I had students that struggled to read everyday words and I had students that struggled with pulling ideas out of passages. In the middle school, the multiple-choice scores overall were promising. My students that receive reading services fell within a range of 28% to 85% and to be honest, that is the where all the students fell. Only two in the middle school received full marks on the multiple-choice questions and even better to me, no one scores less than 28% (which was two of seven).

In the post-assessment for the middle school, five students improved their scores in the multiple-choice section; three students had scores that stayed the same and six students had scores that decreased overall. The essay portions show a deeper development though as more students completed the essay questions the second time around. In both the pre-and post-assessment essay questions, ten students scored either full marks or missed one question. The improvements I noticed were the students who scored zero or one on the pre-assessment that then improved on the post-assessment: four students. One of my 7th graders reads and writes at an early elementary level and so to have this student correctly write answers to questions from an article he had to read was
great progress! I know this is something consistently being worked on both in school and at home is his confidence in his ability to do it.

For my high school students, the pre-and post-assessment literacy tests helped me to see where my students sit in their reading comprehension in science. Do they understand what they are reading and can they pull information from the text to answer questions? Overwhelmingly I would say yes, my high school students are more confident and proficient readers based upon their test scores. I did notice that the essay questions on the post-assessment improved while the multiple-choice answers declined. I do not know if this was due to content or some other reason (it was the day before Christmas break).

In response to the third sub question regarding student attitude towards reading goals and learning, I learned this is the biggest obstacle I have in my classroom for this project. After the end the first grading period, I had my students do to self-evaluation to see what they honestly thought of the effort they were putting forth in their studies. We were doing a lot of reading in class and students were giving a fair amount of effort in class. Outside of class however, was a different story, especially in the middle school. I wanted them to evaluate themselves. My middle school students (100%) stated that they felt they earned the grade they received (good or bad) because of the work they had done. They also wrote down that the importance of reading and understanding what they read is helpful to them on their homework and in the classroom.

**Teaching Practice**

Though the data may not show this research as successful in terms of black and white results, (see Tables 5-8) I gained a lot of valuable data and insight on my students:
how they learn, their attitudes towards learning and the layers of resistance that we have to overcome to get down to the soft, squishy center of a teenager’s brain. That part still likes to learn, to read, to use the imagination and really wonder how this world works. It is my job as an educator to reach that center and draw it out as often and in as many ways as possible.

I learned that reading is hard for a few teens, it truly is and that is heartbreaking (see Table 7). And in these same kids, I see sparks of learning through hands-on activities, group work, verbalizing, and active memory recall. I find myself encouraging students who constantly beat themselves up because they do not read well or struggle with understanding what they just read. Nobody calls themselves ‘dumb’ or ‘stupid’ in my classroom, or anybody else for that matter, and gets away with it. Group mentality in a classroom can be helpful or harmful at any given time. Depending on the day or even the time of day, we can all be cheering each other on or I spend half the period putting out fires started by poor choices of words or actions.

Some of this negative attitude was evident of the pre- and post-assessment and surveys. One student (8th grade student 3 on the assessments) said “I don’t like to read waste of time”. This same student is on an IEP, receives services for reading but is a capable and bright young man. He also comes from a broken home and has spent much of this year bouncing back and forth between parents, at times had nowhere to go for the night and this chaotic climate was reflected in his attitude, behavior and work at school.

I have learned that students who like science enjoy being around students who like science. When asked their favorite subject in the pre-treatment survey, only 11%
expressed that science was their favorite subject (see Appendix B). During my observations, when the students were engaged in their activities and having fun while learning, the classroom atmosphere was positive. Students asked each other questions, made discoveries through teamwork and came up with conclusions based on their own data collections. Sometimes this was in the lab and other times it was through a tabletop activity they worked on in groups.

I have seen classes become contagious with interest when we spark on some sidetrack of learning that might be out in left field, but I am not about to stop this train! When my senior high physics students wanted to learn more about ice pack and climate change, even though it had nothing to do with what we were discussing in class, I went for it. We used the interactive white board and pulled up real data on the internet, read live blogs by scientists in the arctic and learned how the lengthening crack in the Larsen Shelf in Antarctica is a cause for concern here in Montana. They never studied climate change before and had no idea why the smallest ice pack year on record was a problem! In the post assessment survey, my upper level high school students understood the importance of reading current news articles and how that allows them to understand world events (see Appendix C).

