

LITERACY INSTRUCTION IN A MIDDLE SCHOOL SCIENCE CLASSROOM

by

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of the requirements for the degree

of

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in

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I wanted to thank my family, who have always supported my education in a myriad of ways, which not only allowed me to become the first in my family to graduate with an undergraduate degree, but now also allows me to be the first to earn a master's degree.

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ABSTRACT

I've noticed that students have been struggling to communicate what they know in science class. Having a large English Language Learners (ELL) population at my school, I had initially written this off as language acquisition or struggling with the science content knowledge. I came to realize that reading abilities were strongly impacting not only student's abilities to do well on assessments, but also to work independently in class. Our school uses a comprehensive online reading assessment called STAR reading. The test is administered multiple times a year to assess reading abilities and growth. By collecting this data, we know that the average reading level in the 8th grade was well below what would be considered functional for 8th grade. In fact, it is much closer to 4th grade reading level. Upon completing research on literacy instruction in science classrooms, I realized that students need to interact with text materials more in order to gain a better understanding of the content. I chose to focus on teaching student's strategies to interact with text more often to see if reading levels and science content knowledge would increase. After completing a STAR literacy test and science content pre assessment, I began a novel study, and small group instruction on close reading strategies. Students were taught close reading strategies that were evidence-based practices for ELL learners. Students immediately applied that close reading strategies to content aligned articles, while also reading a fictional novel aligned with our current science unit. Science content knowledge was assessed throughout the unit. When the unit was completed, a second STAR literacy test was administered. Statistically, the close reading instruction and novel study did increase reading scores. More students were also able to show mastery of science content knowledge by the end of the unit. Giving the students tools to use while reading, as well as more opportunities to read, does help both reading scores and science content knowledge grow.

CHAPTER ONE

INTRODUCTION & BACKGROUND

Context of the Study

The 2023 – 2024 school year was my eighth year at St James the Less Catholic School, which is located in Columbus, OH. I've taught science at the 7th and 8th grade level the entire eight years, and taught 6th grade for the first two years I have worked here. At the time of writing this paper, I was the team lead for the 6th – 8th grade teachers, and with eight years at St James, I am one of the most veteran teachers on staff. During the 2023 - 2024 school year, of the 457 students enrolled at St James the Less school, 12% of the students have either a service plan (IEP equivalent) or an academic support plan (504 equivalent). During the same school year, 49% of our student body were designated English Language Learners, or ELL. Finally, the entire school received free breakfast and lunch, and all students received an EdChoice scholarship to attend the private school.

The majority of my 7th and 8th grade students are native Spanish speakers, with a few being designated as English Language Learners, hereafter known as ELL. Teaching in this community for more than seven years, it has been common knowledge that the majority of our students read below or well below grade level. Although the low reading levels are not necessarily caused by being ELLs, there is correlation, as ELL students need stronger and longer supports in reading and writing instruction to master skills that non-ELL students achieve at the same grade level (Francis et al., 2006).

As a middle school science teacher, I have felt that there is not very much I could do to build reading skills and still teach grade level content. I have tried to build some reading supports into my daily class, working with my science textbook. Although science textbooks are advertised as being written at a reading level that matches the grade they are targeting, Groves (1995) states that the amount of new vocabulary in science textbooks is similar to the amount of recommended new vocabulary for learning another language at middle grade levels. Words often have double meanings, and the ability to convey what you know can be hampered when you aren't sure which word to use. In addition, many words for a content area can sound similar, like precipitation, condensation, and evaporation within the water cycle. So, even though most of my students who have learned English as a second language are considered proficient, as a Science teacher, I am now asking them to learn a third language.

During my time at this school, I have developed and improved my ability and strategies for vocabulary instruction. However, content knowledge improvement and reading skills have not seemed to grow. Although students do seem to retain the vocabulary, they cannot always apply it to different situations. I have also noticed that students often cannot show mastery over content because they do not understand what they are being asked to do. For example, on an assessment at the end of last school year, I asked students to explain how matter and energy move through an ecosystem. I had a student explain that the content "...mattered because energy is always reused." Although the student explained a scientific phenomenon correctly, they did not know or understand that I had used the scientific definition of "matter".

This type of mistake is common on my assessments, and based on my observations, has to do with low reading levels, in addition to the process of learning English as a second language.

In September of the 2023 - 2024 school year, 8th grade students took the STAR reading test, and of the 50 tested, seven students tested at or above grade level reading skills in English. Ten students tested at basic reading level skills, and 35 students tested at a limited reading level. Basic and limited levels within STAR testing recommend an intervention process with that student. Two students took the STAR test in Spanish, and read at or above grade level in Spanish. This means that even if my science textbooks are written at grade reading levels, the students are not able to read them proficiently. They would be reading at a frustration level at best, which has been defined as reading material that contains 93% or fewer known words (Gickling & Armstrong, 1978).

My intention with this research project is to be more direct with my reading supports within science class, including adding in sources of science content that is not from the science textbook, and is in fact not expository at all, but fictional. By adding in direct reading strategy instruction as well as science based fictional novels that match my content, my hope is to see growth not only in science content, but in reading levels as well. In other words, my plan is to introduce a novel study, as well as close reading instruction, into my science curriculum.

Implementing real text applications will benefit me, since students will be able to better understand the content and be better able to explain what they know. Students will benefit, because, as I say to them all the time, every test is a reading test. Although that sounds very school focused, I do not necessarily mean a paper and pencil test, but tests in life. For example:

work contracts, getting their driver's license, medical instructions, getting loans, etc. I believe this will benefit my school community as well. If this does prove to increase student reading scores, that should translate to all classes, not just science.

Finally, as I started my research, I noticed that most research on adding literacy instruction to science classrooms is focused on lower elementary grades, like kindergarten and first grade. This makes sense, since most foundational reading instruction happens at that grade level. However, as I stated earlier, ELL students need stronger and longer reading supports in order to match non-ELL peers in mastery of reading skills. I also think that a lot of apathy towards reading seen in middle schoolers is because they have grown to only associate reading with school work. Doing a novel study and introducing students to a novel that they may not otherwise read, might open their eyes to the world of reading for pleasure. By completing this study, I hope to add to the small amount of research on literacy in middle school science classrooms, which may show other middle school science teachers that we can teach reading skills and still cover science content in a deep and meaningful way.

Focus Statements and Questions

My focus question was How does a novel study, aligned with the science content, build science knowledge and literacy skills?

My sub question includes the following, which I think is important at an 8th grade level.:

1. To what extent does implementing real text application in my science classroom build comprehension skills?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

English Language Learners in a Science Classroom

English Language Learners, also known as ELL, are already learning a new language. Although there are tools to understand and support students in their language growth, most pre-service teachers have not been prepared for the amount of ELL students that are now found in American classrooms. We are a nation of immigrants, and it is necessary to support these learners to become the best that they can be.

In *Teaching Science to ELLs Part I* (Bautista & Castañeda, 2011) the authors discuss the fact that many education programs did not prepare the current teachers for the amount of students they would be teaching that are considered ELL. Teachers are taught to match lessons to state aligned standards, but have no idea that they need to be setting objectives that help students to develop their language skills as well. “Language objectives focus on the specific vocabulary, grammatical, rhetorical and discourse structures needed to learn the science content” (Bautista & Castañeda, 2011, p. 37).

There are a variety of strategies that are recommended for helping students with language acquisition, but one of the most important is for student interaction. “Through interaction, ELLs not only develop their scientific communication skills, but also clarify their understanding with classmates who are more proficient in English” (Bautista & Castañeda, 2011, p. 38). Another largely stressed strategy, that is left out of a lot of pre-service education programs, is knowing the English language proficiency of your students, and being able to match assessments and

lesson objectives to best fit our students' needs. ELL students' main barrier to mastering science content is the ability to be aware of their expectations, and the language levels to communicate what they know. In order to build the students ability to do this, teachers need to build accommodations into their lesson and assessment plans (Castañeda & Bautista, 2011).

Silva et al. (2013) explored the importance of interactions further by describing their own experiences with language acquisition in a science classroom. Emphasizing the differences between academic and everyday language, they were able to interest their students in developing their own vocabulary. The three teachers focused on not only frontloading vocabulary, but also revisiting vocabulary in context of scientific learning, and maintaining a word wall that students use regularly as a resource to help them "...express specific meanings or when confirming conventional spellings" (Silva et al., 2013, p. 36). The authors stress that this interaction between themselves and their students and the interaction between the students and the word wall, really helps the students to build their ability to show mastery over science content.

