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Vocabulary instruction: impacts of using a science notebook in a dual language setting to teach science vocabulary and content.

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VOCABULARY INSTRUCTION: IMPACTS OF USING A SCIENCE NOTEBOOK IN A DUAL LANGUAGE SETTING TO TEACH SCIENCE VOCABULARY AND CONTENT

by

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VOCABULARY INSTRUCTION: IMPACTS OF USING A SCIENCE NOTEBOOK IN A DUAL LANGUAGE SETTING TO TEACH SCIENCE VOCABULARY AND CONTENT

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University of Nebraska, 2019

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Language learners and students in general often struggle to close the achievement gap in monolingual schools because they lose academic content due to lack of vocabulary. To combat this issue, programs such as dual language schools have been introduced and have gained popularity due to their ability to help students keep learning academic content in their native language while becoming literate in the second language and also maintaining literacy in the content areas. Although these programs offer different instruction models and teaching techniques that teachers are implementing to improve science literacy, many teachers still struggle to find creative and effective methods of teaching science vocabulary and content. Vocabulary acquisition is of great importance to science literacy because it is major factor in understanding and applying science in context during classroom instruction and assessment. This action research study focused on using a supplemental science vocabulary notebook to teach content vocabulary in an elementary dual language classroom. The results of the study suggest that the use of science vocabulary notebooks may help students attain content vocabulary, as evidenced by students’ notebooks, quiz scores, and performance on chapter tests.
Keywords: dual language, reading comprehension, vocabulary development, science literacy, and vocabulary notebook
DEDICATION

This work is dedicated to Jorge and Carmen Andazola. They are my parents who migrated to the United States and sacrificed everything and spent a lifetime in another country so that their children could achieve the American Dream through education. They may have only achieved a sixth-grade education, but they raised a son who is a lifelong learner.

To my wife and children who supported me through this educational process and provide me with the motivation to keep my dreams alive.

To Dr. Thomas, Dr. Smith and the Nebraska STEM staff, who took the challenge of creating the opportunity to open the door for many teachers in rural Nebraska by bringing the NebraskaSTEM graduate program to the University of Nebraska-Lincoln. Your work and dedication will bring great positive impact in the way we educate our students.
GRANT INFORMATION

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CHAPTER 1: INTRODUCTION

The United States has long been a country of immigrants. People have come from all corners of the world to share their rich culture and traditions and mold into an existing culture that is many times referred to as a melting pot of American culture. Along with culture comes a rich diversity of languages. According to the National Center for Education, in fall 2016, the percentage of students who were ELLs (English Language Learners) was higher for school districts in more urbanized areas than for those in less urbanized areas. ELL students constituted an average of 14 percent of total public-school enrollment in cities, 9.3 percent in suburban areas, 6.5 percent in towns, and 3.8 percent in rural areas. In many rural areas across the country, the percentage of ELL students is higher. For instance, according to the Nebraska Department of Education (https://nep.education.ne.gov/snapshot.html#24-0001-003), the rural community where this study takes place has a population of 14,000 and 35.7% of the school district’s population are ELLs.

As families assimilate to make the United States a permanent home, the children of these families attend school while often learning and using one language at home and another at school. The transition to acquire a new language is often difficult and can hinder academic success in core subjects like science because the student may struggle with academic content due to lack of vocabulary associated with the content. Science is an essential component for developing student thinking, as students’ progress through grade school without having mastered science concepts, the students are affected by lacking skills to become literate in the content area as well as develop reading and writing skills (Amaral, Garrison, & Klentschy, 2002). Carrier (2011) stated, “to many English-
speaking students science words seem like a new language, and to English language learners, these words are a new language” (p.1). This language problem may lead to an academic barrier for language learner students’ success in the United States and consequently may create a setback in opportunities of success for much needed STEM related content fields that are growing at four times the rate of total employment (Hossain 2012).

At the elementary level, teachers who teach science also implement different methods that will provide vocabulary-learning opportunities for students that have a language barrier. A strong assessment culture and rigorous science state standards have added a lot of pressure for students to be science literate (Amaral, Garrison & Klentschy, 2002). As future citizens of our country, it is important for school districts to consider science curricula that are rich in vocabulary instruction while addressing the language issues. It is equally important for teachers to find solutions to better implement teaching techniques that will help students learn vocabulary in content areas like science and make teaching consideration for those that are bilingual emergent. The more sophisticated their usage and understanding of science content vocabulary, the more students will be successful in STEM related career areas (Hossain, 2012).

Many communities have high percentages of emergent bilinguals and to help keep achievement levels proficient, dual language schools are put into place to keep students learning proficiently in content areas while becoming literate in both languages. According to Thomas and Collier (2002), by implementing one-way or two-way dual-language programs, schools can expect one-fifth to one-sixth of the achievement gap for English learners to close each year while also teaching native English-speaking students a
new language and learning content in both languages. Dual language schools offer students the opportunity to gain content knowledge because content is taught in a language the students are familiar with, while also learning new vocabulary and content in a second language. In some contexts, dual-language programs consist of language immersion in a one-way model in which the second language being learned is used for instruction in early grades as much as 90%. The percentage of content taught in the second language is eventually equalled out in later grades by incorporating English at higher percentages as the students’ progress through the grade levels. Classes are generally made up of mostly English speakers or non-English speaking students.

Other programs offer bilingual instruction in a two-way program in which content instruction is divided by daily or weekly schedules of incorporating content in both languages so that students receive instruction in both languages equally. This model classroom makeup consists of native and non-native English-speaking students, which is considered the most effective model of the two (Thomas and Collier, 2002).

Within this study, dual language refers to a school program that implements a two-way or 50/50 model. There are two instructors with separate classrooms for each grade level. One instructor is assigned to teach in English while the other is assigned to teach in Spanish. The students are designated in two class sections containing roughly 20 students per section for each teacher. The sections are assigned as homerooms to each instructor. Each section begins the day in their home room and are taught in the language assigned to that instructor for half of the school day.

The students receive the core subjects like Math, Science and Social Studies in
their respective classrooms, while the other session receives the same instruction in the other language. Half way through the school day, the students switch instructors and receive reading and writing in the other language. This schedule is followed on a biweekly schedule. At the end of the first week, students change homerooms and the schedule is repeated but alternating teachers so that each group receives the same time of instruction in both languages. No lessons are repeated, but rather the students continually learn content in both languages while becoming proficient in both languages.

In teaching of science, vocabulary is directly aligned with concepts and content material being taught. English learners must have strong science vocabulary and language development skills in order to be science literate. Elementary students need to have a strong foundation and basic understating of science concepts that will lead to more sophisticated progression of science concepts in middle school and high school and consequently better prepare them for STEM-related careers (Hossain, 2012). For this reason, this action research study was carried out in a dual language setting to explore the effectiveness of using science notebooks to learn science content-based vocabulary and concepts. The study measured the effectiveness of science notebooks through student outcomes including student artifacts such as weekly science quizzes, student notebooks, and chapter test.

**Purpose and Research Question**

The purpose of this study is to explore the impact of incorporating the use of a science notebook as a supplemental tool to teach science vocabulary and content in a rural, dual-language elementary classroom setting. Teaching science requires students to
be able to learn new vocabulary and put it into context to understand the science concepts they are learning. Students need to be able to effectively process and communicate concepts encountered in science through the use of precise vocabulary. The problem facing many teachers is using effective classroom strategies to teach science vocabulary in context and ensure proficiency in the science content area. This study focused on the usage of science notebooks as a supplemental instructional tool to the school-provided curriculum to teach and reinforce vocabulary and content. The research question to be answered in this study is the following:

**How does the use of science vocabulary notebooks help students in a dual language classroom learn content-based vocabulary?**

This study helps to explore if the supplemental science notebook had an impact in maintaining proficient levels of vocabulary comprehension through a chapter by examining student artifacts such as the science notebooks, weekly quizzes, and chapter tests.

**Methods Overview**

This action research plan utilized quantitative assessment data and qualitative artifacts of student work to gauge the effectiveness of implementing a supplemental science vocabulary notebook. The study used 4th Grade level Spanish science curriculum at a rural, dual language elementary school in central Nebraska. Data sources included in the study include weekly quizzes, student notebooks, and a chapter test.

