DEVELOPING KINDERGARTEN AND SECOND GRADE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE OF ACADEMIC SCIENCE VOCABULARY INSTRUCTION

A Record of Study

by

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ABSTRACT

An extensive academic vocabulary in science is a critical component required for students' abilities to construct their own conceptual understandings about how things work in the natural and designed worlds. While science curriculum reformers use hands-on, minds-on scientific investigations to form the heart of science learning for young children, the acquisition of science vocabulary is also an essential part of the process of science learning. Words allow students to communicate their ideas to others and "make sense" of the world. Words are the representations of experiences and ideas about students' experiences within the world. Despite the importance of vocabulary acquisition, little research has been done on methods for teaching primary students academic science vocabulary. The purpose of this study was to explore how professional development alters primary grade teachers' abilities to incorporate vocabulary instruction during science lessons.

The solution explored in this record of study was to develop and assess the effectiveness of a self-designed model for professional learning preparing teachers in primary grades to teach academic science vocabulary. This model included four and a half hours of professional learning, a pre- and post- vocabulary questionnaire, four classroom observations including instructional support and coaching, post-observation conversations, one interview per participant, and one group discussion. The study took place over a four-month period. Participants included three kindergarten teachers and

three second-grade teachers, and took place in a rural public primary school near San Antonio, Texas.

The researcher used a mixed methods approach to investigate teachers' subsequent use of vocabulary instruction methods in their own classes while teaching science. Quantitative data were collected from teachers' responses to *the Science Vocabulary Questionnaire (SVQ)*. Additionally, the rating scale on the *Science Classroom Observation Worksheet (SCOW)* was used to generate a scaled score. Qualitative data included teachers' open-ended responses from the *SVQ*, observational notes entered on the Rationale for Rating section on the *SCOW*, teachers' responses to post-observation interview questions, and teachers' responses during the informal group discussion.

Analyses of the data revealed five out of six teachers implemented suggested methods of teaching academic science vocabulary during their science lessons. Furthermore, four of the six teachers consistently improved their practices of teaching vocabulary instruction after each individual professional development sessions. In the teachers' final remarks regarding their professional development experiences, five out of six teachers stated they believed the individualized model of professional support was more effective than whole group professional development. Results from this exploratory study provide preliminary evidence associating the professional development model the researcher developed with teachers' improved used of vocabulary instruction during science lessons.

DEDICATION

"What makes the difference between wishing and realizing our wishes? Lots of things, of course, but the main one, I think is whether we link our wishes to our active work. It may take months or years, but it's far more likely to happen when we care so much that we'll work as hard as we can to make it happen. And when we're working toward the realization of our wishes, some of our greatest strengths come from the encouragement of people who care about us."

Mr. Rogers

For Christine and Steven

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INTRODUCTION

The demands placed on elementary teachers have increased greatly over the past ten years. This is especially true for elementary science teachers in the state of Texas. In 2001, the No Child Left Behind Act (NCLB) initiated the requirement of measuring the yearly progress of students; encouraging high academic standards and implementing greater accountability of our nation's schools. Academic progress includes the assessment of students' knowledge about science in elementary, middle school and high school. In Texas, the assessment in science was initially the Texas Assessment of Knowledge and Skills (TAKS) and currently is the State of Texas Assessments of Academic Readiness (STAAR). With the increased rigor of the STAAR comes the need for fluency in science academic language as well as knowledge of science content (Jackson & Ash, 2012).