The authors go on to explain that students are regularly encouraged to explain what they have learned using several different styles of communication. Speaking, drawing diagrams, writing how to style narratives, or completing step-by-step explanations of what occurred during class or labs. This regular practice allows students to build necessary communication skills, as well as eventually showing mastery over the science content.

Literature in the Science Classroom

It was difficult to find resources aimed at introducing fictional resources into a science classroom that fit my students' age group. Most resources focus on the lower elementary grades, where students are still learning to read. By middle school, most students should have made the

flip from learning to read to reading to learn (Michie, 2023). Expository reading is difficult for any student, no matter the age, but grade level science materials for students who may already be below reading levels are going to be even more difficult.

Cook and Dinkins (2015) followed pre-service teachers who were able to find and integrate popular novels into their science classrooms. They did so by connecting them to concepts like ecosystems or the spread of pathogens. Although it isn't specifically stated in the paper, the pre-service teachers focused on building interactions between the students to increase content knowledge and build vocabulary. One student teacher in particular used the jigsaw method to allow students to share individual readings, so that all students could become experts in the topic. Another pre-service teacher had the students think-pair-share to create main idea or "gist" statements. While interacting with their peers, the activities that they were completing also allowed the students to interact with important vocabulary and build a better ability to explain content and their understanding of it.

Fang et al. (2008) took the time to train teachers to better implement literacy instruction in a science classroom. Although this paper seemed to focus on changing the way science teachers looked at including literacy in the classroom, it lays out a very good structure on how to include different readings within the science classroom. Again, although this wasn't really the intention, the teachers built interaction into the reading instruction. This time, students were taught a specific reading strategy in order to interact with the biographies they were reading. "...the goals of this project was thus to equip students with strategies they can use to help build comprehension of science texts." (Fang et al., 2008, p. 2072). This gave me another basis to help move forward with the research project, by giving students tools to interact in a deeper and more

meaningful way with what they were reading. The study focused on the second and third quarters of a school year, and so several different reading strategies were taught, but it was emphasized that each lesson lasted about 15 - 20 minutes.

Both Herried (2005) and Bradbury et al., (2022) again emphasize the importance of interaction, without explicitly intending too. In both papers, the students take the time to discuss the novels they were reading. Herried (2005) had the students discuss the legitimacy of Michael Crichton's scientific content. They had done independent research on topics covered in the book and compared the content of the novel to their own research. The students were a little older than the population of students were in the study, but this study shows how fictional novels can be connected explicitly to content. Bradbury et al. was an example of cross curricular novel studies, and although students were not just reading the novel in order to learn a science phenomenon better, they were able to discuss scientific topics using the examples found in the novel. The ability to converse about the different concepts in multiple classes allowed students to build a deeper understanding of things like polio, and specifically how human systems would be affected by it.

Das (2019) had a similar idea that sparked my idea for a capstone: how can we increase literacy levels and reading interest? Das chose a novel that was more scientific, a young readers version of *The Martian* by Andy Weir. The importance here is that the author taught the students reading strategies that help the students to interact with the text in a deeper way. The author used strategies that they stated were specific to the ELL students in her class, which could be used in regular content reading like from the textbook. Das set up the novel reading so that the book and reading instruction would happen alongside her Earth and Space science unit, which is a sensible

way for a science teacher, with little to no reading instruction training, to include this extra instruction in the class.

All of these papers, whether intentionally or not, discuss and provide evidence that interaction is very important for language acquisition. Not just speaking with peers but learning new and deeper ways to interact with text, both expository and fictional. Interacting with teachers, and even words themselves. All those separate interactions are able to help students, specifically ELL as well as native English speakers, build stronger vocabularies, express themselves and their ideas better, and ultimately show mastery over scientific content.

CHAPTER THREE

METHODOLOGY

Demographics

In the 2023 - 2024 school year, I had two sections of 7th grade science and 8th grade science. Due to having taught my current 8th graders for 7th grade as well, we have a previous rapport, which helped me to decide to do this research project with them. They will hereafter be called the class of 27–28. They are a class of 54 students, broken into two groups of 27.

All the students in the class of 27–28, and their parents, were asked to be part of the treatment instruction. Three families chose not to have their students data included, and one student missed all of the treatment instruction due to health issues. The data collection took place over the second quarter of the 23–24 school year. This brings my number down to 50 students. As stated earlier, of these 50 eighth grade students, 45 of them tested below the expected 8th grade reading level, one month into the school year.

Treatment

My treatment consisted of what I titled “Literacy days”. With the students, I often referred to them as small groups. Students rotated through stations, one of which includes class time to read the novel that is aligned with my plate tectonics and seismic waves unit. I have chosen the novel, *Paperquake: a Puzzle* by Kathryn Reiss (2002). This book is a mystery involving time travel, age appropriate romance, and middle school aged main characters. The mystery focuses on earthquakes happening in modern day Berkeley and San Francisco, but also touches on the earthquakes in San Francisco in the early 1900’s, which destroyed most of the

city. I chose to record myself reading aloud so that students were able to listen to the novel as a reading support.

One of the stations was with me, where I taught a mini lesson on a close reading strategy that is an evidence based intervention to support students who are ELL. When I started this process, I chose to focus on Double Entry Journals, Collaborative Strategic Reading (CSR), and Concept Maps.

A third and fourth station included using the strategy right away. Students picked from one of three articles on the topic we were learning about, and used the reading strategy they were taught to read the article. Between my small group and the independent close reading, at least one article was chosen from ReadWorks. Although everyone has their choice of articles, within the group, all three articles were read. After everyone was done reading the articles, at the fourth station, they used the “Jigsaw” method to share what they read about. Each student shared what they learned in the article, so that all students in the group could write summaries of the article onto their Jigsaw worksheet.

The fifth station asked students to answer comprehension questions from the assigned chapters. The sixth station was a miscellaneous category. Some weeks, students worked on a previously established vocabulary activity. Other weeks, students watched lesson aligned EdPuzzles. Small groups happened once a week, while the other days were for regular science instruction and lab activities. In the last two weeks, in order to make sure that all work was finished before Christmas break, students were given a chance to catch up on missing work at one of the stations.

Anticipating that it would take students more than one class period to rotate through all six groups, I planned on this treatment lasting for six weeks, and I focused on implementing three close reading strategies. Each week, during our block period day, students rotated through three 20 minute stations. On the first week, when students had yet started *Paperquake*, I directed groups 2 – 5 to just read for the first 20 minutes. As I got through the small group instruction, and as students started to read the novel, I was able to add in stations 2 and 5, and then station 3. I started my unit on Plate Tectonics and Seismic Waves at the end of October. The unit finished in December, right before Christmas break.

Table 1. Description of treatment stations.

| Station Number | Station Description |
|-----------------------|---|
| 1 | Teacher led: Students will receive direct instruction on a close reading strategy. Strategies chosen were evidence based intervention to support students who are ELL and include Double Entry Journals, Collaborative Strategic Reading (CSR), and Concept Maps. |
| 2 | Students choose one of 3 articles to read, using the close reading strategy. |
| 3 | Students use the Jigsaw method to share what they read about, and write article summaries in their notebooks. |
| 4 | Students read <i>Paperquake</i> |
| 5 | Students answer the comprehension questions for each chapter of <i>Paperquake</i> |
| 6 | Miscellaneous: <ul style="list-style-type: none"> • Students watch relevant EdPuzzle videos matching with current science content • Students practice lesson vocabulary using classroom established practices |

Data Collection and Analysis Strategies

The data collection took place over the second quarter of the 23–24 school year. Since I am comparing the students to themselves, the pretest for science content and the STAR test for literacy happened before the treatment instruction began. During the treatment process, formative assessments and comprehension checks would be collected. At the end of each lesson, a post assessment for science content was given. At the end of the treatment process, the Language Arts teacher has agreed to administer a second STAR test.

Although some of these data collection strategies will work for both questions, I identified which tools would be best suited for data for each question and listed them in the table below.