**Definition of Key Terms**

**Dual-language classroom**: Multiple types of dual language programs exist but generally it refers to a classroom where instruction is given in another language and there is a mirror
classroom that generally is English. This study took place in a program in which students’ alternate classrooms and language instruction on a recurring schedule to receive all content as equally possible in both languages. The classroom in the study was in a two-way program in which the classroom has native and non-native speaking students. The study took place in a Spanish classroom where content material is taught in Spanish. There was a mirror English classroom and instructor where the students alternate time learning both languages and content is taught in both languages. The science content during the study was only taught in the Spanish classroom due to scheduling of the program and curriculum available.

**Science literacy**: Composes the knowledge needed to understand science concepts being learned.

**Science vocabulary notebook**: A notebook that is used by students to store vocabulary words and other classroom work such as illustrations, diagrams, graphs, pictures or other graphic organizers presented during instruction time.

**Target vocabulary**: Refers to vocabulary that is part of the textbook teaching guide and assessed on quizzes and the chapter test by definition or in context to material presented in the chapter.
CHAPTER 2: LITERATURE REVIEW

Overview

Vocabulary instruction has long been a researched field. According to Marzano (1988), “The importance of vocabulary development to general academic achievement has been recognized for years” (p.1). There have also been growing disagreements on the time and emphasis that should be placed on direct vocabulary instruction (Marzano, 1988). Many methods of instruction and models have sought to help teachers develop and implement teaching strategies that produce better results in student acquisition of science vocabulary and content comprehension. As a teacher of science in a dual language setting, experience has shown me that vocabulary is a central component to learning a language and the content of the subject being taught in that language. To ensure that learners get to know new words and use them correctly in context, they will need a variety of opportunities to engage with the vocabulary and to put them into work in a variety of ways (Thornbury, 2006). Instruction to vocabulary can be introduced, practiced, and assessed in different ways. This literature review will focus on important researched components in teaching vocabulary and content to students. In particular, this chapter will review research relating to dual language classrooms, vocabulary instruction, science vocabulary instruction, and science notebooks.

One of the most important issues of the learning gap today is the difference in the vocabulary students know coming into school. Vocabulary teaching may encompass many different techniques because each classroom has different demographic scenarios in which students need to learn vocabulary to be able to become better readers of science and comprehend the material that they are instructed with (Artzi, August and Mazrum,
Each class and demographics require some type of tweaking in instruction. Lee, Buxton, Lewis, and LeRoy (2006) found components that lead to successful acquisition of vocabulary that teachers can adapt in their classroom. These methods can then be used to teach essential vocabulary in many settings and offer suggestions to integrate into successful inquiry-based science instruction and provide students with science literacy abilities to be successful in STEM related fields.

This chapter reviews literature around three major themes. The first section highlights research pertaining to dual language instruction. The next section summarizes studies about vocabulary instruction strategies followed by research specific to science vocabulary instruction. The last theme in the review is on the use of vocabulary notebooks as an instructional tool to teach content vocabulary.

**Dual Language**

General recommendations for promoting language and literacy development among dual language learners (DLLs) include: (a) keeping consistent routines and classroom organization so that children can follow activities, feel comfortable, and become socially integrated; (b) creating language- and- literacy-rich environments and using supportive methods: visual aids, gestures, emphasizing important words in a sentence, keeping the message simple, and repeating key vocabulary words; and (c) using a curriculum that helps DLLs actively participate by providing concrete experiences and materials, and being responsive to cultural and linguistic differences (Dickinson & Tabors, 2002; Tabors, 1998). Important to this study is using supportive methods such as visual aids and repeated exposure to vocabulary to provide a language and literacy rich environment.
Thomas and Collier (2003) identify a number of goals for dual language programs. These goals can be summarized as follows:

- A minimum of six years of bilingual instruction;
- A focus on the core academic curriculum rather than a watered-down version;
- High-quality language arts instruction in both languages, intergraded into thematic units;
- Separation of the two languages for instruction (no translation and no repeated in other language);
- Use of the non-English language for at least 50 percent of the instructional time and as much as 90 percent in the early grades;
- An additive (that is, adding a new language at no cost to students’ first language) bilingual environment that has full support of school administrators, teachers, and parents;
- Promotion of positive interdependence among peers and between teachers and students;
- High-quality instructional personnel, proficient in the language of instruction; and
- Active parent-school partnerships. (p.61)

These goals offer a guide to research-based components in dual languages schools. While not all components fit in every setting, they are research-based suggestions to a
successful dual language program. Each program is unique, based on the demographics where the program is implemented.

Alanís (2013) recognized the effects of pairing students from different native languages to offer each other support, as implemented in the dual language program the study takes place in. Alanís (2013) learned that students help each other and facilitate each other in learning language and sharing culture from each other. Partnering students from two language backgrounds lets them serve as language models for one another and allows them to scaffold each other’s learning while also sharing tradition and culture.

Through this type of dual language model and the above-mentioned components, students work together by using each native’s language to help the non-native speaking student and vice-versa. These are basic components in dual language schools and a necessary foundation for student learning. According to Thomas and Collier (2002), by implementing one-way or two-way dual-language programs, schools can expect one-fifth to one-sixth of the achievement gap for English learners to close each year. One-way programs refer to language instruction in two languages in a classroom with either native or non-native speaking students. A two-way immersion program offers language instruction in two languages in a classroom that consists of native and non-native speaking students grouped together.

For dual language learners, it is important for schools to implement a strong literacy and language program. Curriculum might be more beneficial if it is selected to support both languages with rich academic and language learning. Such programs need to
be mindful and take into consideration how they will deliver language and literacy instruction and how much time will be devoted to learning in the two languages.

To comprehend reading material in a dual language program, students will need to have high vocabulary knowledge in both languages. As stated in Lenters (2004):

Reading in the first or second language is founded upon oral knowledge of the language. One cannot read with comprehension a language one cannot speak and comprehend: reading instructors of young second-language learners need to be mindful of this. While a definitive level of the oral proficiency essential for reading instruction to begin is difficult to pinpoint, it appears that readers must be familiar with a minimum of 95% of the vocabulary in the text for comprehension to occur. (p. 331)

This further strengthens the need for students to know content vocabulary in a dual language setting, because the students learn content in both languages. In order to be literate in both languages, there needs to be a high percentage of vocabulary comprehension.

**Vocabulary Instruction**

According to many experts in vocabulary instruction, many students have not acquired the skills to be reading at grade level. Approximately 70% of students in the United States in upper elementary through high school have not attained the skills needed to read material at grade level (Buancarosa & Snow, 2006; Deshler, Palincar, Biancarosa, & Nair, 2007; Hayes, Flanigan, & Templeton, 2012). Research has suggested for many years that vocabulary is a main component of language. People who are language learners understand that there are limitations to being able to communicate successfully when
there is a lack of vocabulary. Communication suffers when people cannot use the correct vocabulary to express themselves to others (Allen, 1983; Sadeghi & Sharifi, 2013).

Vocabulary in general is essential for student learning and constructive dialogue to take place in a classroom. During science instruction, it is an essential part of explaining ideas and concepts to the teacher and expressing their knowledge and comprehension to others. Precise vocabulary is needed to be able to become science literate and communicate to others about what they are learning. To ensure that learners get to know the new words, they will need multiple opportunities to engage with the words and to put them to work in a variety of contexts (Thornbury, 2006). Vocabulary instruction is not just exposure to reading or writing the definition of a word. Vocabulary learning is a memory task, but it also involves creative and personalized use, that is, learning and using (Thornbury, 2006).

A word is to be presented and exposed in different context and content areas when possible. Sadeghi and Sharifi (2013) studied pre and post teaching activities to measure vocabulary acquisition. Sadeghi and Sharifi (2013) measured different activities and outcomes to exposure of vocabulary words. The researchers used a variety of methods to expose one hundred and sixteen adult Iranian elementary emergent bilingual learners to vocabulary instruction through the use of pre and post activities such as writing, role playing, games and speaking tasks to see if these activities helped the students learn and recall the vocabulary instructed.