As an elementary science specialist associated with a state-supported organization, I provide professional development for kindergarten through eighth grade teachers from various districts throughout the state of Texas. In my 11 years as an instructional and curriculum specialist, I noticed many teachers lack in-depth knowledge of methods of how to instruct students in acquiring academic science vocabulary. The limited knowledge of teachers is significant in that the relationship between reading comprehension and vocabulary has been well established (Beck, McKeown, & Omanson, 1987; Nagy & Herman, 1987). In elementary science, word concepts can be

learned through observation, investigation and communication. An emphasis placed on both written and oral communication in the state standards for science (TEA, 2010) requires teachers provide structured opportunities for students to encounter and use new words on a regular basis. Strategies should be both authentic and engaging (David, 2010). Learning should be dynamic and interactive (Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.), 2000). The purpose of this study was to determine the effectiveness of a professional development model designed to increase elementary teachers' effectiveness in teaching academic science vocabulary. The model included two whole-group professional development sessions (for a total of three hours) with the participating teachers, three half-hour individualized learning sessions with each participating teacher, coaching in the context of the classroom setting, formal interviews, a group discussion, and informal conversations occurring after classroom observations.

Background of the Study

Learning and understanding vocabulary is an important part of a student's education. The Texas Education Agency (2010) standards for English Language Arts state:

> It is imperative that reading instruction should be comprehensive and that students receive instruction in phonemic awareness, phonics, decoding, and word attack skills while simultaneously being taught academic vocabulary and comprehension skills and strategies. (Texas Ed Code, Chapter 110.11)

The introductory statement for the science standards states:

> The study of elementary science includes… while addressing the major concepts and vocabulary, in the context of physical, earth, and life sciences. (Texas Ed Code, Chapter 112.11)

The English Language Proficiency Standards state:

> One of the responsibilities of school districts is to "…provide them with the foundation of English language vocabulary, grammar, syntax, and English mechanics necessary to support content-based instruction…" (Texas Ed Code, Subchapter 74.4)

The more students understand academic vocabulary terms, the easier it is for them to understand information they may read or hear about the topic (Marzano & Pickering, 2005).

A major challenge for students learning science is the academic language in which science is written. Academic vocabulary is defined as the vocabulary critical to students' understanding of the concepts and labels of the content taught in schools (Snow, 2010). Additionally, academic vocabulary supports students' comprehension of instructional content. Academic vocabulary exposes students to word origins, multiple meanings of words, and reference to abstract concepts relating and connecting directly to the targeted content area. Academic vocabulary prepares students for academic success by helping them preview, build background knowledge, learn and practice vocabulary in subject area content (Marzano & Pickering, 2005). Academic language is distinct from the social language used in school, and it encompasses the vocabulary, syntax, and discourse features that are necessary for accessing grade-level curriculum (Bailey & Heritage, 2008). Students need help in learning academic vocabulary and how to process academic language if they are to become independent learners of science (Snow, 2010).

Organization of the Study

This study is organized into five chapters. Chapter I includes an introduction to the problem, background of the study, organization of the study, statement of the

problem, research questions, significance of the study, and the definition of the terms. Chapter II contains the review of related literature and research related to the problem in the record of study. This chapter includes historical perspectives of vocabulary instruction, the research base surrounding effective vocabulary instruction, instructional techniques to learn vocabulary and the design of professional development for adult learners. Chapter III describes the methods and procedures used to gather and analyze data to support conclusions about the effectiveness of the professional development model I designed and employed to increase elementary teachers' effectiveness in teaching academic science vocabulary. Six research questions guided the collection and analysis of the data. Chapter IV details the findings and analysis of data collected to answer the research questions. Chapter V presents conclusions about the effectiveness of the professional development in which I use the results of my data analyses to support my overall conclusions. This chapter also makes recommendations for further study and for general practice regarding the use of vocabulary instruction in science teaching.

Statement of the Problem

Science achievement is low in many schools. Eighty-two percent of our nation's twelfth graders performed below the proficiency level on the 2000 National Assessment of Educational Progress (NAEP) science test (Fisher, Grant, & Frey, 2009). Why are students not doing well in science and why are students losing ground as they progress through school? McMurrer (2008) believes these problems might occur because science instruction is neglected in favor of the tested subjects of math and reading/language arts. Ohana, Miller, and Hanley (2013) reported that while

nearly 77% of new teachers felt well qualified to teach reading, less than 30% felt well qualified to teach science. Fisher, Grant, and Frey (2009) suggest the problem might be a mismatch between the current focus on reading-strategy instruction and the actual requirements for understanding science reading. Folse (2010) agrees reading comprehension is critical to academic success, but reinforces the idea that both reading and science teachers are responsible for vocabulary development. Elementary teachers who teach science can benefit from strategies to teach scientific words to children and assist them in using them to make sense of the world in which they live.