Table 2. Data Collection Tools.

| Question | Data Collection |
|---|--|
| 1. How does a novel study, aligned with the science content, build science knowledge and literacy skills? | <ol style="list-style-type: none"> 1. Comparison of STAR testing data before and after unit 2. Comparison of pre and post content assessments 3. Formative assessments 4. Student review survey |
| 2. To what extent does implementing real text application in my science classroom build comprehension skills? | <ol style="list-style-type: none"> 1. ReadWorks Comprehension questions - accuracy data collected over time 2. Accuracy of answers to the comprehension questions from the novel study 3. Summarizing science articles accurately 4. Student review survey |

To answer my main question: “How does a novel study, aligned with the science content, build science knowledge and literacy skills?” I looked at STAR testing data, which measures student reading comprehension and growth. The test was administered by the Language Arts

teacher in September of the 2023 - 2024 school year, so I used that data as my starting point. After finishing the novel integrated unit, the Language Arts teacher agreed to administer a second STAR test. The other data point I used to answer this question is curriculum aligned, self designed pre- and post-tests.

To answer my secondary question: “To what extent does implementing real text application in my science classroom build comprehension skills?” I used ReadWorks comprehension questions, comprehension questions aligned with the novel, and summarizing scientific articles accurately. ReadWorks articles were chosen based on their availability of comprehension questions. As students answer the questions, their accuracy is displayed to the teacher in the ReadWorks website, which can be compared over time for mastery. For comprehension questions aligned with the novel and summarizing science articles accurately, a rubric was created and used. Students displayed mastery if they are able to show all of the skills outlined in the rubric, found in Appendix A. I reviewed the work as it was completed, and provided feedback so that students could improve over time.

This rubric was used to grade all article summaries and students' answers to the comprehension questions aligned with the novel. It was administered to all 50 of my 8th grade students many times over the course of the treatment time. This rubric was created with help from Chat GPT, using the following prompt: “Create a rubric that assesses students ability to summarize articles or novel chapters, has three levels of proficiency, for middle school”.

At the end of the project, and before Christmas Break, I offered students the chance to fill out a survey and “grade” my project. Not every student chose to respond, and overall students

had positive comments regarding how this project helped them with the science content this quarter.

To explore the validity and reliability of my assessments, I chose to document my thoughts in the table listed below.

Table 3: Assessment validity and reliability.

| | STAR Reading Assessment | Comprehension Rubric | ReadWorks Assessment Questions | Pre and Post Science Content Assessments |
|--------------------|---|--|--|---|
| Validity | <ul style="list-style-type: none"> - The assessment was administered to the students in each homeroom at the same time. - Students who require small group testing due to their academic support plan were placed in a small group environment to test. | <ul style="list-style-type: none"> - Students received small group instruction on how to complete each style of graphic organizer to show comprehension. - Students were given access to an audiobook version of the novel, <i>Paperquake</i> in order to have full access to the content. | <ul style="list-style-type: none"> - This website is designed to measure student comprehension growth over time by comparing the data collected each time comprehension questions are answered by the student | <ul style="list-style-type: none"> - The pre assessment was administered to assess levels of prior knowledge on scientific content. - The post assessments were administered after direct instruction in class on the scientific content was completed. |
| Reliability | <ul style="list-style-type: none"> - STAR reading assessments are used throughout the whole district to assess student reading levels and respond accordingly. | <ul style="list-style-type: none"> - This rubric was used multiple times to collect comprehension data throughout the project. - Professors and colleagues provided input on the validity of the rubric | <ul style="list-style-type: none"> - ReadWorks was used multiple times throughout this project to measure comprehension growth. - ReadWorks is used to help students develop and grow basic reading a comprehension skills in multiple | <ul style="list-style-type: none"> - Content questions were written based on similar source material taken from the curriculum used in class, McGraw Hill and Savvas. |

| | | | | |
|--|--|--|--------------------------|--|
| | | | schools country wide. | |
|--|--|--|--------------------------|--|

This research project was reviewed and approved by the IRB process, the approval can be found in Appendix C.

CHAPTER FOUR

DATA ANALYSIS

ResultsPre Assessment

This data is from the pre assessment for an 8th grade science plate tectonics unit. The pre-assessment was assigned to students to complete after a lesson quiz; students had one class period of 45 minutes to complete it but had the option to take it either Wednesday or Thursday. Some students did not complete the work on time and ended up taking the pre assessment on the following Monday. The assessment is a Google Form, which was assigned in Google Classroom.

The second set of data is from Renaissance Star testing. Students were instructed to take the Star Reading test during their English/Language Arts class, hereafter known as ELA, on September 22nd. This is a regular part of our school instruction. Any student who did not take the Star Reading test in ELA was scheduled with another staff member to take in as a small group at a later date. Students log into Renaissance through Clever, a program that connects our student information system (SIS) with thousands of EdTech programs, automatically rostering our students with any program used on a regular basis and saving their login information. STAR Reading is programmed to ask students questions at their reading level. Based on how they answer the current question, the level may go up or down for the next question. After 30 minutes of testing, student reading level changes are calculated. Both sets of data address the primary research questions, how does a novel study, aligned with the science content, build science

knowledge and literacy skills? My secondary research question data collection happened throughout the treatment time.

Pre Assessment Data

Figure 1 shows student mastery over two state standards prior to instruction. Ohio Earth and Space Science Standard 1, which covers seismic wave properties, hereafter known as ESS.1, and Ohio Earth and Space Science Standard 2, which covers plate tectonics, hereafter known as ESS.2. The following grade categories are used throughout the school: Meeting the standard is defined as 80% or better, working towards the standard is defined as 60% - 79%. Not meeting the standard is defined as 59% or less. Out of the 50 students who completed the pre assessment, 12 students were able to meet ESS.1. Thirty seven students were not able to meet ESS.1. Out of those same 50 students, one student was able to meet ESS.2. Three students are working towards meeting ESS.2, and 46 are not meeting the standard.

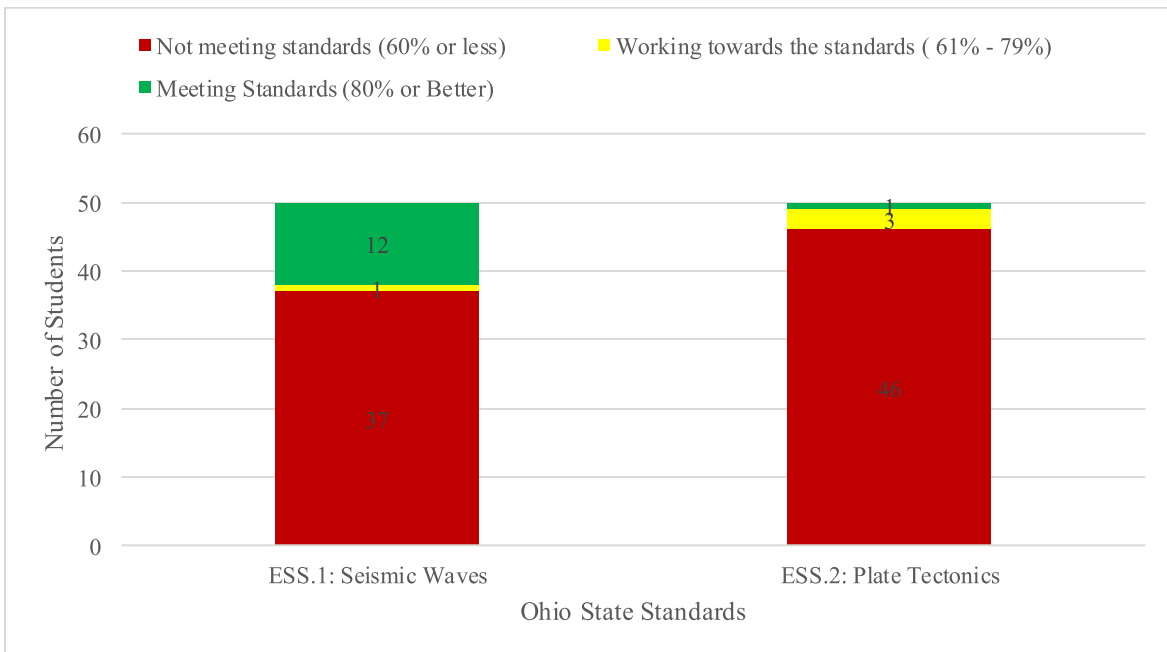


Figure 1. Plate tectonics and seismic waves pre assessment, (N=50)

Figure 2 shows the Scaled Reading Score of the students in 8th grade who, along with their parents, agreed to participate in this research project. Another student was not included due to missing all of the treatment instruction. All but two students included in the data above took the Star Reading test in English. Student 12 and 21 took the test in Spanish, which will ultimately change how much growth they may make throughout the progress. They are considered emerging levels with English language growth, according to the Ohio English Language Proficiency Test.