Nation (1982) argues that using and exposing words in a number of varied environments will help students grasp the meaning of the word at deeper levels of comprehension. The results of Sadeghi and Sharifi (2013) indicated that these activities
did help students increase vocabulary knowledge. In particular, students who were given the use of games to practice vocabulary, obtained better results than those that received speaking tasks and story writing as their treatment. Role-playing had the highest yields in the study. The study recommended instructors take instruction time to use such activities when teaching vocabulary. The activities consisted of kinesthetic movement or activities that most children would deem interactive and fun (Sadeghi & Sharifi, 2013). Students many times like activities in which they are active participants or are involved in taking part and creating the material they are learning. Using these activities to teach vocabulary may provide an exciting activity while also using that stimulus to learn vocabulary words and concepts. These activities often provide students with a positive fulfillment of learning.

A much larger-scale research synthesis gathered and reviewed 324 studies on current research on vocabulary instruction by the National Reading Technical Assistance Center (Buenger, Butler, Eisenhart, Hunt, Gonzalez & Urrutia, 2010). The synthesis used current findings to help guide trends and suggestions in effective vocabulary acquisition issues for teachers to use in their classrooms. The final written study synthesis included 14 of the 324 studies ranging from the year 2004 to 2009. The researchers agreed that vocabulary instruction is a crucial part of instruction. According to Buenger, et al. (2010), the goal of vocabulary instruction is to help students learn the meanings of many words so they can communicate effectively and achieve academically. The study found important research themes and suggestion when implementing vocabulary instruction. Buenger, et al. (2010) offered the following suggestions:
• Frequency of exposure to targeted vocabulary augments children’s understanding of words and their use of target words.

• Explicit instruction increases word learning.

• Language engagement through dialogue and/or questioning strategies during read-aloud enhances word knowledge. (p. 3)

The research synthesis by Buenger, et al. (2010) confirmed the benefits of explicit teaching over implicit teaching when teaching vocabulary development.

**Science Vocabulary Instruction**

Traditional methods of teaching science lessons include teachers asking students to find and write down definitions of words or look up words in dictionaries or glossaries of textbooks. Carrier (2011) argued that this model of instruction presented words in isolation only for definition of words, but not deeper understanding or use in context and without application to concepts in the science field. This traditional method of teaching often leaves students memorizing key words in the definition and students learn to find those key words in test or quizzes without truly knowing what the word means in context to what they are learning. Word definitions are often memorized for the short-term use and the word may never make it to long-term memory storage.

Carrier (2011) also argued that limited time is a factor in good science vocabulary teaching and that eagerness to teach content under time restraints provide only a brief introduction of science terms. Suggestions to teaching science vocabulary in other ways than that of traditional methods as described above include giving time to talk and using visual representations. Giving time to talk provides students with needed instructional conversation in order for them to process what they are learning. Using pictures and
labels, words games, word list and graphic organizers are other effective strategies for teaching science vocabulary. Carrier (2011) stated that the modeling of words throughout instruction not only reinforces students’ comprehension, but it also maximizes teachers’ instructional time. Vocabulary instruction is effective and engaging when it includes different kinesthetic support. Providing physical levels of support is very important in content-area teaching. Teachers can use graphic representations to convey understanding of science concepts that prove to be beneficial to student from diverse backgrounds. (Best, Dockerell & Braisby, 2006; Carrier, 2011).

In a review of research by August, Artzi and Mazrum (2010) on effective science instruction for English language learners, two findings from intervention studies were reported that measured the effectiveness in enhancing academic and content specific vocabulary in students. The first reviewed intervention used the Full Option Science System (FOSS) materials. FOSS is a research-based science curriculum that was developed by the University of California at Berkeley. The intervention methods intended to develop students’ general academic and content specific vocabulary through the use of FOSS lesson plans using shared reading and discussions that required using targeted vocabulary. This method intended to reinforce the meaning of the words and have the students use the words in context. Glossaries, concept maps and review games were used to reinforce the targeted vocabulary as well.

The second intervention was part of Quality English and Science Teaching (QuEST). This intervention consisted of components that were supplemental to the district’s curriculum (August et al., 2010). The instructional material followed an inquiry approach to teaching vocabulary that was developed by the Biological Science
Curriculum Study. The Five E model of learning was used and consisted of activities designed to engage, explore, explain, extend, and evaluate. According to August, et al. (2010), visuals were consistently used in science lessons, including illustrations of vocabulary concepts and graphic organizers during the teaching of lessons. Both interventions were effective in developing the academic vocabulary of the students. Importantly, this study showed that scaffolding and a focus on language development was an effective method for helping students learn content-based vocabulary in science classrooms. Posttest results showed that students who received the interventions had statistically significant improvement over students who did not receive interventions for both science knowledge and vocabulary (August et al., 2010).

Providing students with inquiry vocabulary strategies can significantly support their understanding and interest concerning the language of science (Young, 2005). Young (2005) draws upon the following recommendations from Gunning (1998) to improve students’ comprehension by increasing their vocabulary:

- Contextualize word meanings: Use the words within real and meaningful content-area text.
- Establish relationships: Help students discover how new vocabulary words are related to each other and to words they already know.
- Provide multiple exposure and usage of words: Promote accessibility, active manipulation, and internalization. (p.12)

These recommendations can serve as guidance to teachers and administrators when developing instructional methods within their classrooms and school curricula.
Science Notebooks

Despite the abundant number of methods and techniques teachers implement in their classrooms to help learners learn the new vocabulary items at proficient levels, less attention is paid to techniques that help the retention of those items. Learners are usually left with a large number of items they are expected to recall after the initial instruction on definitions and use of words, most of which fade away over time (Sadeghi & Sharifi, 2013).

To combat this issue, many teachers have implemented some form of a notebook to have students store their work and thoughts in science. Students need to have a place and means to reflect their ideas and learning process. Student science notebooks are a student’s personal record, an extension of their mental activities, and store of personally valued information (Klentschy, 2008). Depending on the grade level, a notebook may consist of inquiry-based methods of writing down vocabulary words. The students may also add graphs, drawings, tables or diagrams to reinforce what they are learning in class. Some methods also include writing down daily thoughts of what they learned to internally process their thinking and knowledge of the content they are learning. Student science notebooks have also been shown to be the best record of the science that is actually taught by teachers and learned by students in classrooms and provide a useful ongoing assessment and feedback tool for teachers (Ruiz-Primo, et al., 2002).

Bozkurt and Walters (2009) examined the effects of vocabulary acquisition by using vocabulary notebooks on three lower-level intermediate bilingual emergent students. A vocabulary notebook was used with a treatment group while the other two served as a control group. The study was implemented over a 4-week period. The results
demonstrated that the treatment group outperformed the control groups on receptive and controlled productive vocabulary tests. The treatment groups were also able to correctly use the target vocabulary learned in the writing exercises. The control groups did not demonstrate this ability. The results of this study demonstrate that vocabulary notebooks are more effective in helping students to learn the target vocabulary in a set of course materials, in direct contrast to more traditional method of addressing vocabulary (Bozkurt & Walter 2009).

**Summary**

Dual language programs serve to close achievement gaps for bilingual emergent students and also offer students proficient in English the opportunity to learn another language, while maintaining proficient levels in content areas such as writing, reading, social studies and Science in both languages. Vocabulary acquisition is the foundation for strong literacy skills that will help students acquire knowledge in a content area. Vocabulary is of great importance for success in content areas and essential for students to be successful in a dual language setting.

Important to this study, the literature review summarizes key components in vocabulary instruction. Vocabulary forms the foundation for students to become science literate and effectively communicate their thoughts and ideas to others. Equally significant, science literacy provides deep knowledge of how the targeted vocabulary can be applied directly into context of the content they are learning. Research is the field of vocabulary instruction is vast and many methods and suggestions have been found to be effective. Of importance to this study is the gap in literature of usage of science vocabulary notebooks in a two-way immersion dual language setting to enhance student
learning by giving the students a venue to store thoughts, work and acquired knowledge through an organized manner. The vocabulary notebook is a tool of instruction for students and teachers to reinforce learning that is taking place in the classroom.
CHAPTER 3: METHODS

Overview

As a bilingual dual language instructor who teaches science content in Spanish, I have found that students often need more time and different methods for learning content vocabulary well enough to apply it in context, as assessed in weekly quizzes and chapter tests. My classroom instruction in science is limited to 30 minutes per day. I have taken special consideration to how I teach the science content vocabulary so that students can learn the word definitions but also learn and recall the vocabulary in context for exams. I try to gear away from only memorization of definitions and prefer to introduce the word and content using a variety of techniques focusing on definitions, pictures, and kinesthetic activities such as writing, coloring, and pasting organizers into a science notebook.

