THE EFFECTS OF USING AN ENGLISH BASED READING STRATEGY IN SCIENCE TO HELP SECOND LANGUAGE LEARNERS ACQUIRE SCIENCE CONTENT KNOWLEDGE

by

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of the requirements for the degree

of

Master of Science

in

Science Education

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DEDICATION

To my loving wife who has supported my pursuit of Master's of Science Education. Thank you for giving me the time, space, and focus to see what I was meant to get my Masters in. To my Grade 7's that participated in my research. To my school that gave me the freedom to implement my action research plan.

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ABSTRACT

This research was designed to investigate how using an English based reading program in science helps second language learners (native Arabic in particular) acquire scientific content knowledge. Students were taught science content in English using informational texts and a chapter book pertaining to the unit being studied to aid in literacy and language development. They were tested in content vocabulary, general inquiry vocabulary, content writing, writing clarity, writing argument, and writing with the use of science vocabulary.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

Since 2016, I have taught second language learners[1] science using Western curriculum (British and American NGSS). If I were to give a rough estimate of my students' English fluency level when it comes to reading, or writing, or use of academic language, I would say that less than a quarter are on grade level, half are two years behind, and a quarter are four or more years behind. This does not create a good foundation for my students to learn science. Moreover, due to the advancement of modern technology, nations are communicating with each other at a faster rate, and they are using English as the ultimate language medium. In the United Arab Emirates (UAE) where I teach it is no different.

This is a nation with a short history, of only 45 years, and is comprised of 80% foreigners. But from the beginning, the country's leaders set out to make the other dominant language in their land English, along with the region's native Arabic. Consequently, English language instruction has become a requirement throughout the Emirates' private and public school systems. According to TIMMS, an international study center that compares countries in Math and Science, the UAE ranks 23rd out of 39 countries in Science (TIMMS, 2015). The goal for the UAE is to be in the top 15 of nations in both Math and Science by 2050. To address this issue, over the past decade the

[1] *Second language learners* in this paper, the usage of the term "second language learner" is synonymous with ESL (English as a Second Language) students. "ESL" is a term used in the United States but is not used in this region.

UAE has employed English-Medium-Teachers (EMTs) such as myself to teach Math and Science to the local population of Emiratis.

My personal goal is twofold. Firstly, Í would like to help the UAE and the Emirati nation to meet their own goal achieving a high ranking in TIMMS, as this is my daily work. But I must consider what is needed to achieve that goal. Here enters the second goal: to find out how incorporating informational text and a science related chapter book into science improves second language learners' scientific literacy level, scientific content knowledge, scientific vocabulary, scientific writing, and general attitude towards science.

Focus Question

The focus question for this study was, Does an English based reading program in science help second language learners acquire science content knowledge?

Sub-questions included the following:

1. How does an English based reading program in science improve second language learners' science vocabulary?
2. How does an English based reading program in science improve a second language learner's ability to write in science?
3. How does an English based reading program in science using informational text and a chapter book motivate second language learners to learn science?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Challenges of ESL Students in Science

Even though research on how second language learners, or ESL students, learn science in English is fairly new, there are extensive and recent articles out there on language, science, and second language learners. The common thread between a lot of this research is that there is an achievement gap between second language learners and native speakers and preservice teachers are ill-prepared to teach science to second language learners. Therefore, it is recommended to integrate the English language and literacy aspects into the science classroom for ESL students (Irby et al., 2018).

From their research, Irby et.al. pointed out that ESL students struggle with words that have different subject-specific meanings such as volume or property and face two big challenges inside the science classroom. One of those challenges is that ESL students need to investigate the natural world using English, and the second challenge is that they must engage in a type of discourse that is different than what they are used to. Both have their language barrier problems. The final point that Irby et. al made was that when students get to middle school, they are expected to have the ability of reading to learn. As Irby et al. (2018) points out, ESL students do not have the English literacy skills necessary to do this, and it becomes a key reason for teachers, preservice and experienced, to learn the skills necessary in teaching ESL students.

In a different yet similar study, a group of researchers went into six universities across the state of Arizona to provide preservice teachers with the instructional practices necessary to teach ESL students. A highly significant point mentioned in this article, was how the NGSS has placed a greater emphasis on using language and that is why it so critical to incorporate ESL strategies into the classroom. A few other critical and interesting points mentioned in their article were how using English based strategies develops an ESL students' ability to reason and communicate and that there are sociocultural and sociolinguistic theories that recognize the "important role of talk and social interaction" (Lyon, 2018). That is why this action research project was built around an English based reading program. It is necessary for second language learners to get the appropriate literacy skills necessary to facilitate academic growth in science. These learners need to acquire more vocabulary and academic writing skills in order to communicate and reason with their native English-speaking counterparts as well as developing the ability of reading to learn.