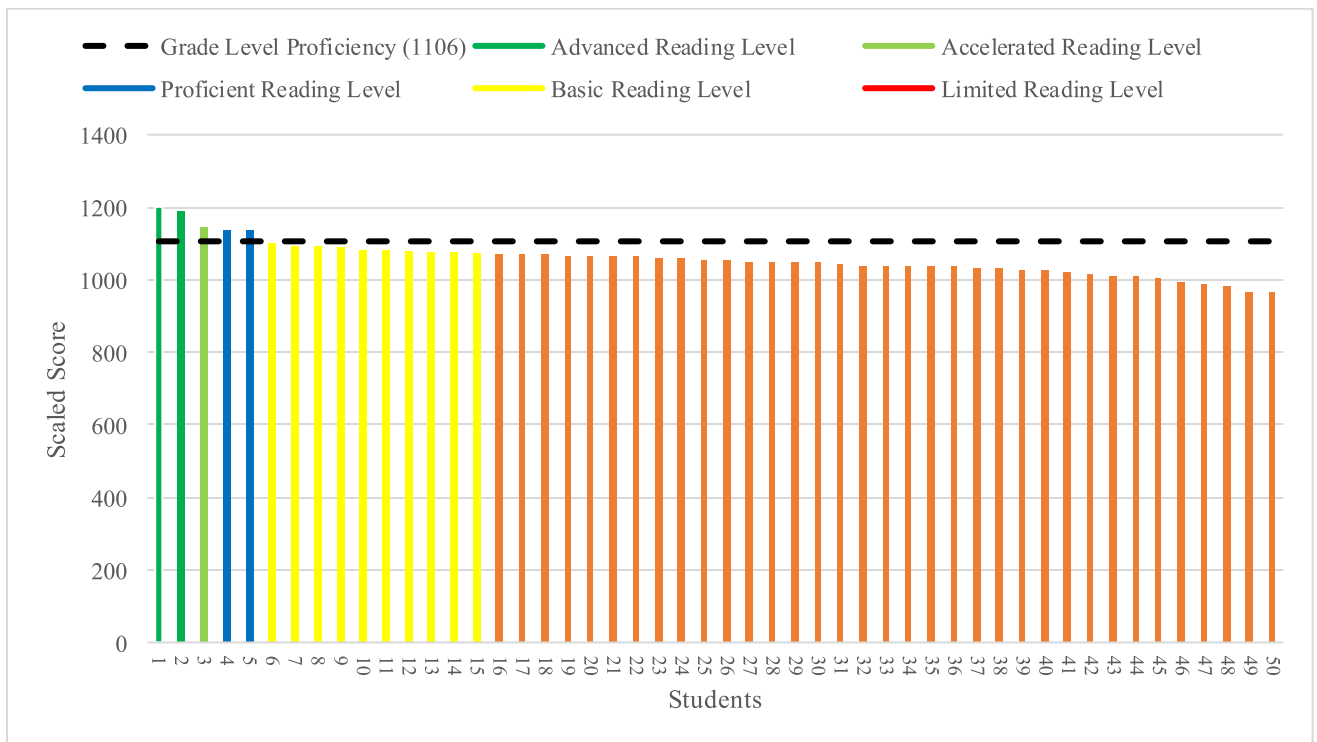


Figure 2: 8th grade STAR reading scaled score before treatment, (N=50)

The dotted line shows 40th percentile rank for this round of testing. Any students who test above the 45th percentile are considered at or above benchmark reading levels. Any students that are 44th percentile or below are considered below benchmark reading levels. Both dark and light green indicate students that are advanced or accelerated above grade level proficiency, which at

the time of the test, was three students. Blue indicates students who are at grade level proficiency, their scaled score is within 35 points of the expected proficiency. Yellow and red both indicate students that are below grade level proficiency. Red indicates that students are in need of interventions to meet grade level reading proficiency. It is very clear in this figure that most of the 8th graders who took the Star Reading test this September are below or well below expected reading proficiency compared to other peers in the state.

Post Assessments

Throughout the science unit, students were assessed on content as each lesson concluded, with teacher made quizzes sourced from McGraw Hill and Savaas material. A sample quiz can be seen in Appendix D. In addition, every week, students had a variety of assignments where they were assessed on their ability to comprehend science articles and the *Paperquake* novel using the rubric found in Appendix A. Student comprehension data was also collected from the mastery of comprehension questions on articles assigned through the ReadWorks website. When the treatment plan was completed, students took a second STAR test to assess their reading levels.

Post Assessment Data

When comparing the science content knowledge, students were assessed on two Ohio State Science Standards, ESS.1: Seismic Waves, and ESS.2 Plate Tectonics. Figure 3 compares student mastery of ESS.1 pre and post treatment. Figure 4 compares student mastery of ESS.2 pre and post treatment.

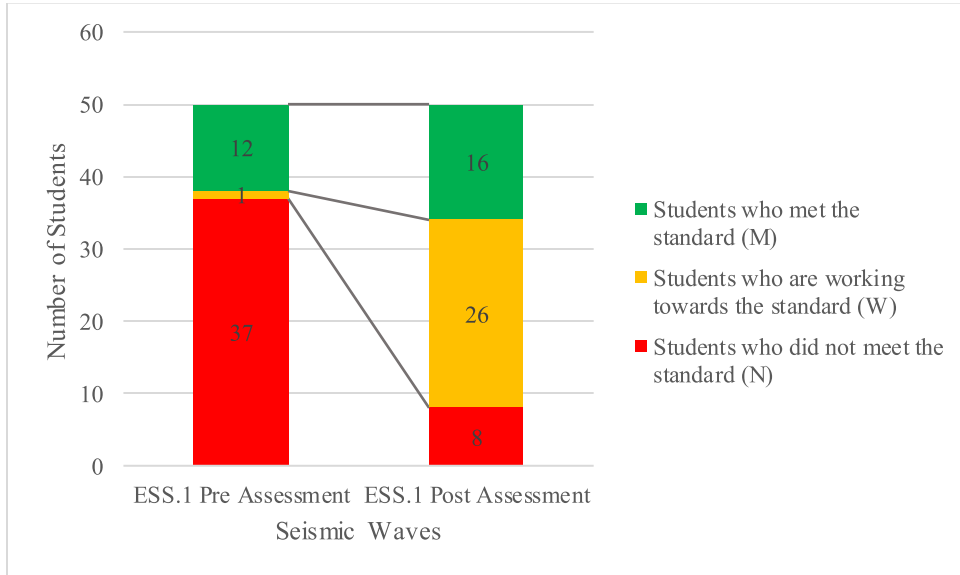


Figure 3. Earth and space science standard 1 seismic waves student mastery comparison, (N=50)

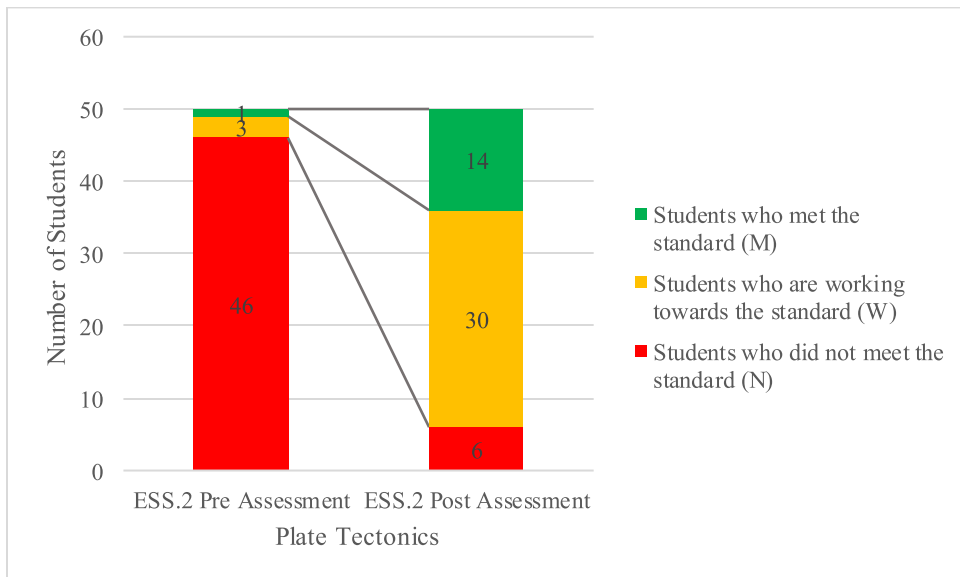


Figure 4. Earth and space science standard 2 plate tectonics student mastery comparison, (N=50)

When presented with both graphs, the number of students who did not show any mastery of the science content before the lesson was reduced. More students were shown to be working towards the standard over meeting the standard entirely.