The data from student artifacts were compiled during the length of the study for approximately four weeks for overall observation of general academic progress and proficiency in science quizzes and chapter tests. During this time, the intervention use of a science notebook was used as an instructional tool to reinforce content and vocabulary learning. Three student artifacts were collected to gauge for learning from each participant. The first artifact was a weekly quiz of content learned during the week that consisted of vocabulary definitions and applying it in context over a short period of instruction. The second artifact was a chapter test that assessed the content learned over a longer period. Both of these artifacts are provided and developed by the curriculum company as assessment tools. The third artifact was the science notebook; it consisted of student notes developed by the researcher along with aligned supplemental material.
purchased by the researcher from Teacher Pay Teacher. These materials consisted of kinesthetic activities that helped strengthen instruction of the target vocabulary introduced in the textbook. The action research plan hypothesis was that the notebook would have a positive impact on the students’ recognition of the content-based vocabulary and aid in recalling and using the vocabulary in context when taking quizzes and the chapter test.

Context of the Study

This study took place at an elementary school in central Nebraska. The school is a K-5 dual language campus that serves 350 students in Grades K-5 in self-contained classrooms. The campus integrates a 50/50 model in which half of instructional time is divided into Spanish and English with content material taught in both languages. Students learn school subjects with no repeated lessons. The goal is to have students become bi-literate while maintaining proficiency in the content areas in both languages. During this study, science was taught in Spanish.

The school district where this study took place has 3,051 students (2017-2018). The free and reduced lunch percentage for the district was 75.7%. The mobility rate was 14%. The English language learner percentage was 35.7% and a total of 25 different native languages are spoken with in the district. The graduation rate is 89.3% with a 72% college-going rate compared to the state of 88.3% graduation rate and 75% college-going rate. Student ethnicity for 2015-16 was 73.7% Hispanic, 16.5% white, 5.8% African American, 2.4% more than two races and Alaskan Native, Asian and Pacific Islander were all less than 1%. Enrollment rates have increased from 2011 to 2015. Median household income in 2016 was $44,834. The percent of population in poverty was 20.4%.
As a Spanish instructor in a two-way immersion dual language program, content in my classroom is delivered in Spanish using Spanish written textbooks and materials that mirror textbooks and materials in the English classroom. Due to state testing in the English language, some material is reinforced in English, after initial Spanish instruction by the Spanish instructor to make connections with cognates in both languages. The dual language program fits well in our community because there is a high percentage of ELL students.

Dual language resources are limited and can be difficult to attain. In fourth grade, students learn Nebraska History and material for this content is only offered in English. During the second semester when this study took place, all science was taught in Spanish while Nebraska History was taught in English. For this reason, the teaching intervention of a science notebook to help students learn and reinforce science content and vocabulary was implemented in Spanish during the study. Under other circumstances, science would be taught in both languages according to the two-way immersion model in place at the campus.

The textbook used in the study was Scott Foresman Ciencias (2008): Una nueva luz para el aprendizaje. Grado 4. A typical science lesson during this action research consisted of roughly 30 daily minutes in which students received instruction through reading the science textbook, class discussions, short video presentations, asking and answering questions, and writing notes and graphic organizers in the science vocabulary notebooks. The allocated time was structured with 10 to 15 minutes spent introducing new content and associated vocabulary and 15 minutes were spent on reinforcing the
content using the science notebook through discussion and questions. This schedule was followed on a weekly timeline and an assessment on the covered material was given on the last day of the week. This weekly assessment was used as a data source during the study, as well as chapter test at the end of the chapter and the student notebooks. Vocabulary content was taught in Spanish but for the purpose of this study, they are used in context of their English translations. A summary of the chapter used in this study can be found in Table 1.

Table 1

*Overview of Science Chapter in This Study*

<table>
<thead>
<tr>
<th>Chapter Number</th>
<th>Science Content Focus</th>
<th>Number of Lessons</th>
<th>Number of Quizzes</th>
<th>Key Vocabulary Terms (English)</th>
<th>Key Vocabulary Terms (Spanish)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3* Ecosystems</td>
<td></td>
<td>3</td>
<td>3</td>
<td>Ecosystem, population, community, niche, herbivores, carnivores, omnivores, decomposers</td>
<td>Ecosistema, población, comunidad, nicho ecológico, herbívoros, carnívoros, omnívoros, descomponedores</td>
</tr>
</tbody>
</table>

*The intervention took place during Chapter 3*

Each lesson took approximately one week to complete. A summary of the lesson themes and target vocabulary for each specific lesson can be found in table 2.
### Table 2

*Overview of lesson themes and vocabulary presented in each lesson.*

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Theme</th>
<th>Target Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1</td>
<td>¿Cuáles son las partes de ecosistemas?</td>
<td>ecosistema (ecosystem), población (population),</td>
</tr>
<tr>
<td></td>
<td>(What are the parts of ecosystems?)</td>
<td>comunidad (community), nicho ecológico (niche)</td>
</tr>
<tr>
<td>Lesson 2</td>
<td>¿Cómo fluye la energía en un ecosistema?</td>
<td>Herbívoros (herbivores), carnívoros (carnivores),</td>
</tr>
<tr>
<td></td>
<td>(How does energy flow through ecosystems?)</td>
<td>omnívoros (omnivores), descomponedores (decomposers)</td>
</tr>
<tr>
<td>Lesson 3</td>
<td>¿Comó fluye la materia en un ecosistema?</td>
<td><em>New vocabulary was not taught during this lesson.</em></td>
</tr>
<tr>
<td></td>
<td>(How does matter flow through ecosystems?)</td>
<td></td>
</tr>
</tbody>
</table>
Participants

The participants in this study were fourth grade students in my dual language elementary classroom. The classroom consisted of 19 students, 8 of these students received parent consent to participate in the study. The students consist of four females and four males. Five of the students were from English-speaking households and three from Spanish-speaking households. The range of academic performance consist from two students who are considered high ability learner students, five general education students and one student who was verified for special education but was not receiving services at the time of the study. The class is organized in a dual language model that has approximately 50% native English speakers and 50% native Spanish speakers. The science content and related materials were taught in Spanish for all participants.

Data Collection

This study utilized 4th grade level science weekly quizzes, a chapter test from the school science curriculum, and the science notebook as data sources. The teaching strategies consisted of regular lecture activities and a science notebook with kinesthetic vocabulary and materials to see if the science notebook implementation had an impact on student achievement in science content application and vocabulary recognition. The material presented in the science notebook asked students to cut, draw, color, and paste diagrams and vocabulary words into organizers. Students’ were tasked with keeping these activities in their science vocabulary notebooks to reinforce their learning as presented in the textbook. Some vocabulary words were printed and others required students to write manually. For each vocabulary word, the organizers included the term, definition, and a
picture or diagram to help the students put the target vocabulary into context with the
lesson material taught during lecture.

Chapter 3 was chosen from the curriculum textbook based on standards that
needed to be taught during the study timeframe. During this chapter, I added an
intervention of using the science vocabulary notebooks as a supplemental tool for
teaching vocabulary and reinforcing content that was presented in the textbook. This
chapter took approximately four weeks to complete.

**Weekly progress quizzes.**

The weekly quizzes consisted of questions that ask for vocabulary identification
and also to be used in context from the material presented in the lesson. This included
definitions of vocabulary or questions that required applying the vocabulary into context
with the material learned in the chapter and implemented in the science notebook
activities.

Weekly quizzes were given to the participants to measure their progress in learning
vocabulary and content from each lesson in the chapter. The chapter used in the study
was chapter three of the textbook and consisted of three lessons and three quizzes. The
quizzes consisted of vocabulary definitions and questions applying the vocabulary in
context. (See Appendix A.)