Additionally, this research project was built around constructivism and Driscoll views of how students learn. Like the Lyon (2018) article above, in the constructivist framework, the teacher knows that if his learners lack the appropriate skills or knowledge prior to the situation, then they will not gather new knowledge and this problem needs to be remedied. With second language learners, they lack the appropriate linguistic skills to gather a scientific understanding. Therefore, to advance their knowledge or skills in science, second language learners need meaningful activities that build up their scientific language. One way to do this, is to realize that learning is a communal activity and that the interplay between students will not only help the community grow but also the individual lacking the appropriate skills when compared to their classmates. That is why the teacher cannot be the giver of knowledge but rather a passive captain at the helm who provides his crew with the tools and skills necessary to navigate the academic seas. This conceptual framework aligns with Driscoll's (2005) views as he expresses in the *Psychology of Learning for Instruction*. Driscoll sees learners not as empty vessels awaiting to gather goods of knowledge but rather as vessels awaiting to gather knowledge so they can make sense of the world.

That is why one of the strategies used in this research to improve second language learners' science literacy comes from an unpublished paper by Lauren Kasper (1995) from the Montana State University, *Integrating Literature into the Science Classroom*. In this paper, she describes the best way to improve ESL students' scientific literacy is by using multi-media in a thematic-based ESL reading course. Kasper states that there are strong evidences that suggests ESL students comprehend more, are engaged more, and are motivated more when "ESL reading courses are structured by unifying content-based theme" (Kasper, 1995, p. 1). Kasper also points out that cognitively, a thematic unit with reading connects to schema theory and exposes the students to a list of complex ideas in a subject specific area. To illustrate her point, Kasper described a unit built around a chapter book titled *Never Cry Wolf* by Farley Mowat (1963), some informational texts, a movie connecting to the themes in *Never Cry Wolf*, and English Language Art skills: such as prereading activities, advanced graphic organizers and analogies, reading and writing activities, and audiovisual activities. All but one of Kasper's strategies were used in this research project. There was no movie or multi-media aspect connected. Instead, a series of mini lessons were created within a unit that used informational text, a chapter book, and ESL reading strategies.

Another strategy supporting the use of literature in the science classroom comes from *Moving Toward Inquiry: Integrating Literature Into the Science Curriculum* by Short and Armstrong (n.d.) as they state, “Literature should be an integral part of children's inquiry and meaning constructions of the world rather than just another way to ‘get the facts’” (p. 83). Moreover, they suggest that with an inquiry-based approach in class, literature supports students finding and generating their own questions, and that literature supports inquiry in ways that textbooks cannot. For example, a well written non-fiction book is more focused, modest, and intimate than a dry textbook. Additionally, there is usually enough data in non-fiction books to pull out so that the readers can make up their own minds. On the other side, fiction books add a “more human frame of reference” to understanding the content. For these reasons, and the ones mentioned in Kasper’s article, this research project’s framework was designed using literature as the generator of knowledge within the science classroom.

To find out if using an English based reading program in science was successful, a framework was designed based off of the framework used by Shaw et al. (2014) in their research, *Improving Science and Literacy Learning for English Language Learners: Evidence from a Pre-Service Teacher Preparation Intervention*. In their research, Shaw et. al. used a specific assessment framework called the ESTELL Framework and consisted of 12 multiple choice questions that assessed science content; 30 multiple choice questions which assessed vocabulary in inquiry and content; and two constructed response prompts that assessed the students' scientific literacy. Each data point had a specific mark allocation depending upon its strength. Their assessment framework was used again by Lyon et al. in 2018.

Then to find if an English based reading program motivated second language learners to learn science, this research used the framework developed by Sara Keefer Venturi (2016) in her Capstone project for the Montana State University. Venturi used and described data sources in a clear and logical manner. Her data sources included student surveys and teacher observations. Though she didn't provide any graphs, her data analysis was excellent on student engagement levels. She describes other ordinal data points in a similar manner, such as confidence, assistance to others, and small group discussion. That is why in this research project, a student survey and interview became an essential aspect of this study (Appendices A and B).

CHAPTER THREE

METHODOLOGY

Demographics

This research investigated two classes from grade seven and was conducted from January 7, 2021 to March 15, 2021. Both the comparison and treatment groups had 25 Arabic male students that were from the more affluent families in the UAE and there were no special needs students in either class. From my personal observation, and the grades from the student information system (eSIS), these students were about evenly matched academically according to classroom performance and their official school marks. Furthermore, the students at ADNOC Schools are separated based upon gender and randomly sorted into classes. For the most part, the students stay together as they move up in grade level. That is why the comparison group was a good selection.

Treatment

With the treatment group, data was gathered in six areas: pretest, posttest, external test (for moderation), formative assessments, and student interviews/student survey. A timeline of research activities can be found in Appendix C but for a general overview the pretest, posttest, external test, and weekly formative assessments were administered to measure academic growth in science content writing and science vocabulary. The Likert scale survey and student interview were conducted at the beginning and end to measure how informational texts and a chapter book motivated second language learners to learn science.

The primary "treatment" used in this study consisted of a specially designed unit within the larger NGSS Massachusetts unit of Physical Science. The unit was designed using the "Backward by Design" method and consisted of three mini lessons per week. Each mini lesson lasted about 25 minutes and was followed by the regular lesson for 35 minutes. The students had science class five days a week that lasted one hour.