Figure 5 shows student comprehension data collected throughout the treatment period. Comprehension mastery data was grouped together based on the close reading strategy used for assignments, including ReadWorks assignments, comprehension questions assigned to each chapter of the *Paperquake* book, and a total comprehension score.

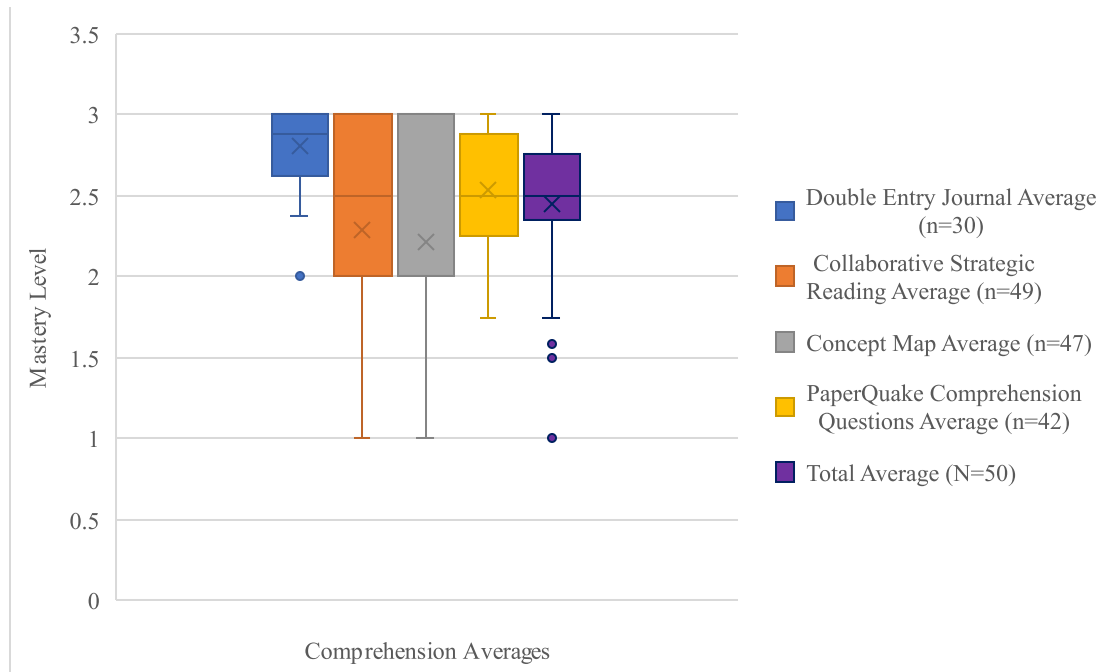


Figure 5. Student comprehension mastery

In this chart, mastery (M) would be 2.5 – 3. Working towards mastery (W) would be 1.5 – 2.4, and not mastering comprehension skills (N) would be 1.4 or below. As observed in the chart above, many students were able to show mastery over comprehension skills for one of the close reading strategies, shown in blue. As well as the *Paperquake* comprehension questions, shown in yellow. Overall, students were slightly below mastery level for all comprehension assignments, shown in purple.

STAR reading data from the post treatment assessment was compared to the STAR reading data taken prior to the assessment. Individual score comparisons can be found in

Appendix D. Figure 6 shows a comparison of the pre treatment reading levels and post treatment reading levels. When comparing the data using a paired t-test, the null hypothesis was rejected. Students reading scores did improve after the treatment plan was implemented. Although Figure 6 shows the basic array of how students compared to the 40th percentile of reading scores, Figure 7 makes the specific amount of students who saw growth in their reading scores more clear. One student tested at exactly the same level pre and post treatment. That student is indicated by the No Change section on the graph.

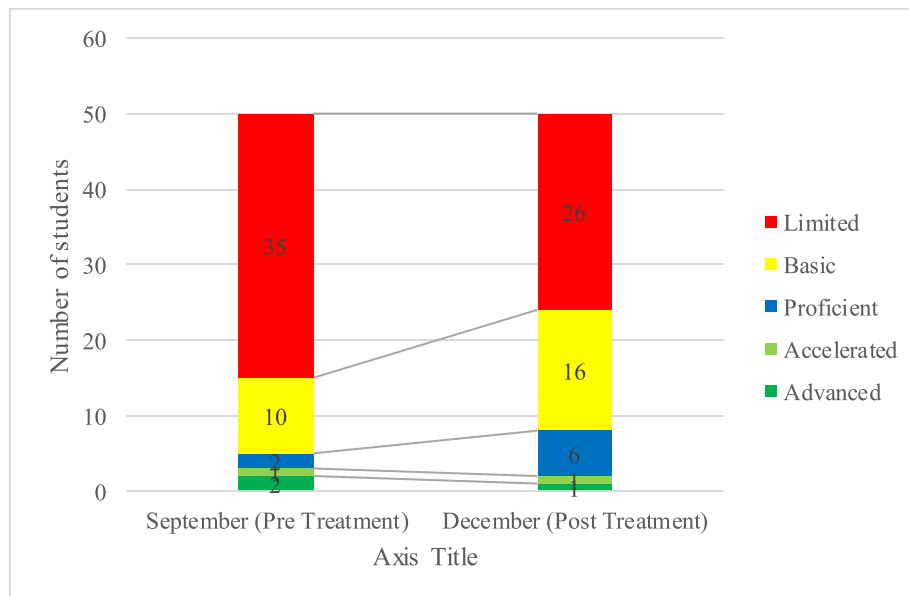


Figure 6. Pre treatment and post treatment student reading levels, ($N=50$)

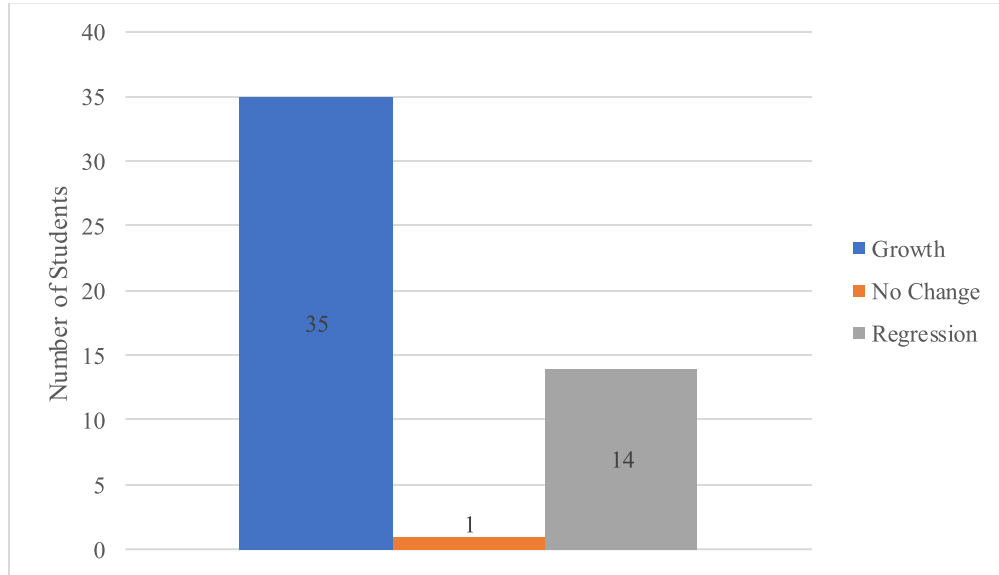


Figure 7. Number of students with reading score growth, ($N=50$)

CHAPTER FIVE

CLAIM, EVIDENCE, AND REASONING

Claims From the Study

My primary research question states: how does a novel study, aligned with the science content, build science knowledge and literacy skills? Although not all students showed individual growth in reading scores, the majority of the treatment group, 70%, did show growth. Statistically, the treatment plan did have a significant positive affect on reading scores. In regard to science content knowledge, data shows that most students were able to show an increase in their science content knowledge by either meeting the standard assessed completely (M) or working towards meeting the standard (W). When assessed on science content knowledge, 84% of the treatment group increased when assessed on ESS.1, and 88% of the treatment group increased when assessed on ESS.2.