**Chapter test.**

The chapter test was provided by the school curricula and was collected to gauge
the impact of using science notebooks to teach and reinforce the vocabulary and content
presented in chapter three. The science chapter test consisted of questions pertaining to
the content of the chapter learned over the study period that was presented in the lesson
and lesson quizzes. The format was mostly multiple-choice questioning and required retention of the content over a longer period than the weekly quizzes. The students needed to recognize content vocabulary and also be able to use the word in context, as well as identify illustration and diagrams.

Data from the chapter test was collected to gauge if the students learned and retained the vocabulary and content presented in class and reinforced with activities in the science notebook. The test consisted of multiple-choice questions that measured understanding of science concepts using the vocabulary presented in the chapter (see Appendix B.)

**Science vocabulary notebooks.**

The science notebooks were given to each student as a supplemental tool to learn content-specific vocabulary presented in the chapter of the textbook. The students were directed by the teacher-researcher to add content to the notebooks as the material was being presented. Time was allocated for students to write, color, cut, and paste the material that was being used in the notebook. Students were also given time to review content in the notebook before lessons in 3-5-minute daily intervals. Students also used their notebooks during class discussions as a reference tool. Students’ science vocabulary notebooks were collected and reviewed for completion of the notebook activities.

Figures 1 and 2 are examples from the student science vocabulary notebooks that show a variety of approaches to teaching vocabulary that were implemented into the science notebook. Figure 1 demonstrates student work showing written definitions complied by the classroom with guidance of the classroom teacher. The definitions are written in the notebook using a t-chart method with the vocabulary on one side and the
definition and examples on the other side. The definition was defined by student and teacher collaboration and reinforced with pictures and examples. Figure 2 shows student work for vocabulary activities that require cutting, coloring and pasting. The vocabulary word definition is student friendly and is reinforced with an illustration to provide an example. See Appendix C for further examples of students’ science vocabulary notebooks.

Figure 1. Example of science vocabulary notebook entry for Ecosystemas.
Data Analysis

Each day of the week, new content was presented and recorded in the student notebooks. At the end of the week the students were given a quiz over the content covered during that time frame. The weekly quizzes and chapter test were analyzed, graded and inputted into GradeBook to measure the extent to which students demonstrated understanding of vocabulary and content while using science notebooks. The data from the weekly quizzes and chapter test were analyzed descriptively. Each student grade was recorded using PowerTeacher Gradebook-PowerSchool 2.8; a district
provided software. Assessment data were analyzed using an online statistical tool to calculate descriptive statistics including standard deviation and mean. Data about percentage grade on weekly quizzes and the chapter test were also summarized.

Since creating science notebook entries was a collaborative class activity, these data were not analyzed individually for accuracy of content. Instead, content analysis was used to analyze science vocabulary notebook entries and their alignment with textbook content and assessment items. Learning opportunities and activities presented in the student notebook samples were compared with research-based strategies and recommendations. Then, items and vocabulary on science notebook pages were compared with items on vocabulary quizzes and the chapter test. This analysis yielded findings about the alignment between what students did in their science vocabulary notebooks, lesson content and vocabulary, and textbook assessments. Analysis of all research data were used to answer the research question:

How does the use of science vocabulary notebooks help students in a dual language classroom learn content-based vocabulary?

Summary

A teaching intervention was implemented in a dual-language elementary classroom to provide insight about how the use of science vocabulary notebooks impacts student learning and retention of science vocabulary. This study examined student outcomes on science quizzes and chapter tests when students used science vocabulary notebooks. Descriptive data from student quizzes and chapter tests were collected for analysis in this study along with the science notebooks. The following section discusses the results of the study and addresses the research question.
CHAPTER 4: FINDINGS

Overview

The findings of the study suggest that the use of science vocabulary notebooks as a supplemental tool for instruction may have helped students learn and retain content-based vocabulary. In this chapter, findings are organized by the research question and presented in a table to provide information on the results of students’ quizzes and chapter test that were taken during the study. The research data are organized into two claims that indicate alignment between science vocabulary notebooks, and students’ demonstration of vocabulary understanding on quizzes the chapter test while using science vocabulary notebooks. Findings suggest that the use of the science notebooks may be beneficial in instruction to help students learn content vocabulary in science and consequently may positively impact quiz and test results.

When the students used the science notebooks, students demonstrated proficient levels of understanding by connecting images, words, and graphic organizers to target vocabulary. The correlations are not direct, but the study suggests that, while using the science vocabulary notebooks, students performed high on lesson quizzes and chapter test. This chapter addresses the research question of the study: How does the use of science vocabulary notebooks help students in a dual language classroom learn content-based vocabulary?

Claim 1: Science vocabulary notebooks provided research-based vocabulary learning experiences that aligned with textbook content

In lesson 1, the target vocabulary was ecosystem, population, community, niche, biotic/abiotic factors and specific characteristic of ecosystems were also taught and
reinforced using the textbooks for initial exposure and reinforcement with the science notebook. Student activities in the notebook in this lesson consisted of learning about ecosystems and their characteristics. The information was presented in the textbook. The first notebook intervention was to create a T-chart of ecosystem examples covered in the textbook and reinforced with student and teacher composed definitions of each ecosystem. This helped as an informal assessment to check if students were understating the content presented in the textbook. Student were exposed to a variety of stimulus such as drawing, coloring and writing for this activity as suggested by Carrier (2011) and implemented throughout the usage of the science notebook. The first definition on the page is of the word “system” in general. The definition was not assessed in quiz 1 but was assessed in chapter test question 1 (See Appendix B).

As suggested by Young (2005), the first definition in this activity offered establishing relationships to words the students may have known with real and meaningful context. Students make connections suing the word and refer to in context to what they know such a bicycle or Nintendo gaming system. Students then applied the vocabulary word in context to how an ecosystem also functions as a system.

Student were given time to talk and brain storm examples of vocabulary as suggested by Carrier (2011) and shared with partners the examples they came up with in reference to a system, as suggested by Alanís (2013). This was followed by class discussion and then student findings were added to the science notebook.

The lesson was continued by students reading aloud in the text book of ecosystems and how the components also form a system with many parts. The textbook then gave examples of different ecosystems found around the world and their
characteristics such as climate and biotic/abiotic factors present in each ecosystem. This information was also added to the science notebook and allowed students to manually participate in their learning. Students helped the teacher come up with student definitions and characteristics about what they had read and drew pictures to represent each ecosystem as a class. This recall and varied exposure to the vocabulary content information helped students to have multiple exposure to vocabulary as suggested by Young (2005) by coming up with collaborative written definitions on the characteristics of the ecosystems presented in the text book and pictures and examples to reinforce meaning. Similar research-based suggestions that were addressed in the literature review were followed throughout the creation of the science notebook.

The following section provides overview of the science notebook content and gives examples of student work in the notebook and explanations of how it correlates to the assessments collected in the study. Figures 3 and 4 show examples of the student notebook page from a participant in lesson 1 as discussed above.
Figure 3. Example of science vocabulary notebook entry for lesson 1 on defining a system and ecosystem.
Figure 4. Example of science vocabulary notebook entry for lesson 1 with characteristics for forest and tropical rain forest ecosystems.
Figure 6 and figure 6 show another method to reinforce the target vocabulary of population, community, and niche in reference to ecosystems as presented in the textbook for lesson one. Habitat and individual were not target vocabulary but were important for overall comprehension of concepts.

The class discussion consisted of first talking about the students’ own community and the different animals found at a local park with a pond. Students were able to identify animals and plants that can be found at this pond such as ducks, fish, birds, trees, flowers and how they make up different populations of animals and plants within the pond ecosystem. The students then learned how these animals interact as a system and interact in a community.

The science notebook intervention consisted of having students cut and paste pre-printed vocabulary definitions and pictures to go along with the target vocabulary. The students were asked to read aloud the definitions and explain the pictures to partners using the target vocabulary after they were finished cutting and pasting. Niche was a target vocabulary word that was not included in the pre-made printout so the students were asked to hand write the definition on the bottom of the page. The teacher-researcher walked around the room listening to students and offering feedback when necessary.
Figure 5. Target vocabulary presented in science notebook with pictures and a hand-written definition for vocabulary term “niche”.
Figure 6. Shows the definition located under the picture and vocabulary definition.