I have learned that reading is still valued by parents, even if it is not practiced at home. I talk to many of my student’s parents almost daily. They pop in or email, checking up to see how their son or daughter is doing, how I am doing, if they can do anything to help. I often say, “You know, I would really like to know what they read. Do you know what they read?” The answer is most often, they do not read. Of all my
students that receive services for reading, I have exactly one student that is required to read each night at home for practice. “But don’t you want them to be better readers,” I ask? Oh yes, every parent wants their student to exceed and do well but the practice is not often evident.

In the post assessment survey, students gave an honest evaluation of how they value reading (see Appendix C). The insight shows how students relate their reading skills and their future. I plan on keeping the surveys, adding new ones in the fall and showing the results to parents early in the new school year. My advice to the parents may be that we need to work together to change the attitude of students towards reading. Parents need to encourage their students to read and possibly become more involved in this aspect of their student’s life. Reading skills are learned so early, I feel many parents (at least the ones I have spoken with) are unaware of how reading is viewed and why it should still be a daily practice by their teenage student.

I have learned that next year we will continue to read. We will continue to break down heavy text, pull out important passages and learn what words mean in and out of context. We will continue to hone our skills of note taking, highlighting and summarizing. Students will begin to master the art of working together towards a common goal. Writing and research will be practiced and practiced until it becomes second nature. Science journal drawings will begin to take shape (and color!) as the year progresses. Middle school integrated science will merge as one and Chemistry lab write-ups will prevail!
As the data suggests in Table 4, only 5% of my students this year found their textbook to be too difficult to read. The material overall is not the issue. It will be my job as their teacher to get them interested in reading about science, involved in what is happening in the world around them through reading and enabling them to discover topics and issues that interest them now. In the post assessment, I asked students if they felt reading outside of class helped them to be successful in class. An overall average showed just above 50% understood that reading can lead to success.

VALUE

I chose to study literacy in science because I feel so strongly that students cannot fully comprehend the material in a 21st century classroom without having a comprehensive reading and writing background. As a forty-something adult, I can honestly say that the reading and writing skills I built in school have served me very well in my adult life. I simply wish there was a way I could convey this to my students and have them take it to heart. Of my 36 students, I have five with true learning disabilities and struggle with reading. The others struggle simply because they do not practice, and that is according to the students, their parents, other faculty and my own observations.

Building a strong academic vocabulary and being able to communicate effectively through writing are essential tools students need to cultivate while in school. The initial attitude survey asked students how many books they had read between August and October and 75% of students had responded with two or fewer. However, these same students willingly admit to spending large amounts of time on social media and playing video games that require them to read. Overall, the problem may not be the amount of
text students read on a regular basis, but more of what they are reading on a regular basis. How do we, as educators, enlighten our students to read more challenging material that will build their literacy skills and lead to a better understanding of subjects like science?

This is my first year teaching full time and I look forward to working with these students throughout their secondary education. As the only science teacher in the school, I have the privilege to lead and guide these students academically for the next four to six years. Building foundational literacy skills by reading science related material, researching topics, and learning to write and communicate findings are all ways I want to enhance their experience in my classroom. I am beginning to understand these tasks will take years for students to conquer as language skills like strong reading and writing continue to be built in core classes.

As I said before, I have the opportunity to work with the same students every year until they graduate. From this study, I would like to continue improving student academic language and communication skills in science. I am already planning next year and want to incorporate some type of science notebook that students will write in on a daily basis. The differences in maturity levels between middle school and high school is significant and next year I want to try something different with my middle school classes to help them understand the unit topics. I do not know if this will be using some type of flip chart note taking system or a more structured science notebook.

My students will participate in reading current science events through a Scholastic magazine for their age group. I feel it is important they become knowledgeable in the larger world as we are in an isolated area. This resource will also help strengthen their
reading and reasoning skills as well as relating science to their lives. Both surveys showed student attitude towards reading and their feelings on how it impacts their lives. By continuing to read different materials I hope it will spark student interest in reading for knowledge as well as enjoyment.