During these mini lessons, a weekly informational text was dissected, and the students reviewed one chapter from their chapter book which was typically read on Thursday as a read-aloud for a lighter and more relaxed day (Thursday is the last day of the week for schools in the Abu Dhabi). When the students would read their informational text, they would work in one of four collaborative levels based upon their academic standing. The teacher would work with each level according to their ability level. Some levels received more attention than others. In the levels, the students (and/or teacher) would extract the key content and vocabulary words necessary to complete the formative assessment or exit slip. After extracting the key information, the students would complete an exit slip/formative assessment that focused on writing and vocabulary. These weekly mini-lessons and assessments lasted 8 weeks.

The chapter book that the students read pertained to the current standard, had the key content and vocabulary, and appealed to the students' (Arabic) cultural background. It consisted of five short chapters and it introduced the students to the scientific facts and concepts about physics while at the same time following fun adventures in a fictitious world. This book relaxed the instruction, making the heavy content and vocabulary associated with physics digestible and relevant. Sometimes, the students would be broken up into their collaborative levels for a quick "Think-pair-share" or other ELA related activities such as character analysis or creating a graphic organizer for the plot analysis.

Finally, as the treatment to measure if using an English based reading program in science motivated the treatment groups' desire to learn more about science, a Likert student survey and interview were administered. The Likert student survey was administered before and after the treatment to gather information about the students' previous exposure to reading in and out of school. After the treatment was finished, an exit interview was additionally administered. This interview allowed the researcher to see and hear if reading had a personable impact in the student's approach to science and to analyze if this research project was successful. The researcher asked open-ended questions as well as yes/no questions that measured student enjoyment, engagement, and general attitude towards reading in science.

This research was designed to see if using an English based reading program in science could help second language learners acquire science content knowledge, improve their scientific vocabulary, improve their scientific writing, and to motivate them to learn more science. This research was approved for exemption by the Montana State University's Institutional Review Board (IRB) (Appendix D). All the instruments were voluntary, non-invasive and complied with working with adolescent students. In order to ensure validity in this research each research question had at least three different data sources collected, and both the internal and external tests were reviewed by other grade level teachers. To ensure reliability the pre- and post-treatment tests were compared with an external grade level exam. These instruments can be seen in Table 1 below.

Data Collection and Analysis Strategies

Table 1. Data Triangulation Matrix.

Questions	Data sources		
	1	2	3
Focus Question: In what ways, would using an English based reading program in science help second language learners acquire science content knowledge?	Internal Research Pre/Post-test External Post Test	Formative Assessments	Student Class notebook
Sub-question 1: In what ways, would using an English based reading program in science improve second language learners' scientific vocabulary?	Internal Research Pre/Post-test External Post Test	Formative Assessment	Student Class notebook
Sub-question 2: In what ways, would using an English based reading program in science improve second language learner's ability to write in science?	Internal Research Pre/Post-test External Post Test	Formative Assessment	Student Class notebook
Sub-question 3: In what ways, would using an English reading program motivate the students to learn science?	Student interviews	Microsoft Forms Survey	Teacher observation

CHAPTER 4

DATA COLLECTION AND ANALYSIS

Student Academic Growth

To evaluate if the focus question was true, the researcher administered a pre and post student assessment (Appendix E) and then compared those scores between the two groups classes using the following data points: mean, minimum, quartile 1, quartile 2, quartile 3, and quartile 4. The results from the pretest, posttest, and external test can be seen below in Figure 1.

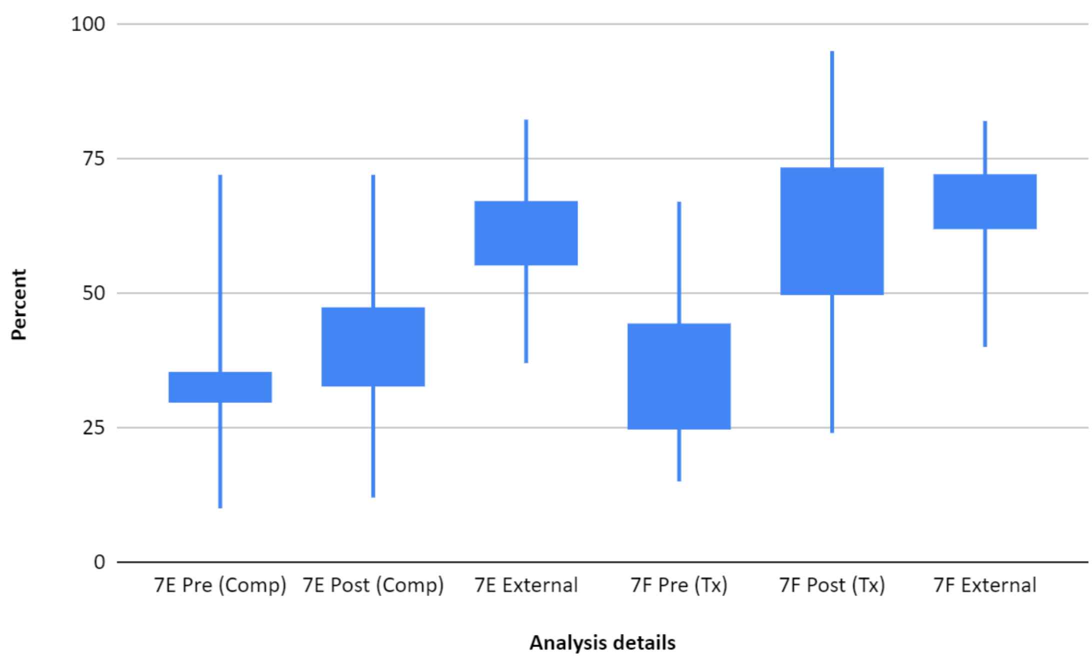

Figure 1. Comparison of summative assessments, Comparison (Comp) Group (*n*=25) and Treatment (Tx) (*n*=25).