**ECOSISTEMA**

Comunidad de seres vivos y elementos no vivos que se hallan en un área determinada

**Un organismo**

Conjunto de poblaciones de diferentes especies que habitan en una misma zona.

**Nicho ecológico:** El trabajo (rol) que tiene un organismo en su ecosistema.
Figure 7 shows the target vocabulary activity for biotic and abiotic factors present in some ecosystems. This activity presents the target vocabulary by providing short and precise definitions of each target vocabulary on the left. Students colored, cut, pasted and sorted examples of each example for biotic and abiotic factors with the corresponding pocket of the target vocabulary definition. As informal assessment, students were asked to first write the corresponding words of the picture in each pocket to assess they understood where each picture should be located and could use the content vocabulary in context of objects they were familiar with, as suggested in Sadeghi & Sharifi (2013).

*Figure 7. Activity for biotic/abiotic factors.*
In figure 8, students were asked to cut and paste the illustrations of two ecosystems and identify the biotic and abiotic factors present in a forest and pond ecosystem. After they worked individually, students were asked to check with a partner before calling over the teacher-researcher to assess and give feedback. Language engagement through dialogue was suggested by Buenger, et al (2010).

Figure 8. Student activity to check for understanding of content presented on biotic/abiotic factors.
Figure 9 shows the lesson 1 quiz that was used to assess the lesson content and vocabulary. The quiz format consists of the first 4 questions assessing definitions presented in the textbook and reinforced with the science notebook activities. Questions 5-8 are true/false questions that pertain to abiotic/biotic factors and characteristics of certain ecosystems that parallel what was written in the science notebook. Question 9 on the quiz was not assessed and was completed as a class. The question addresses a math problem on the population of birds diminishing from one year to the next.

Figure 9. Example of quiz assessment in lesson 1.
Target vocabulary presented in lesson was herbivore, carnivore, omnivore and decomposer. The vocabulary was presented to deepen the understanding of consumers and producers as presented in the textbook and how decomposers play a role in ecosystems. The science notebook activity to reinforce consumers consisted of coloring, cutting and pasting illustrations and definitions behind the pictures as shown in Figures 10 and 11. Students were able to engage with the vocabulary by folding and flipping up the illustration and revealing the definition.

*Figure 10.* Types of consumers are presented with vocabulary word and illustration.
Figure 11. Backside view of definition to different types of consumers.
Figure 12 shows an activity that consisted of coloring, cutting, pasting, and folding the manipulative into the science notebook. This activity was added to the science notebook to offer another exposure to the target vocabulary while also providing a guessing game in which students worked with a partner to try and guess the illustrations that were present in each group as implemented in Sadeghi and Sharifi (2013).

*Figure 12. Multiple exposure to target vocabulary. The flaps manually fold in to cover the target vocabulary words.*
Figure 13 demonstrates an informal assessment completed by the students to demonstrate knowledge of the content presented in lesson 2. In this notebook activity, students were asked to cut and paste the consumers in the corresponding vocabulary boxes according to what type of consumer was shown in the illustrations. Partner talk and class discussion was followed after this activity to address incorrect answers.

Figure 13. Notebook activity to reinforce content from lesson 2.
The following activity in figure 14 was completed in the student notebooks as practice in lesson 2 for identifying consumers, decomposers and producers. This activity consisted of first circling the correct category for each illustration. Then students were asked to cut, paste, and sort illustrations into the three categories, providing the students with another varied approach to interacting with the vocabulary as was suggested by Thornbury (2006).

*Figure 14. Notebook activity to practice content in lesson 2.*
Figure 15 is a foldable activity that helped support content from food chains and energy flow presented in lesson 2 and revisited in lesson 3. Students were asked to color, cut, and paste the diagram into their science notebooks. Students also used this activity as a dialogue activity to explain the flow within the food chain to a partner and the source of energy as assessed in the chapter test question 6 (see Appendix B).

*Figure 15. Food Chain activity.*
Figure 16 was also an activity that presented the students with examples of a food chain and a food web. Class discussion was used to show the similarities and differences between the two. The food web was also assessed on question 8 of the chapter test with another example of a food web (see Appendix B).

Figure 16. Science notebook activity with examples of a food chain and food web.

Figure 17 is a blank copy of the lesson 2 quiz. Questions 1-4 consist of identifying vocabulary presented in the textbook and reinforced using the science notebook. Question 5 and 6 ask students questions using clues in context to the target vocabulary and 7 and 8 ask questions pertaining to how energy moves in a food chain and food web (see Appendix B). Question 9 asked students to write, in order, how decomposers affect ecosystems.
Repasar términos: Unir

Une cada descripción con la palabra correcta. Escribe la letra en la línea junto a cada descripción.

1. consumidores que sólo comen plantas
2. consumidores que sólo comen animales
3. consumidores que se alimentan de plantas y animales
4. consumidores que digieren los desechos y restos de plantas y animales muertos

a. omnívoros
b. herbívoros
c. descomponedores
d. carnívoros

Repasar conceptos: Completar oraciones

Completa cada oración con la palabra o frase correcta.

5. Un ____ puede comer algunos alimentos que comen los carnívoros. (herbívoro, omnívoros)
6. Un animal que tiene garras y dientes filosos probablemente es un ____ (herbívoro, carnívoros)
7. En una cadena alimentaria, la energía fluye en ____ (dos direcciones, una dirección)
8. Todas las cadenas alimentarias comienzan con la energía de ____ (la luz del Sol, los consumidores)

Aplicar estrategias: Secuencia

9. Las siguientes oraciones en desorden explican cómo los descomponedores afectan a los ecosistemas. Usa las palabras clave para escribirlas en el orden correcto. (2 puntos)
Finalmente, los animales se alimentan de las plantas.
Después, los minerales y nutrientes vuelven a la tierra.
Primero, los descomponedores digieren los desechos y restos de organismos muertos.
Luego, las plantas vivas usan los materiales.
Figure 18 was a matching activity used during lesson 3 to practice vocabulary presented in all three lessons. No new vocabulary was presented in this lesson and this activity was used as a review of vocabulary in context to what was learned in the other two lessons. Students worked individually and called the teacher-researcher over to their desk to assess. Students that did not have the correct matching were instructed to try again until successful completion of the activity. Once the student had all the correct matching, they pasted the activity into their science notebooks. As seen in this student example, the vocabulary words were sorted into two larger groups of consumers and ecosystems (left side of figure) demonstrating deeper comprehension of the concepts.
Figure 18. Review activity presented in lesson 3.

Figures 19 and 20 were added to the science notebook to demonstrate flow of energy in a food pyramid. Figure 19 is the top layer that folds to reveal the type of consumer in context to consumers in an energy pyramid. This content was not directly presented in the textbook but was added to the notebook for further development and comprehension of energy flow in an ecosystem.
Figure 19. Front side of energy pyramid activity.
Figure 20. Back layer of energy pyramid.
Figure 21 shows a copy of quiz 3. Question were true/false. The content of question 1-3 assesses content on habitats of organisms found in aquatic ecosystems.

Question number 3 assesses food web content and the remaining questions assess content on decomposers. Question 9 asks students to address what would happen if decomposers did not exist in ecosystems. This question was not included in the grade as was used as a discussion point during lecture.

Figure 21. Lesson 3 quiz.
The science notebook was developed taking into consideration the recommendations and suggestions in the literature review. Research demonstrates that vocabulary notebooks are more effective in helping students to learn the target vocabulary in a set of course materials, in direct contrast to more traditional method of addressing vocabulary (Bozkurt and Walter 2009). The activities presented in the notebooks offer an interactive and varied approach to expose students to science vocabulary and content which contributed to the student success in the assessments as presented below. Through these activities, students were able to reinforce and demonstrate their understanding of science content and vocabulary that aligned with quiz and chapter test assessments from the textbook.

Claim 2: While using science vocabulary notebooks, students’ demonstrated proficient understanding of science vocabulary in vocabulary quizzes and on the chapter test.