A colleague of mine with over 40 years’ experience in the written word as both a published author, professor and high school English teacher has one motto for his students that he shared with me, “students who are not afraid to tackle anything will eventually conquer it.” With each passing year, may I be cheerleader and a guide to students as they conquer science!
REFERENCES CITED


APPENDIX A
TREATMENT SCHEDULE
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APPENDIX B
PRE-TREATMENT SURVEY
Survey #1

How much do you like school on most days? (1 is least and 5 is most)

1 2 3 4 5

What is your name, your favorite subject in school? Why is this your favorite?

How many books have you read since the beginning of the school year?

- None
- Less than 2 books
- 3-5 books
- More than 5 books
- Other

What types of materials do you enjoy reading?

- Fiction Books
- Non Fiction Books
- Magazines
- Newspapers
- Picture Books
Chapter books
Other

How often do you read books or other materials in an electronic format?

Never
Less than once a month
2-3 times a month
Once a week
More than once a week
Other

How do you read popular news articles?

Social media posts
Popular entertainment websites
Popular news outlet websites
Popular magazines
Newspapers
Other

How often do you discuss books or articles you read with your parent/guardian?

Rarely to never
Sometimes
Often
Always
Other
How often have your friends recommended books or magazine articles to you in the past 3 months?

- Never
- 1-2 times
- 3-5 times
- 6+ times
- Other

How often do you read the chapter of science assigned by your teacher? (be honest)

- Never
- I skim as I do the notes but don’t read it completely
- Read chapter only once as I do the notes
- Read chapter more than once
- Other

How would you describe the text in your science book?

- Too hard for me to understand
- Sometimes difficult to understand, but I do ok with reading
- Neither difficult nor easy to read
- Sometimes easy to read with little difficulty to understand
- Very easy to read and understand the information
- Other

This survey was created with SurveyNuts.com
APPENDIX C

POST TREATMENT SURVEY AND CLASS AVERAGES
NAME_____________________________________________________________

Answer the following questions, giving full explanations when asked.

The scale 1-10 is used: 1 is least important or least strongest feeling and 10 is the most important or most strongest feelings for that question.

1. In your opinion, how important is it for a person to read proficiently?

   1  2  3  4  5  6  7  8  9  10

   Explain why you feel this way___________________________________
   ___________________________________________________________________

2. Reading helps a person be successful in and out of school.

   1  2  3  4  5  6  7  8  9  10

3. Reading more in class helps me to understand the lessons

   1  2  3  4  5  6  7  8  9  10

4. Reading outside of class helps me to be successful in class

   1  2  3  4  5  6  7  8  9  10

5. It is important to read current news articles

   1  2  3  4  5  6  7  8  9  10

   Explain why you feel this way___________________________________
   ___________________________________________________________________

6. Reading current news articles helps me to understand the world around me

   1  2  3  4  5  6  7  8  9  10

7. I can tell the difference between real evidence-based science news and “Hollywood” science news

   1  2  3  4  5  6  7  8  9  10
8. I feel that my reading skills are proficient for my age/grade level
   1 2 3 4 5 6 7 8 9 10

9. I feel that I need to improve my reading skills as I go through middle/high school
   1 2 3 4 5 6 7 8 9 10
   Explain why you feel this way________________________________________
   ____________________________________________________________________

10. I feel comfortable reading academic books and texts
    1 2 3 4 5 6 7 8 9 10

11. I find the information in my science textbook interesting
    1 2 3 4 5 6 7 8 9 10

12. The reading guides or power points helped me with homework
    1 2 3 4 5 6 7 8 9 10

13. The reading guides or power points helped me with tests
    1 2 4 4 5 6 7 8 9 10

14. The vocabulary sheets (studying vocabulary) helped me with homework
    1 2 3 4 5 6 7 8 9 10

15. The vocabulary sheets (studying vocabulary) helped me with tests
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APPENDIX D

READING ASSESSMENT EXAMPLE
Discoveries: Mighty Mouse Bred

Cleveland—U.S. scientists have bred a "Lance Armstrong" mouse. It can't pedal a bike, but it can run on a treadmill for more than six hours before pooping out.

What accounts for the mouse's amazing endurance? For one thing, its muscle cells have 10 times the usual number of mitochondria, according to the scientists, who work at Case Western Reserve University. Mitochondria are the main energy sources in a cell.