My secondary research question states: to what extent does implementing real text application in my science classroom build comprehension skills? By giving students the tools and strategies to interact with text, both expository and fictional, students showed throughout the treatment that they could comprehend both expository and fictional texts. Data was collected from five different comprehension assignment categories, which all showed the majority of the groups that completed the assignment mastered the comprehension skills aligned in the rubric found in Appendix A. The class average for all comprehension activities was shown to be around 2.5 points, which is the lowest end of mastery on the 3 point scale that has been used throughout the treatment plan.

Evidence

As shown in Chapter Four, statistically the small group instruction students received did significantly improve their reading scores. Although not many students grew to or past grade level reading ability, 35 out of the 50 8th graders in the treatment group did show growth. In addition, throughout the treatment, students were able to show mastery over comprehension skills in multiple situations. Anecdotally, I saw students mastering the ability to summarize scientific articles while using the close reading strategies we had worked on together. The average score for the whole treatment group over all comprehension strategies was 2.5 points, which is considered mastery. I was also surprised by the number of students who had successfully pulled content from the fictional novel we read: *Paperquake: a Puzzle* by Kathryn Reiss.

When the science content instruction was completed, on average, the majority of the students in the treatment group were able to grow in their understanding of the science content. Of the 50 student treatment group, 84% showed growth over ESS.1 and 88% showed growth over ESS.2. Although much of the treatment group was still considered working towards the standard, or W, that still shows growth from the pre assessment.

Value of the Study and Consideration for Future Research

Reasoning

This project worked to increase student reading abilities, both in general score and comprehension abilities, by increasing the amount of time and strategies students use to interact with texts. Based on the evidence stated above, and student responses, this interaction time helped students to grow. When students could use these strategies to gather more information

about what they were learning in science class, they were also able to grow in science content knowledge. As seen in Fang et al (2008), as well as several other papers used to build my conceptual framework, giving students these tools to have deeper interactions with the text allowed the students to gain a deeper understanding of the science content.

When the treatment plan was completed, students were asked to “review Ms. Huggins” with a survey, which can be found in Appendix F. Regarding reading scores, one student responded, “Reading the book helped me keep a steady score on my star test. Usually I go up and down, but last time I got a good level, and I went up.” This answer showed that some of the students were aware that reading the *Paperquake* novel and scientific articles in class helped them to stay more consistent when assessing their reading levels.

When asked “Which Close Reading Strategy did you like the best?” most students chose Concept Maps. When asked to explain why, most student responses centered around ease of use, for example, “I like the concept maps because they’re easier to work with, and easier to talk with our groups about the information we learned and wrote.” When asked, “Did reading the articles using the close reading strategy and sharing the content with your table group help you with the class content?” most students who responded stated “Yes”. This can be seen below in Figure 8. When asked to explain why they said yes, one student replied, “I choose yes because when we would talk together, we would tell each other what we learned, and we would get ideas from each other and help each other.” Student responses have been edited for clarity.

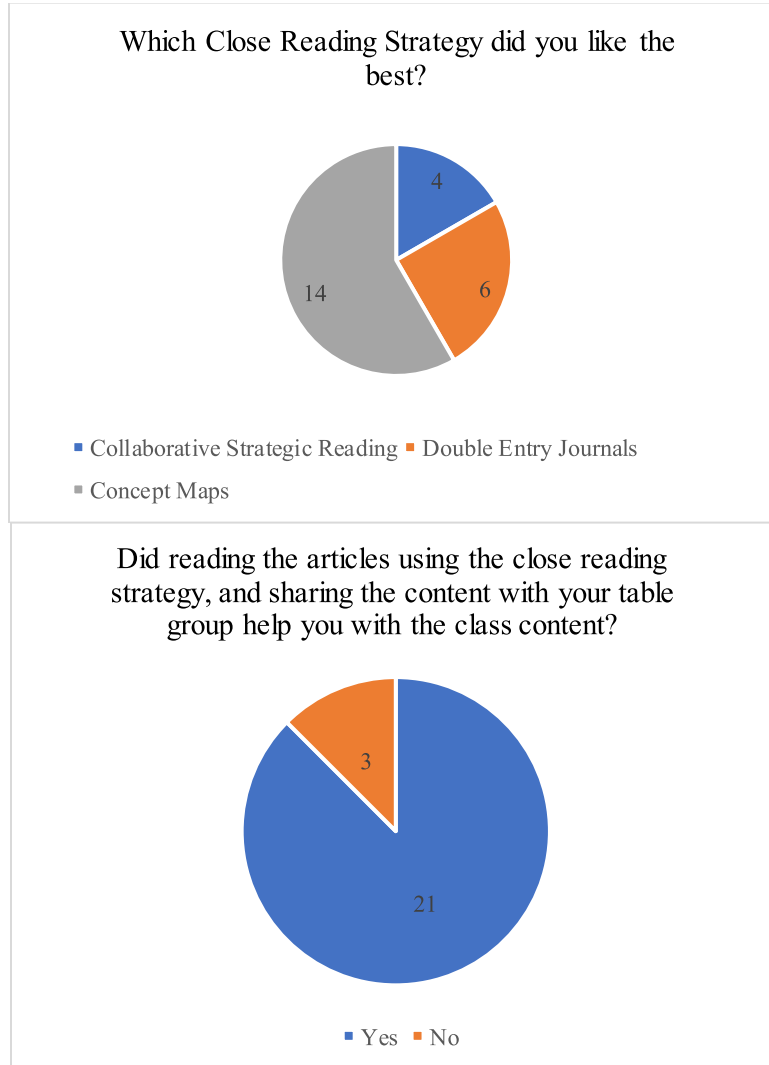


Figure 8. Student responses in review survey, ($n=24$)

Impact of Action Research on the Author

As I implemented this treatment plan, there were a few things I observed that I thought benefited the treatment plan, and a few things that I or others would need to add or change. First off, most of the 8th graders took this project seriously, bought into the work and focused on the work assigned without needing to be redirected. I noticed that they were communicating about educational topics more often and would often help each other to complete the work as needed.

I found that out of the three reading strategies I taught, I liked the Collaborative Reading Strategy the best. It used three different evidence-based practices when working with higher level reading. Students pulled prior knowledge before starting, summarized the main point or “gist” of the article, and allowed space for students to ask follow up questions at the end. As stated above, students enjoyed Concept Maps more. I did notice that the comprehension mastery was slightly better with Collaborative Reading Strategy. Overall, I enjoyed the small group set up, and this gave me the ability to interact with individual students that I don’t often get to talk to, and to make sure that all the students understood the close reading strategy before moving on to individual work.

As I collected data on this project, I’ve noticed myself assigning more independent reading to be done out of class as review, for both 7th and 8th grade. As I moved forward with lesson planning after this project, I was able to implement the close reading strategies I taught more frequently. There are news articles and websites in the past that I have shied away from using due to reading levels. With the implementation of this project, I think I’ve found ways that I as a science teacher can help students with both reading levels and English language acquisition. This finding is backed up by Bautista and Casteñeda (2011): “Another factor for ELL’s success in language acquisition is interaction, an activity that connects input and output”.(p. 38) They go on to say that interactions with text are foundations for language development, because it requires ELL students to comprehend the language input, or reading, and produce language output, or summaries.

Due to unforeseen circumstances, this project started later than I thought it would, and I’ve had to squeeze in all the content and treatment days around the holidays. I’m not sure if

there would be any effect on the data, but if I had the choice, I would have started this project earlier in October to give myself more time to complete the treatment days as well as the science content. That would also hopefully eliminate days lost due to holiday breaks as well. As I wrapped up data collection, I thought it would be useful in the future to either offer students the chance to use the close reading strategy while reading the novel or assign a close reading strategy for each set of chapters.

Two notes that I do think affected the data: students have really struggled with work completion. Although I anticipated some issues, I did not anticipate as many missing assignments as I saw. You can see this in the figure displaying comprehension data (Figure 5), the number of students differs for each group due to the amount of missing work. When I taught this group as 7th graders, they were very dedicated, and the majority turned in the work on time. I had to have several discussions with both classes regarding how important this is to my own homework, as well as repeatedly pass out lists of missing work to get assignments turned in. I'm not sure what I would do to change this in the future, other than possibly incentivizing work completion. I chose not to incentivize work completion, due to the nature of this research project.