Prior to treatment, the researcher found that there was no real difference in values between the two classes. Moreover, the average of students passing with a “C level and Above” (Class 7F: 36; class 7E: 36) and had an average of 44 whereas class 7E had an average of 35. After the treatment, the range (Class 7F = 24 to 100; Class 7E 12 to 100), the median (Class 7F: 73; Class 7E: 47), and the “C level and Above” values (7F: 76; 7E 40) suggests that there were some profound differences in achievement between the two groups. Additionally, this research used an external grade level exam as a source of moderation. Although both groups performed well on the external exam, the treatment group’s post test scores correlated more to the external exam than the comparison group.

Student Vocabulary Growth

To analyze the first sub question and if using an English based reading program in science could improve second language learners’ scientific vocabulary, 10 filled in the blank questions and 20 matching questions were asked. This assessment can be found in Appendix D. Some of the vocabulary words came directly from the science content covered in the texts but some of the general inquiry vocabulary was not covered in the text (i.e. predict, evaluate, observe, etc...). The overall scores were compared between the two groups using the following data points: maximum, minimum, quartile 1, and quartile 3. The scoring for the questions was either 0—1.

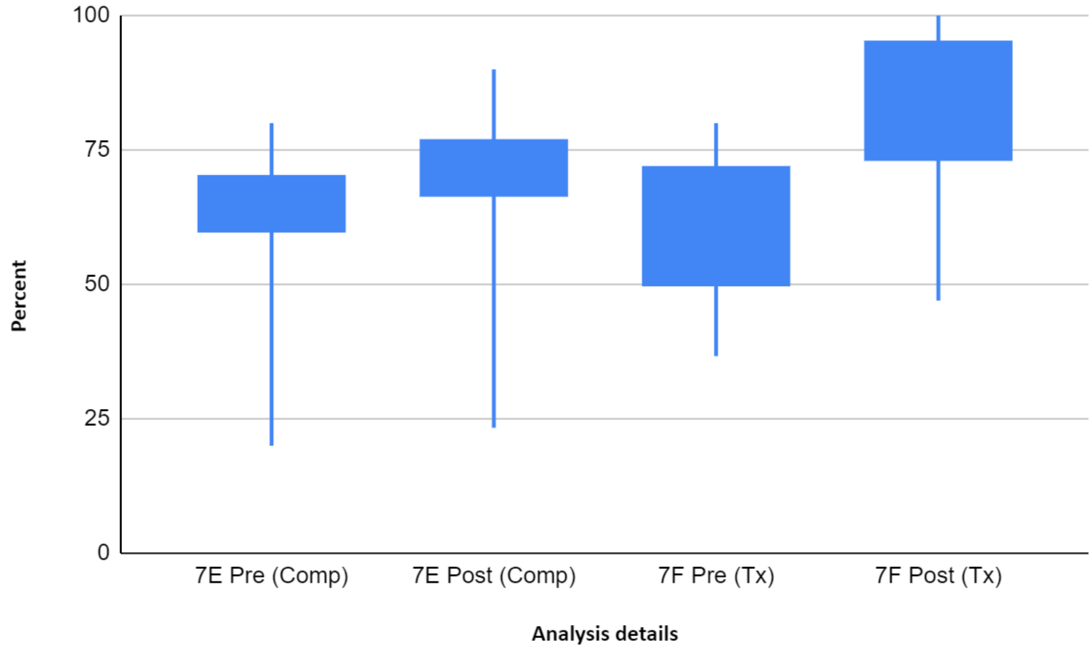

Figure 2. Comparison of vocabulary pre and post assessments, Comparison (Comp) Group (*n*=25) and Treatment (Tx) (*n*=25).

As the above figure shows, prior to the treatment class 7F (the treatment group) and 7E (the comparison group) had no significant difference even though the spread of the data was slightly greater in class 7F. However, the range (Class 7F: 47 to 100; class 7E: 23 100), quartiles of these two groups (Class 7F: 1st = 73, median = 95, 3rd = 100; class 7E: 1st = 67, median = 77, 3rd = 90), and C Level and Above (Class 7F: 96%; class 7E: 80%) suggests that the treatment had a profound effect on the students acquiring science vocabulary.

Student Scientific Writing Growth

To analyze the second sub question if using an English based reading program in science could improve second language learner's ability to write in science, a simple rubric was created focusing on three areas: clarity, argument using claim-evidence-reasoning (CER), and science content vocabulary use. This rubric can be found in Appendix F. Each area was worth 0-3 points and had specific criteria for each point. The overall score out of a 100 was then compared between the two groups.