The results indicate that all participants were able to maintain proficient averages on weekly quizzes during the use of the science notebooks. The overall participant average was 92% proficiency on the three weekly quizzes assigned in chapter 3 during the study. The participant average percentage for the first weekly quiz was 91% proficiency. The week two quiz average for all participants in the study was 94%. The week three average was 92% proficiency. The chapter test average during the study when the science notebook was implemented was 92%. Table 3 shows the average percentage grade for each weekly quiz and average percentage score for the three quizzes combined for each participant along with the percentage grade for the chapter test in which the
science notebook was implemented. Mean and standard deviation is located at the bottom of the table.

Table 3

Chapter 3: Percentage of weekly quizzes and chapter test percentage for each participant during the implementation of the science notebook

<table>
<thead>
<tr>
<th>Participant</th>
<th>Percentage Score Week 1</th>
<th>Percentage Score Week 2</th>
<th>Percentage Score Week 3</th>
<th>Participant Mean Score</th>
<th>Chapter Test Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88</td>
<td>89</td>
<td>94</td>
<td>90</td>
<td>82</td>
</tr>
<tr>
<td>2</td>
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<td>8</td>
<td>91</td>
<td>89</td>
<td>100</td>
<td>93</td>
<td>91</td>
</tr>
</tbody>
</table>

Mean 89.6 93.6 92.2 91.75 92
Standard Deviation 4.09 5.21 6.94 3.56 4.47

Data indicate that the participants were able to maintain a proficient 92% average with a standard deviation of 3.56 when assessed on the content quizzes during the study period.

The findings suggest that students were able to meet proficiency percentages on weekly quizzes while the science vocabulary notebook was in use, and that the addition of science vocabulary notebooks did not hinder academic achievement. The participants were able to meet proficiency percentages at all times during the study which may
suggest concepts being carried over into sequential lesson for deeper understating of the science concepts.

The data indicate that students were able to recall vocabulary and content learned during the use of the science notebook on chapter test. The test average percentage for the chapter test during the study was 92% for all participants, with a standard deviation of 4.47.

The findings of the action research suggest that, while using the science vocabulary notebooks, students retained the target vocabulary and concepts learned in context and demonstrated that understanding during the chapter test. Concept activities presented in the notebook helped students have multiple exposure to the vocabulary and may have aided in retention of concepts and vocabulary when assessed on the chapter test.

Summary

The action research on science vocabulary notebooks suggests that implementing the notebook as an instructional tool to reinforce vocabulary and content, provided the opportunity for students to learn target vocabulary and content while helping to retain the information presented for both weekly quizzes and the chapter test.
CHAPTER 5: DISCUSSION AND CONCLUSIONS

Overview

The following chapter includes discussion on the findings from my study, conclusions of the study, and ends with limitations and directions for future research.

Science vocabulary notebooks

To ensure that learners are able to learn new words, they need plentiful opportunities to engage with the words and to put them to work in a variety of contexts (Thornbury, 2006). The main usage of the notebook was to provide the participants with multiple and meaningful exposure to the content vocabulary as well as the concepts for the chapter. The activities of writing, coloring, cutting, matching, sorting and pasting gave the students exposure to the content in an organized kinesthetic approach. The findings suggest that the variety of exposures to vocabulary and content may have allowed students to tie together the vocabulary and concept at a proficient percentage as assessed in the lesson quizzes and chapter test. According to August, Artzi and Mazrum (2010), visuals consistently used in science lessons, including illustrations of vocabulary concepts and graphic organizers during the teaching of lessons, help students build effective knowledge of target vocabulary in context.

Discussion

This study suggests that science vocabulary notebooks were a useful tool for supporting student learning and retention of science vocabulary, as demonstrated by proficient percentages on weekly quizzes and a chapter test. Elly (1989) claims that frequent and varied exposure to new vocabulary in a meaningful context helped students achieve higher vocabulary gains (Sadeghi & Sharifi, 2013). In my study, science
vocabulary notebooks provided the students with a variety of exposures to the vocabulary words by using the science notebook, as well as the how the content was presented using more hands-on opportunities and time for review as was done at 3-5-minute periods before lessons. This is consistent with suggestions by Bozkurt and Walters (2009) and Carrier (2011) to allow students time for review and talking to other classmates about their work. The activities created an interactive way to reinforce the content being taught and provide multiple exposures to new vocabulary as suggested by Carrier (2011).

The chapter test analysis suggests that the use of the science vocabulary notebooks may have helped students retain vocabulary and content information during the time of the study. A possible explanation could be the 3-5-minute review time of the notebook before each lesson that may have played a factor in higher retention and percentages for the chapter test during the study. Allowing students to physically get involved in learning vocabulary by writing, drawing, cutting, pasting and coloring allowed students to be exposed to the vocabulary in a variety of methods as found in Elly (1989).

Conclusions

Findings of this study suggest that science vocabulary notebooks can be a useful educational tool to reinforce vocabulary and concepts taught during science lessons in a dual language setting. Teachers may find science vocabulary notebooks to be an effective tool in teaching science content and vocabulary. The study hypothesized that the science vocabulary notebooks would be an effective supplemental tool to help students learn science vocabulary and content. The science notebooks added a varied approach to
vocabulary instruction as suggested by research by Bozkurt and Walters (2009). In my study, when students used science vocabulary notebooks, they learned and retained information presented in class during the weekly quizzes, but most notably in chapter tests. The students’ high performance on the chapter tests and findings from analysis of alignment between chapter content and science notebook activities suggest that the activities presented in the notebook exposed the students to the vocabulary and content in kinesthetic form which may have led to better retention of the content material.

Based on the results of this study, I will implement research-based strategies presented in the literature review into other science lessons, as well as explore other content areas and the use of vocabulary notebooks. Suggestions include allowing more time for review through notebook game activities and also allowing some students to manually write more definitions. It is recommended that teachers and administrators implement the use of science vocabulary notebooks as a supplemental instructional tool to teach science vocabulary and content. This study can be used to present to staff at staff meetings and professional development, and shows that science vocabulary notebooks can provide aligned learning opportunities, as well as positive results on science and vocabulary assessments. Sharing these strategies and findings with other teachers can provide them with useful insight to impact their own students’ learning of science vocabulary.

**Limitations**

Limitation in the study include the lack of data on student perspectives on the use of the science notebooks. Student feedback plays a vital role in strengthening teacher and student expectations on how content is delivered. Student interviews or surveys could
have provided additional insight about student learning that was not available for inclusion in this study. It is also possible that students in this study may have had a higher interest or prior knowledge about the content in the chapter during which the study took place. Even though they could recall information for the weekly quizzes, a lack of interest could hinder the students’ processing and retention of the information in context, as assessed in a chapter test. Student attendance can also be a factor in how much content is learned. The time of the year could also play a factor. The study period was done during mid-semester in contrast to the comparison chapter without the notebook that was done at the end of the year.

Other considerations should also focus on the limitations that a chapter test or quiz lends when measuring student understanding. Most questions on the student test and quizzes of this study were multiple choice and required circling in the correct response. These assessments do not always give an accurate performance rating because a student may guess on a question or simply circle a correct answer based on incorrect knowledge of the actual content of the question and still technically score the question correct. The result of such assessments may lead to inflated test scores. Formal assessments may also provide test anxiety in students. Students who are affected by test anxiety may not be able to fully demonstrate understanding of their learning.

Limited vocabulary is another factor that may influence how a student performs on assessments. The vocabulary and wording in questions on assessments may be confusing or misleading. This may lead to students answering the question incorrectly while possibly having the knowledge to answer the question correctly under other forms of assessment that do not give the student anxiety.
Future Research

Much research still needs to be done to understand the most effective activities and instructional methods for vocabulary learning and retention in elementary science. Using the science notebook might provide an insight to how students are able to retain information. The way content is delivered may be a factor in how students are able to retain information in long-term memory vs. short-term memory. In this study, content information for the science notebook was given in the form of written notes with pictures as well as graphic organizers that had printed definitions already made. Further research can be done to see if students are able to retain vocabulary and content when students write out given information versus reading previously printed information. Further research may also be necessary on language development using cognates in science in a dual language setting. Furthermore, research can also be done on different types of vocabulary assessments. Alternative forms of vocabulary assessment using dioramas, class presentations and science fair posters might also be an area of interest when assessing vocabulary assessment in science. Alternative methods of assessments may be further examined to address the limitations such as test anxiety and having students present their knowledge to others in different forms other than formal assessments methods. Future research on the effects of using vocabulary notebooks along with kinesthetic activities for special education students, may also be beneficial.
REFERENCES


See *Digest of Education Statistics 2018*,


Repasar conceptos: Completar oraciones
Completa cada oración con la palabra o frase correcta.