The mouse also produces less lactic acid, a byproduct of metabolism that is released in large amounts during physical exercise. If too much lactic acid builds up in the body, the excess can lead to fatigue and a burning sensation in the muscles. The mighty mouse's body is very similar to that of champion cyclist Lance Armstrong, which produces energy without releasing too much lactic acid, keeping Armstrong from tuckering out.

When put through a grueling uphill treadmill test, the mouse ran for 32 minutes, compared with 19 for regular mice. To maintain that pace, the mouse eats 60 percent more food than other mice do yet weighs half as much.

The mighty rodent is called a PEPCK-Cmus mouse after a certain enzyme that is abundant in the mouse's body. An enzyme is a protein that speeds up a chemical reaction in the body.

The scientists have bred 500 PEPCK-Cmus mice, with more on the way. Female mice normally stop reproducing at 1 year of age. The PEPCK-Cmus females reproduce until they are 2½, the equivalent of an 80-year-old woman having a baby!
1. Which of the following does the body release during physical exercise?
A mitochondria  
B muscle cells  
C lactic acid  
D protein

2. Scientists have bred PEPCK-Cmus mice. All of the following are effects on the mice EXCEPT
A the mice eat more food, yet weigh less than other mice  
B the mice have fewer mitochondria than normal mice  
C the mice have a better than usual endurance  
D the mice can reproduce until they are 2½ years old

3. After reading the passage, what can you conclude about the PEPCK-Cmus mice?
A The PEPCK-Cmus mice will one day greatly outnumber regular mice.  
B All regular mice will soon be bred to become PEPCK-Cmus mice.  
C Scientists will study PEPCK-Cmus mice to learn more about exercise.  
D Many people will soon be able to buy PEPCK-Cmus mice as pets.

4. Read this sentence from the passage: “When put through a grueling uphill treadmill test, the mouse ran for 32 minutes, compared with 19 for regular mice.”
In this sentence, the word grueling means
A abnormally oversensitive  
B extremely demanding  
C relatively easy  
D similar in nature

5. Which statement best describes the central idea of this passage?
A U.S. scientists have bred a mouse with amazing endurance.  
B Mice normally get tired after taking an uphill treadmill test.  
C Scientists are trying to learn more about Lance Armstrong.  
D Too much lactic acid in the body can lead to sore muscles.
6. When do female mice normally stop reproducing?

7. Why might the writer have compared the new breed of mouse to Lance Armstrong? Please cite evidence from the text.

8. The question below is an incomplete sentence. Choose the word that best completes the sentence.
When put through an uphill treadmill test, the mighty mice ran 13 minutes longer ______ the regular mice.
A and
B than
C for
D but

9. Answer the following questions based on the sentence below.
U.S. scientists at Case Western Reserve University in Cleveland called the new type of mouse they bred PEPCK-Cmus after an enzyme that is abundant in the mouse’s body.
Who?
Where?
(did) What? called the new type of mouse they bred PEPCK-Cmus
Why?

10. Vocabulary Word: abundant: having plenty of something. Use the vocabulary word in a sentence:

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APPENDIX E
INTERVIEW QUESTIONS
1. How important is reading to you? Why do you say that?

2. Have you always felt reading wasn’t important?

3. Did you like reading more when you were younger? Why? What did it change?

4. It is recommended that people read 20 minutes a day. How do you feel about that?

5. What are the types of materials you like to read?

6. What is one way you could increase your reading every day? What is something you can do every day to read a little bit more? Do you have to read a book?

7. How many of you are on the internet, social media? Do you read when you are on the internet? How much?

8. How do you connect reading with understanding science? If you are not reading, how is that helping you in science?

9. Do you need to read more science in understand science?

10. How many of you are hoping to go to some sort of school after high school? What to do thing your reading level is going to have to be in order to be successful? Do you think your current reading skills and habits are enough for you to be successful after high school? If not, what can you do to change that?

11. How many of you play sports? How do you get better at sports? How do you get better at reading?
APPENDIX F

IRB EXEMPTION FORM
TO: Cindee Parker and Walter Woolbaugh  
FROM: Mark Quinn  
DATE: September 12, 2016  

RE: "The Effects of Increased Literacy Upon the Comprehension of Science in Middle and High School Age Students" [CP091216-EX]

The above research, described in your submission of September 12, 2016, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

( ) (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

X (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects financial standing, employability, or reputation.

( ) (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b) (2) of this section, if (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

( ) (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

( ) (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

( ) (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.