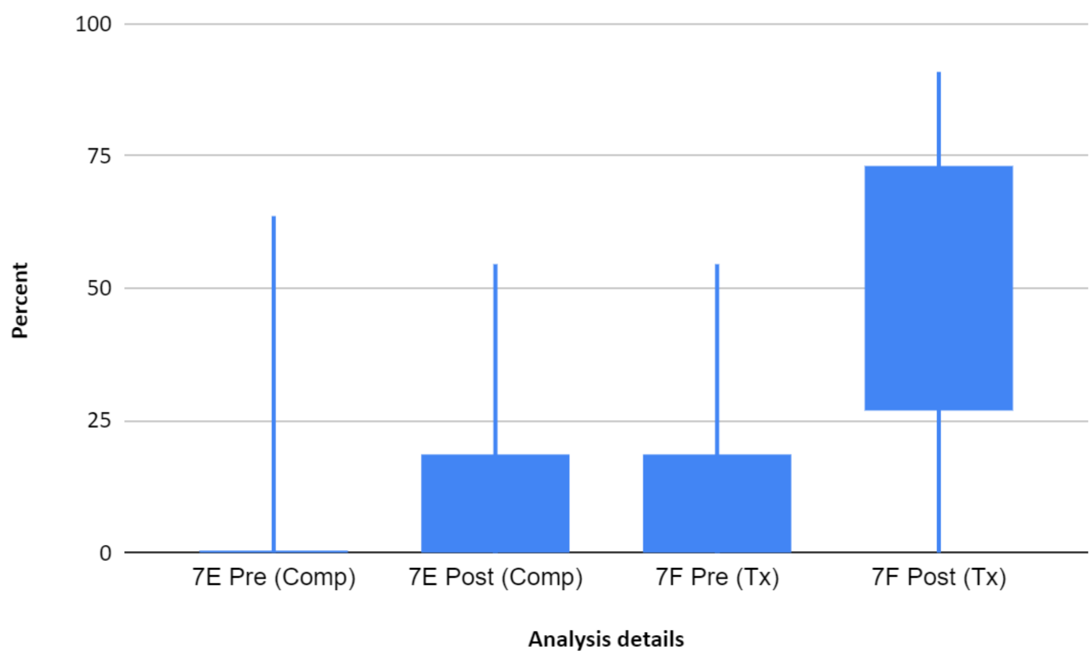

Figure 3. Comparison of writing pre and post assessments, Comparison (Comp) Group (*n*=25) and Treatment (Tx) (*n*=25).

Figure 3 shows a significant improvement in writing over the course of the unit for the treatment group 7F. Moreover, a comparison of the first quartiles (Class 7F pre-writing = 0; final writing = 73) and third quartiles (Class 7F: pre-writing = 55; final writing 91) strongly indicated that the change in medians also reflected an improvement amongst the lowest and highest achieving students. Of the students that scored less than 50% on the pre-writing, 32% of them improved to have a 50% or greater whereas the comparison group showed no significant change in writing even though the data was spread out more.

When asked to explain, "How does a rollercoaster work in terms of energy and energy conversion?" the majority of students in the treatment group improved and wrote more detailed paragraphs explaining the content well while correctly using more science terminology. Below is a sample from one student's pre and post treatment:

> *Pre-treatment:* "When the roller coaster is going up, it goes slow. The energy conversion happens when the roller coaster is falling to the bottom."
>
> *Post treatment:* "A roller coaster works by converting potential energy to kinetic energy. The roller coaster cars gain potential energy as they are pulled to the top of the first hill. As the cars descend the potential energy is converted to kinetic energy, also when it falls down sound energy comes."

Student Motivation and Reading Background

Finally, to analyze the last sub question, if using an English based reading program could motivate the students to learn science, a student survey was administered at the beginning of the research and an exit interview/survey was administered at the end. The survey gathered evidence about the students' school reading activities, non-school reading activities, and general reading activities, but in short, it allowed the researcher to find out if the students enjoyed reading and how much exposure the students had with reading informational texts and chapter books in English.