1. Un ____ son todos los seres vivos y las cosas sin vida que hay en un ambiente. (ecosistema, nicho ecológico)

2. Todos los miembros de una especie que viven en la misma área de un ecosistema constituyen ____ (una población, un hábitat)

3. ____ son las diferentes poblaciones que interactúan en un área. (Un nicho ecológico, Una comunidad)

4. ____ de un organismo es el rol que tiene en su hábitat. (La adaptación, El nicho ecológico)

Repasar conceptos: Verdadero o falso
Escribe V (verdadero) o F (falso) en la línea que está antes de cada oración.

5. El aire, el agua, la tierra y la luz del Sol son partes sin vida de los ecosistemas.

6. Los desiertos son los ecosistemas más secos de todos.

7. El ecosistema de tundra siempre es cálido.

8. Los ecosistemas de bosque lluvioso reciben lluvia todo el año.

Aplicar estrategias: Calcular
9. En un ecosistema de bosque, se cuenta todos los años el número de aves de una población. Si en el año 1 había 2,927 aves y en el año 2 había 1,958 aves, ¿en cuántas aves disminuyó la población? Muestra tu trabajo. (2 puntos)
Nombre

**Repasar términos: Unir**
Une cada descripción con la palabra correcta. Escribe la letra en la línea junto a cada descripción.

1. consumidores que sólo comen plantas
   -  a. omnívoros
2. consumidores que sólo comen animales
   -  b. herbívoros
3. consumidores que se alimentan de plantas y animales
   -  c. descomponedores
d. carnívoros
4. consumidores que digieren los desechos y restos de plantas y animales muertos

**Repasar conceptos: Completar oraciones**
Completa cada oración con la palabra o frase correcta.

5. Un ____ puede comer algunos alimentos que comen los carnívoros. (herbívoro, omnívoros)
6. Un animal que tiene garra y dientes filosos probablemente es un ____. (herbívoro, carnívoros)
7. En una cadena alimentaria, la energía fluye en ___. (dos direcciones, una dirección)
8. Todas las cadenas alimentarias comienzan con la energía de ____. (la luz del Sol, los consumidores)

**Aplicar estrategias: Secuencia**
9. Las siguientes oraciones en desorden explican cómo los descomponedores afectan a los ecosistemas. Usa las palabras clave para escribirlas en el orden correcto. (2 puntos)

   Finalmente, los animales se alimentan de las plantas.
   Después, los minerales y nutrientes vuelven a la tierra.
   Primero, los descomponedores digieren los desechos y restos de organismos muertos.
   Luego, las plantas vivas usan los materiales.

   __________
   __________
   __________
   __________
Nombre _____________________________

**Repasar conceptos: Verdadero o falso**

Escribe V (verdadero) o F (falso) en la línea que está antes de cada afirmación.

____ 1. En los hábitats de agua dulce y de agua salada viven los mismos organismos.

____ 2. Las algas son productores en los ecosistemas de pantano.

____ 3. Una red alimentaria muestra cómo se conectan las cadenas alimentarias.

____ 4. La descomposición siempre ocurre con la misma rapidez en los ecosistemas.

____ 5. La descomposición es más rápida cuando hay más humedad.

____ 6. Los hongos y las bacterias son dos tipos de descomponedores.

____ 7. El proceso de descomposición libera dióxido de carbono hacia el aire o el agua.

____ 8. Cuanto más fría la temperatura, más rápido ocurre la descomposición.

**Escribir**

Usa oraciones completas para responder la pregunta 9. (2 puntos)

9. Escribe una descripción de lo que ocurriría si no hubiera descomponedores en un ecosistema.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Lee las preguntas y escoge la mejor respuesta.
Rellena el círculo que está junto a la respuesta correcta.

1. ¿Por qué un desierto es un sistema?
   A. Porque allí no vive gente.
   B. Porque consta en su mayoría de plantas.
   C. Porque cada parte del desierto es independiente.
   D. Porque tiene partes que trabajan en conjunto con un propósito.

2. ¿Cuál es la mejor descripción de un ecosistema?
   A. un sistema en el que las poblaciones permanecen iguales
   B. cualquier lugar en el que hay un solo tipo de organismo
   C. un sistema en el que los seres vivos y las cosas sin vida interactúan
   D. un lugar donde siempre hay lluvia, tierra, luz del Sol y aire

3. ¿Cuál es la mejor explicación de la disminución en la población de aves en una comunidad?
   A. Disminuye la cantidad de alimento.
   B. Aumenta la cantidad de espacio.
   C. Aumenta la cantidad de agua.
   D. La cantidad de aire sigue siendo la misma.

4. Mira atentamente esta ilustración de un perro de la pradera.

¿Qué muestra mejor la ilustración?
A. el nicho ecológico del perro de la pradera
B. el hábitat del perro de la pradera
C. el ecosistema del perro de la pradera
D. la comunidad del perro de la pradera
5. ¿Cuál sería la adaptación más útil para un animal cuyo nicho ecológico es comer néctar de las plantas?
   A. aletas
   B. alas
   C. piernas rápidas
   D. pico corto

6. ¿Cuál es la principal fuente de energía para la vida en la Tierra?
   F. agua
   G. luz del Sol
   H. sustancias químicas
   I. plantas verdes

7. ¿Cuál de los siguientes es un productor?
   A. el venado
   B. el pasto
   C. el halcón
   D. el gusano

8. Mira atentamente esta ilustración.

¿Cuál es la mejor descripción de la ilustración?
   F. red alimentaria
   G. productores
   H. consumidores
   I. cadena alimentaria
¿Qué es un descomponedor?
- un animal o una planta que ha muerto
- los restos de animales y plantas muertos
- un consumidor que obtiene energía comiendo sólo plantas
- un organismo como un insecto que se come los restos de los animales

¿Qué es más probable que pase si la mayoría de una población de animales muere a causa de enfermedades?
- La red alimentaria se detendrá.
- Los descomponedores morirán.
- La red alimentaria cambiará.
- Los productores también contraerán la enfermedad.

¿Qué es un omnívoro?
- un animal que es un productor
- un animal que sólo se alimenta de plantas
- un animal que sólo se alimenta de consumidores
- un animal que se alimenta de plantas y animales

¿Cuál de estas cosas que los animales necesitan viaja a través de una cadena alimentaria?
- herbívoros
- ecosistemas
- aire y luz del Sol
- nutrientes y minerales

¿Qué lugar ocupa el caracol de agua dulce en la cadena alimentaria de un pantano?
- Es alimento para las algas y las garzas cenizas.
- Se alimenta de algas y es alimento para las garzas cenizas.
- Se alimenta de zooplancton y pez sol con lunares azules.
- Es alimento para el zooplancton y las grullas canadienses.
Nombre  

1. ¿Cómo ayudan los organismos que se descomponen en un pantano a crear la siguiente generación de organismos?
   a. Los organismos que se descomponen crean un nuevo hábitat.
   b. Los organismos que se descomponen crean bacterias y hongos.
   c. Los organismos que se descomponen liberan oxígeno en el aire.
   d. Los organismos que se descomponen devuelven minerales al suelo.

2. ¿Qué palabra describe mejor el papel del zooplancton en una cadena alimentaria?
   a. protista
   b. productor
   c. consumidor
   d. descomponedor

Escribe en las líneas las respuestas a las preguntas.

3. ¿Cuál es la diferencia entre el nicho ecológico y el hábitat de un correcaminos del desierto? (2 puntos)

4. Explica qué es una red alimentaria y en qué se diferencia de una cadena alimentaria. (2 puntos)

Escribe la respuesta en una hoja aparte.

5. Rachel mira un pantano. Ve unas grullas canadienses que descienden en picada, ve algas en un estanque, pequeños caracoles, hongos y algunos peces. Explica cómo lo que ve Rachel es útil para explicar cómo están conectados los organismos que ve y cómo contribuyen a que el ecosistema del pantano prospere. (4 puntos)