Lastly, the school had a change in leadership, and the returning assistant principal made it their mission to improve reading scores throughout the school. Overall, encouraging students to read more often, as well as building time into the day to just read, was added to our days. Students that have significant reading and comprehension deficits worked with reading tutors and/or worked with an individualized reading intervention program called Lexia. This was a significant increase in dedicated time to interact with text, and so I'm not sure if any increases in reading levels can be credited to my work specifically.

A note on further research, I believe that it would be beneficial for my students and my teaching practice to explore only a novel study with the close reading strategies. I felt that reading the novel added to building comprehension skills, but that I could have done more with the novel given enough time. There are a lot of scientific novels out there, both fictional and non, that are rated very highly by the NSTA, and it might even be beneficial to do one novel for Earth, Life and Physical science separately. Although reading the scientific articles added to the students understanding of the content, I think giving them more time to read the novel might have helped overall.

As stated earlier, we are a nation of immigrants. As we continue to change and grow as a nation, we are seeing more diversity after decades of separation and stagnation. The Department of Education completed a study of ELL growth across the nation. Between the 2009 – 2010 school year, and the 2014 – 2015 School year, Columbus City Schools had an 18% growth in English Language learners. Data could not be found specific to the Columbus Catholic diocese, which due to size and a high population of Hispanic Catholics is probably different, but my point remains. As we grow as a nation, we will need to increase our ability to teach students who are learning in a language that is separate from the one they speak at home. Research on best practices, and training on how to use them will need to be increased so that language growth can continue as students grow.

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APPENDICES

APPENDIX A

RUBRIC FOR ASSESSING STUDENT MASTERY OF SUMMERIZING ARTICLES

| Criteria | Mastery |
|----------------------------|--|
| Understanding of Content | <ul style="list-style-type: none"> • Demonstrates understanding of the article/chapter's main ideas and key details. |
| Organization and Structure | <ul style="list-style-type: none"> • Presents a clear summary with an introduction, main points, and a conclusion. • Uses clear language and sentences to express ideas. |
| Conciseness and Clarity | <ul style="list-style-type: none"> • Summarizes the content without unnecessary details. • Stays focused on the main ideas. |
| Critical Thinking | <ul style="list-style-type: none"> • Makes thoughtful observations or connections about the content. |
| Engagement | <ul style="list-style-type: none"> • Shows interest in the material. • Attempts to engage with the text. |
| Mechanics | <ul style="list-style-type: none"> • Contains 3-5 errors in spelling, grammar, and punctuation. |

APPENDIX B

TEACHER SUPPORT TEAM

Although my entire 6th-8th grade teacher team, who acted as a morale support group during this process. I to specifically mention two members:

- Kathryn Patterson (7th and 8th ELA) - She is part of my morale team and is helping to develop and refine the comprehension questions I will be using in my novel study. She is part of my writing team, specifically on grammar and spelling, while working on this project.
- Jessica Lehr (7th and 8th Social Studies) - Jessica worked as a librarian for a long time before transitioning to a classroom teacher, and in addition to morale support, specifically helped with formatting.

The other members of my teacher team are Lynn Schwalm (6th Science and Math), Doreen Kohrmann (6th ELA and Social Studies), and David Mitchell (7th and 8th grade Math)

- Terri Parrish (Reading Specialist) - I wanted to include Terri as part of my support team because of the help I received during the 2022 - 2023 school year. I was able to bounce ideas off of her, and she gave me several resources that I could use, and helped develop my question on comprehension growth. She no longer works with me, and I did not use her as a resource past work last year, but I felt it was important to mention.
- Patrick Favo (Building Substitute) - During the implementation of my research project, I felt it would be necessary to have another adult in the classroom while I worked with the small groups. I wanted to be able to focus all of my attention on one group, and Patrick was able to step in, field other questions, and keep the other groups on task while I focused on the group I needed to work with.

APPENDIX C

IRB APPROVAL

At 4:22 PM on Thursday, September 21, 2023, NoReply@TOPAZTI.com wrote
Hello Huggins, Sarah,

Your protocol was reviewed by the IRB and has been approved.

PI: Huggins, Sarah
Approval Date: 9/21/2023
Title: Literacy Instruction in a Middle School Science Classroom

Protocol #: 2023-920-EXEMPT
Review Type: Exemption
Expiration Date: 9/21/2028

Work described under this protocol may now commence. The PI is responsible for ensuring that the protocol accurately describes research practices being conducted.

- > Review Category designation determined by the IRB can be found in the final section of your protocol.
- > IRB-stamped active Consent Forms are attached within your protocol where applicable.
- > Any changes must be submitted via Amendment prior to implementation.
- > Per the Common Rule, research only requires Interim (annual) Review by the IRB if 1) it was reviewed via Full Committee or 2) is regulated by the FDA.
- > All research is subject to post approval monitoring.
- > All protocol types must be renewed 5 years after approval.
- > Inform the IRB once your research is complete so that the protocol may be inactivated.

Please contact your IRB Program Manager with any questions or if you are in need of assistance. Thank you for your diligence in the care of human subjects research participants.

Institutional Review Board for the Protection of Human Subjects | Office of Research Compliance | Montana State University

Access your protocol anytime at <https://montanaprod.topazti.net/Elements?emailLink=11%2c102%2c10228>.

APPENDIX D

SAMPLE SCIENCE CONTENT POST ASSESSMENT

Moving Continents Quiz

This lesson check covers lesson 1 in the Dynamic Earth unit

Use pages 34 - 37 to help.

Choosing not to participate in the research project will not affect your grade.

True or False: Some early mapmakers thought that the coastline of South America matched the coastline of Asia. *

- True
- False

True or False: Scientists at the time rejected Wegner's hypothesis of continental drift because he could not explain how or why Earth's continents move. *

- True
- False

The presence of the same _____ on several continents supports the hypothesis of continental drift. *

- Fossils
- Rocks
- Neither Fossils or Rocks
- Both Fossils and Rocks

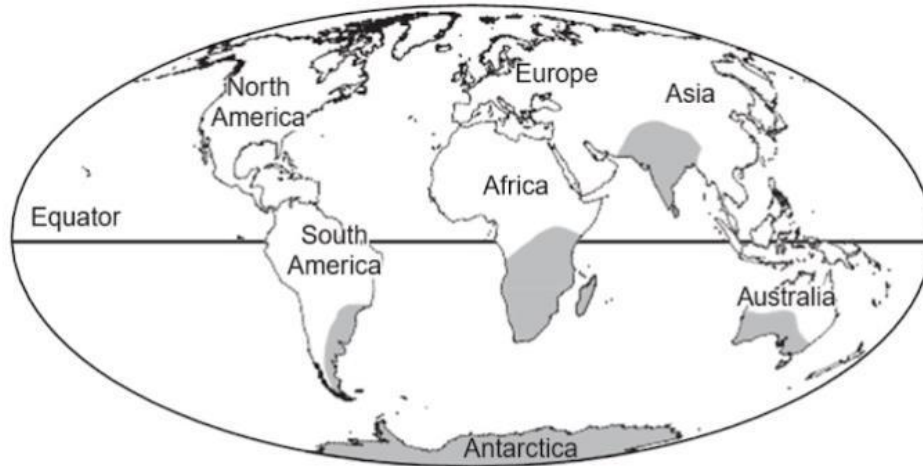
A lack of explanation for continental drift prevented many scientists from accepting that a single supercontinent called _____ once existed. *

- Glomar
- Glossopteris
- Pangaea
- Wegener

Matching _____ on different continents are evidence for continental drift. *

- River systems
 - Rock structures
 - Weather pattern
 - Wind Systems
-

The map below shows where glaciers existed 250 million years ago. What can we claim based on this map? *



| Key | |
|-----|------------------------------|
| | Location of glaciers 250 mya |

- Glaciers formed in the locations show on the map because at that time, the southern hemisphere was cold enough to experience an ice age.
- At one point in time, glaciers covered all of the continents on Earth, but have since melted. The locations shaded on the map show where glaciers still exist today.
- There is evidence of glaciers in the shaded areas on the map because the current climate in those areas is still cold enough to support glacier formation
- Glaciers existed in the areas shaded above because at one time, those continents were connected to Antarctica, near the south pole. Over time the continents moved apart

What observation did Alfred Wegener make that led him to believe that all the continents had once been joined? *

Your answer _____

BONUS POINT: _____ is a fossil fern that helped support Wegener's hypothesis of continental drift *

- Gondwanaland
- Kannemeyrid
- Mesosaurus
- Glossopteris

Gathering Evidence

Answer each part of this section to explain how the evidence Alfred Wegener gathered supported his hypothesis.