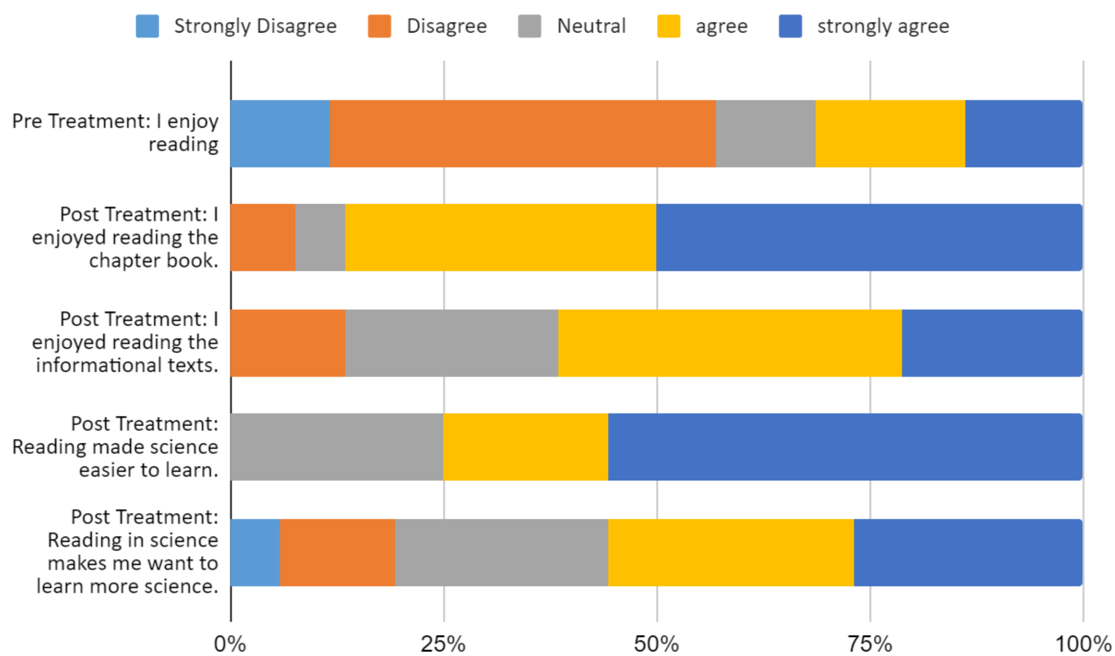

Figure 4. Total percent of reading activities for both the Comparison Group *(n*=25) and Treatment Group *(n*=25).

The most common response to the pre-treatment survey statement about if the students enjoyed reading was "Disagree," and over 50% of the students responded with either "Strongly disagree" or "Disagree," suggesting that the students do not enjoy reading. In contrast, by the end of the treatment the most common response for the statement about reading the chapter book was "Strongly agree." Furthermore, over 75%

of the students responded with “Strongly agree” or “Agree,” suggesting that there was a shift in attitude toward reading for enjoyment. A final note, just over 50% of the students responded with “Strongly agree” or “Agree” when they rated reading informational text for enjoyment.

The evidence gathered from the interview found if the students enjoyed reading more in science and if it changed their attitude toward science in a positive way. This interview suggested that the students did enjoy reading more in science. Here are a few responses: “Because it made it (Science) not so boring;” “It gave us more practice (using English)”; and “I enjoyed reading it because it is better than doing work.”

This interview also suggests that the content became easier. When asked if the science content became easier, the average rating was 4 stars out of 5. Then, when asked how it became easier, the students responded by saying the following: “Because we only read when they ask us a question about what we read and I like this;” [meaning, we read to get the answers, but I enjoyed reading this book]. Another student answered, “I understood things in the passage that I didn’t understand before because of context clues.”

Finally, this interview found out that the treatment did have a positive effect on the students. When asked if they wanted to read more fun books, the average rating was 4.2 stars out of 5 which suggests that the students are motivated to learn more science when the text is interesting. However, when asked if the students wanted to read more informational texts in science, the average rating was 3.23 stars out of 5.

CHAPTER 5

CLAIM, EVIDENCE, REASONING

Claims From the Study

This action research project sought to investigate if using an English based reading program in science could help second language learners acquire science content knowledge as well as motivate them to learn science. For the focus question, it suggests that there seems to be benefits in using more informational texts and a short chapter book in science to help second language learners become more scientifically literate. The evidence gathered in this study suggests that the treatments designed made the science content more accessible for second language learners. As the literature suggested in Chapter 2, second language learners have different academic challenges than native English speakers and it is essential that they are given the correct support needed to facilitate academic growth.

In looking at the differences between the two groups as identified in Figure 1 from Chapter 4, the treatment group outperformed the comparison group. What is more, not only did the students respond well to the treatment, but they also enjoyed it. As identified in Chapter 4, it was mentioned how over 75% enjoyed reading the chapter book, around 60% enjoyed reading informational texts, and over 50% felt more positive about science. This answered the third question on whether informational texts and a short chapter book would motivate or engage students to learn more science.

In regard to the second sub-question on whether informational texts and a short chapter book would improve a students' ability to write in science. Prior to the treatment, only 28% of the students had a writing score that passed but after the treatment 60% of the students had a score that was above the passing level. Finally, in regard to my first sub-question and whether informational texts and a short chapter book would improve a students' scientific vocabulary, it was found that the median jumped 25 percent between the pre-treatment and post-treatment test.

Value

This research treatment positively affected my students in a few areas. First, my students proved a deeper understanding of the science content by being able read and articulate the content better than before. This can be seen by referring back to the second sub-question and a students' writing ability. Second, my students' English fluency level improved within the science subject and they could see this in the growth of their vocabulary use and scientific writing. Finally, my students were more engage by having a fun story that related to their culture while also teaching them science. Again, this can be seen by referring back to the third sub question.

Yet although there were these successes from this research, there were some irregularities. As identified in chapter four, student writing improved but the researcher found that the students still struggled with "Claim-Evidence-Reasoning (CER)." For example, the students could cite facts or explain with content on how a rollercoaster worked but would often skip the claim and get right to the evidence or not connect the reasoning. Not to speculate, but the students may not fully understand how claim-evidence-reasoning works. Even though some basic examples were provided, the students still struggled and need more practice answer questions with the CER format. A good idea for future research would be to ask a question a day that needs a claim. The teacher could then conduct mini lessons on what is a claim and what is needed to prove the claim.

Impact of Action Research on the Researcher

Until more research comes out, my next steps will include continuing to use children's literature as suggested by Kasper, Short, and Armstrong as well as using other ESL reading strategies in science. For each trimester, if the content allows, I will repeat this research and design mini lesson plans that specifically work in reading activities to facilitate literacy and language development as well as English fluency. In the future, I will also administer an English fluency exam to more definitively know if an English based reading program increases the English fluency of a second language learner. This was an area of weakness in this study. As I see it, and the literature suggests, the second language learners in science do not have the fluency level to be able to read or communicate on the appropriate grade level. Therefore, future research should focus the fluency level or Lexile level of second language learners. To do this, teachers should not rely on only project-based learning or STEM related lessons. It is not what second language leaners' need; instead, the science lessons should rely on reading with hands-on activities to enrich their learning. That is why I will continue to develop myself in this area professionally and hopefully provide support or contribute to future research in this area.

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APPENDICES

APPENDIX A

STUDENT READING SURVEY

Reading Activities Pre-Treatment Survey					
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I like to read in my free time					
I like to raise my hand to read					
I like to bring books to read to school					
I think reading is hard					
I like to read just enough to answer questions					
My parents read to me when I was a child					
We have a lot of books in our home					
I enjoy reading					
I often just look at the pictures					
I read 2 or 3					

pages and then quit					
Post Treatment Survey					
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
I enjoyed reading the chapter book.					
I enjoyed reading the informationa l texts.					
Reading made science easier to learn.					
Reading in science makes me want to learn more science.					

APPENDIX B

STUDENT INTERVIEW QUESTIONS

Student Interview Questions

1. Did you enjoy reading Eissa's Big Surprise (the short chapter book) in science??

2. Why or why not?

3. Did you enjoy reading the newspaper articles and other informational texts in science?

4. What books would you like to read? (Magic School Bus, Space Adventure, Nature, Animals)

5. Did reading in science make science easier?

6. How did the science content become easier?

7. Did reading in science make you want to learn more science?

APPENDIX C

RESEARCH TIMELINE OF ACTIVITIES

Table 2. Timeline of activities.

Activity	Treatment?	Topic	Tentative Dates
Lessons 1-8	Informational Text and Narrative appx. 750 words* of the text		Weeks 1-2
Administer pre-tests (week 1)			
Administer Likert Student Survey (week 1)			
Administer a Formative Assessment (Week 1 & 2)			
***Note**—When we read and discuss a text as a class, I have noticed my students can get through appx. a 500-word text in 20 minutes. Of course, I would also follow the pace of the book.			
Lessons 6-8	Informational Text and Narrative appx. 750 words of the text		Week 3-4
Administer a Formative Assessment (week 3 & 4)			
Conduct Informal Student Interviews			
Lessons 11-13	Informational Text and Narrative appx. 750 words of the text		Week 5-6
Administer Formative Assessment (week 5 & 6)			
Lessons 19-21	Mastery Learning Cycle		Week 7-8 (9)
Administer a Formative Assessment (week 7)			
Administer student post test (week 8)			
Conduct Final Student Interviews/Survey (week 9)			

APPENDIX D

MONTANA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD

EXEMPTION CERTIFICATE

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
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Administrator:
Cheryl Johnson
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cheryl@montana.edu

MEMORANDUM

TO: William McDonnel and Walter Woolbaugh

FROM: Mark Quinn *Mark Quinn CJ*
Chair, Institutional Review Board for the Protection of Human Subjects

DATE: October 26, 2020

RE: *"Effect of Using an English (or ESL) Based Reading Strategy in Science to Help Second Language Learners Acquire Science Content Knowledge" [WM102620-EX]*

The above research, described in your submission of October 25, 2020, 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:

_X_ (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; and (iii) the information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by section 16.111(a)(7).

___ (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.

APPENDIX E

STUDENT PRE AND POST ASSESSMENT

Grade 7 Science Potential and Kinetic Energy + Conversions

MS-PS3-7(MA). Use informational text to describe the relationship between kinetic and potential energy and illustrate conversions from one form to another.

Directions: read the text below and fill in the blanks with the correct term.

Word Bank:

Kinetic, convert, potential, sound, chemical, light, gravitational, thermal, electrical, light, energy

___________is the ability to do work and every second of every day, energy is being converted or transformed from one form to another. The law of conservation of energy states that energy in the universe cannot be created or destroyed, simply changes from one form to another. There are different forms of energy, such as potential and kinetic, that transfer from one to another. Potential energy is stored energy while kinetic energy is energy in motion.

____________ includes items in motion, such as sound, light, and thermal energy. _________ energy is the movement of energy through a substance (like air or water) caused by vibrations, and travels in the form of waves. _________ energy travels in waves as well, but it is visible to the human eye. Light contains photons, which are like tiny bundles of energy that are created by the heating up of atoms. ______________ energy (or heat energy) is produced when a rise in temperature occurs causing atoms and molecules to vibrate and collide. A warm mug of hot chocolate is a good example of thermal energy.

_________(stored) energy can include gravitational, elastic, and chemical energies. ______________energy is the energy stored in an object due to its height above the Earth. The further away from the center of the Earth, the more gravitational energy an object would have. _________energy is energy stored in an object when there is a temporary strain on it, like in a coiled spring. The spring would absorb energy when compressed and releases it when it springs back out. ___________energy is energy stored in the bonds that connect atoms with other atoms and molecules with other molecules. When a chemical reaction takes place, the energy is released. ___________energy is potential as well.