Identify one piece of evidence Wegener used to support the hypothesis of continental drift. *

Your answer _____

Explain why the piece of evidence supports Wegener's hypothesis of continental drift. *

Your answer _____

Identify a second, *different* piece of evidence Wegener used to support the hypothesis of continental drift. *

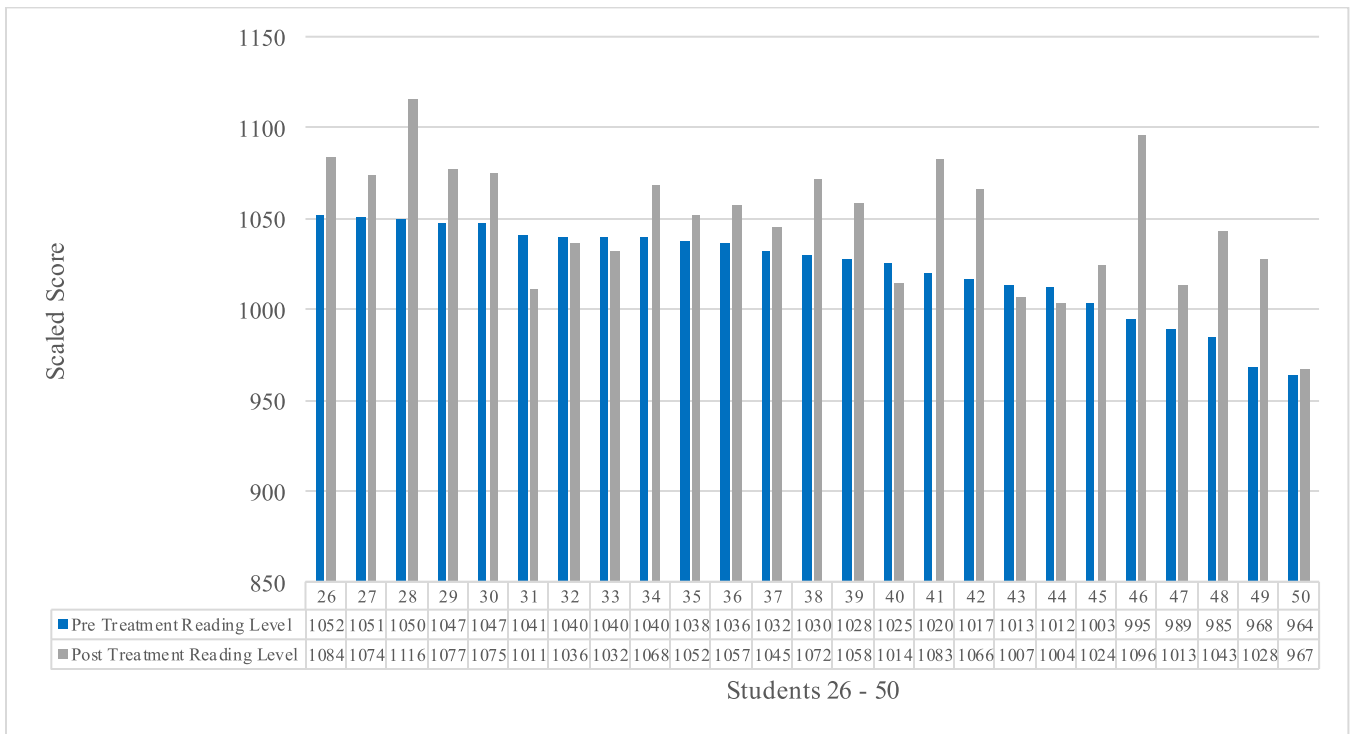
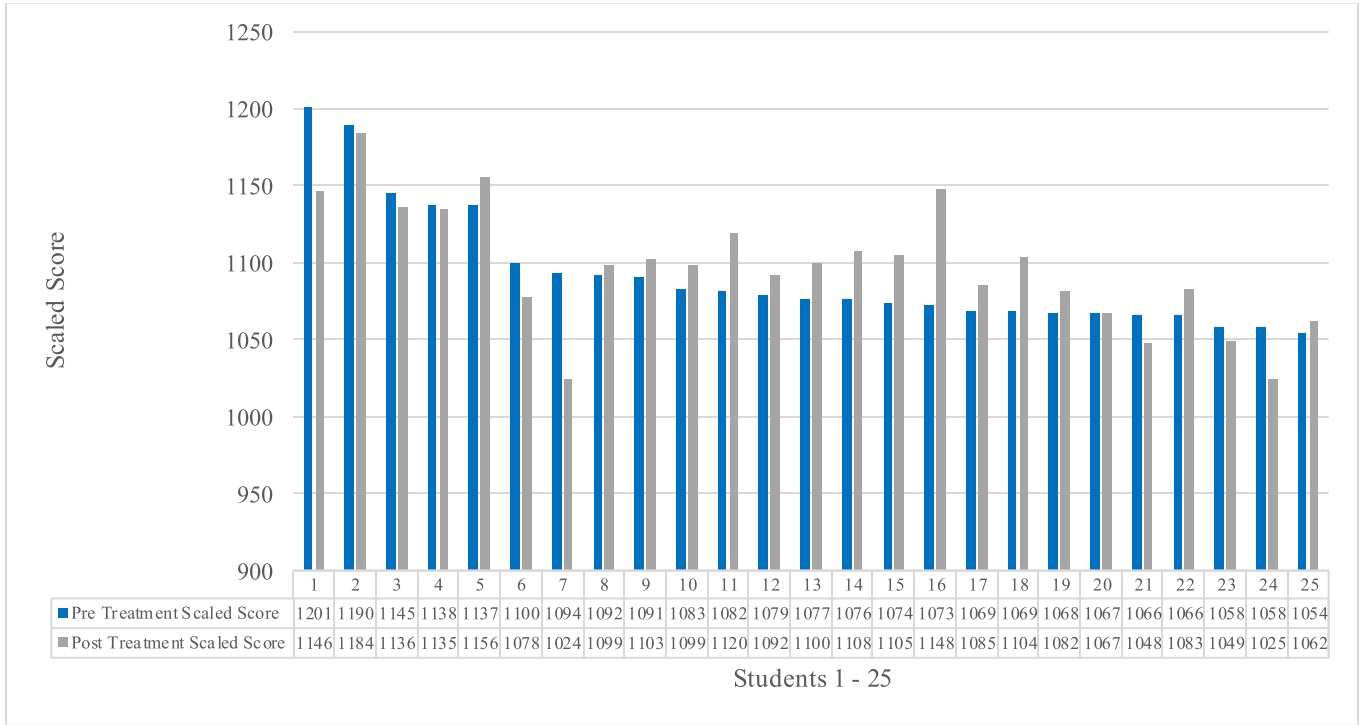
Your answer

Explain why your second piece of evidence supports Wegener's hypothesis of continental drift. *

Your answer

APPENDIX E

COMPARISON OF READING SCORES BY STUDENT



APPENDIX F

REVIEW MS HUGGINS STUDENT SURVEY

Review Ms. Huggins Research Project

This form is anonymous, fill it out honestly

Which Close Reading Strategy did you like the best? *

Name _____ Date _____

Title _____

As you read the text, select a few phrases that you find meaningful or interesting. Write each phrase in the first column below, then write your reaction or comment, question, connection made, or analysis for each quote in the second column.

| Page to read | From the text | My thoughts |
|--------------|---------------|-------------|
| | | |
| | | |

Double Entry Journals

Title _____

| Before reading | Before reading | Predict |
|----------------------------|----------------|---------|
| | | |
| What's the gist? | | |
| Questions about main ideas | What I learned | |

Collaborative Strategic Reading

Use this map to organize your thoughts and make connections to your topic. Write the main idea in the center, and add supporting ideas or related topics in each surrounding oval. Continue to expand on your thoughts by adding more ovals to the map.

Diagram description: A central blue circle is connected to six surrounding circles (two yellow, two orange, and two green) by lines.

Concept Maps

Why? *

Your answer

Did reading the articles using the close reading strategy, and sharing the content *
with your table group help you with the class content?

Yes

No

Explain why you chose that option. *

Your answer

Review *Paperquake: a Puzzle* *

0 1 2 3 4 5 6

Did not finish

The best book I've ever read!

Why did you pick that number? OR if you didn't finish the book, explain why. *

Your answer