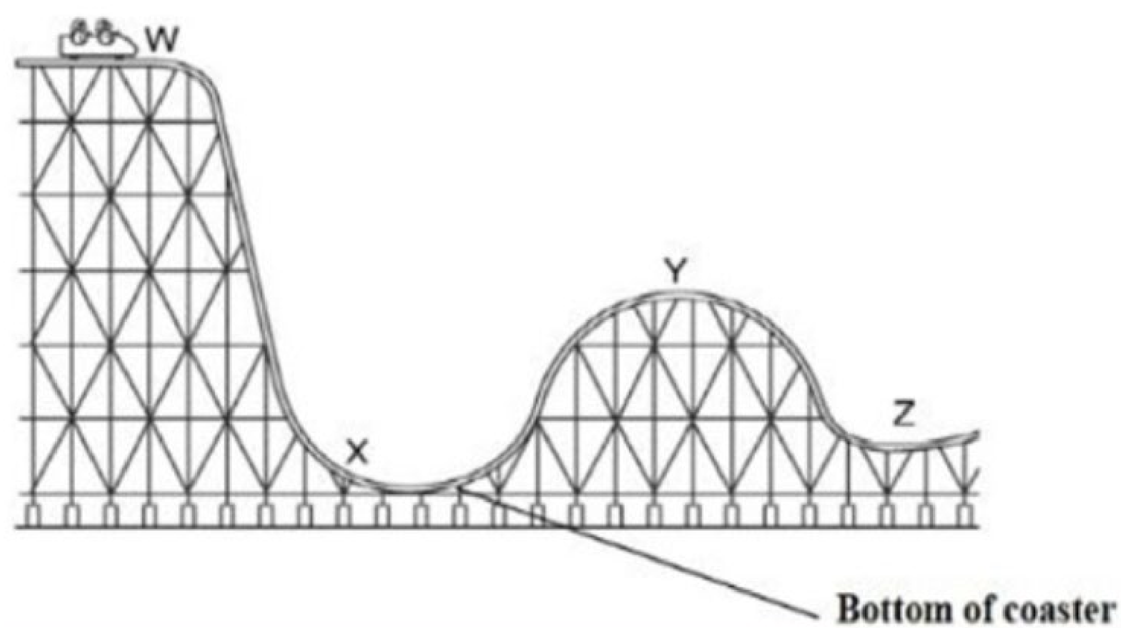
These types of energies can be convert from one to another. For example, a natural gas stove converts chemical energy into thermal energy that we use to cook food. A ball being held high off the ground would be an example of gravitational (potential) energy that would convert to kinetic energy after it was dropped. Energy is all around us and conversions are always occurring.

Directions: put the definition letter next to the term.

Definition number	Term	Definition
	Radiation	**1.** an act, process, or instance of changing place
	Conduction	**2.** A measure of the force of gravity acting on an object
	Convection	**3.** the transfer of heat between objects by direct contact
	Speed	**4.** a measure of the amount of matter in an object
	Mass	**5.** equivalent to a specification of an object's speed and direction of motion
	Gravity	**6.** usable power; never "made" only transformed or changed from one kind to another
	Observe	**7.** to conclude (something) from evidence and reasoning rather than from explicit statements
	Analyze	**8.** is a collection of quantitative or numerical data that describes a property of an object or event.
	Predict	**9.** the conversion of one form of energy into another, or the movement of energy from one place to another
	Explain	**10.** gathering information, and data, using your senses or scientific instruments
	Claim	**11.** are simply the end of the scientific experiment: What you found in your study
	Evidence	**12.** to build or make (something, typically a building, road, or machine
	Reasoning	**13.** a physical and/or conceptual representation of a system of ideas or processes
	Model	**14.** the action of thinking about something in a

		logical, sensible way.
	Construct	**15.** the available body of facts or information indicating whether a belief or proposition is true
	Results	**16.** to state or assert that something is true, typically without providing evidence or proof.
	Investigate	**17.** make (an idea or situation) clear to someone by describing it in more detail or revealing relevant facts.
	Measure	**18.** what you expect to happen if your hypothesis is true
	Infer	**19.** to study or determine the nature and relationship of the parts of something
	Transformation	**20.** a set of approaches and techniques used to make judgments.

How does this work?



Directions: Write one long paragraph telling me how a roller coaster works in the terms of energy and energy conversion.

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APPENDIX F

STUDENT SCIENTIFIC WRITING RUBRIC

	Writing Marking Scheme		
	3	2	1
Clarity of Writing	The Information was correct and made sense. Grammar mistakes did not hurt understanding. Instructions were followed.	1 of the 3 components was missing.	2 out of the 3 components were missing.
Argument CER	Claim was established, evidence was used, and reasoning was provided	1 out of the 3 components was missing	2 out of the components were missing.
Vocabulary Use	4-5 or more science vocabulary words or general science vocabulary words were used correctly: Energy, Kinetic Energy, Gravitational Potential Energy, Conversion, Transformation, etc..	2-3 science words or general science vocabulary words were used correctly.	1 science words or general science vocabulary words were used correctly.