As a science provider, I have collaborated with many district science specialists to provide learning opportunities in both science process skills and science content. My support has included efforts to increase science content knowledge, as well as methods of teaching language proficiency skills (reading, writing, listening, and speaking) during science lessons. Although vocabulary is a critical part of the reading and writing components, teachers' understanding of a variety of methods of teaching academic vocabulary has not been apparent. Teachers predominantly teach vocabulary as a pre-reading activity during reading time, not during science. In science, vocabulary instruction is often reduced to memorizing a list of words. Vocabulary knowledge is an outward representation of conceptual knowledge. Conceptual knowledge supports and fosters comprehension (Anderson & Freebody, 1981). Efforts should therefore be made to increase vocabulary acquisition in order to increase comprehension of science content.

Purpose Statement

The purpose of this study was to assess the effectiveness of a self-designed professional development intervention on methods of instruction for three kindergarten and three second-grade teachers in the area of academic science vocabulary. Classroom observations and teachers' written responses to questionnaires and verbal comments during interviews and conversations provided data for the assessment of my intervention.

Research Questions

The overarching question for this record of study was: What do the findings of this research study suggest about the benefits of a model for professional development training and coaching on a small set of kindergarten and second-grade teachers' abilities to implement vocabulary instruction in their classrooms? In response to this question, I investigated teachers' perceptions, practices, and extent of coverage of science vocabulary before, during, and after teachers received individualized professional development training and coaching related to academic vocabulary instruction. It was suggested I used a Four-phase Mixed Sequential-Concurrent Design (Stuessy, personal communication) to guide a series of phases of data collection and analyses to evaluate the benefits of the professional development model. Research questions appearing below reflect the four phases of the design, which included three individual data collection phases, separated in time, and a fourth data analysis phase occurring after all data were collected. These six questions guided the collection and analysis of data associated with this Record of Study:

1. What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons? (Before Intervention - QUAN)
2. What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons? (Before Intervention – QUAN/QUAL)
3. How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention? (During Intervention –QUAN/ QUAL)
4. How did participating teachers' incoming perceptions change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAN)
5. How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAL)
6. In what ways do quantitative and qualitative analyses agree? (Post-Intervention – MIXED).

Significance of the Study

Little information exists about research investigating the teaching of academic science vocabulary specifically in the primary grades. Much of the current research

focuses on how vocabulary instruction improves reading comprehension in grades three and upward. Some evidence does exist supporting the importance of including vocabulary instruction in the primary classroom (Blachowicz, Watts-Taff, & Fisher, 2006) however it focuses on improving reading comprehension, not science content knowledge. Most research has been conducted on vocabulary instruction for primary students during read-aloud time (Biemiller & Boote, 2006). Unfortunately, limited information exists about whether science vocabulary instruction is really occurring in the primary classroom during non-read-aloud time, such as during science instruction.

Researcher's History, Interest, and Qualifications

I have been an educator for 24 years. During this time, I have taught students in elementary grades as well as students in the pre-service teacher program at the University of the Incarnate Word. I have been a professional development provider for the last 10 years. Presentations have been made for a variety of Educational Service Centers and districts throughout the state of Texas. Additionally, I have conducted professional development sessions for the Texas Association for Supervision and Curriculum Development (TASCD), Texas Science Education Leadership Association (TSELA), Texas Regional Collaboratives (TRC), TEKS Resource System, and Texas Council of Elementary Science (TCES).

My interest in science started when I was in seventh grade, developed further when I lived in Great Britain during high school, and expanded while working on my Master's degree. One aspect of science education that captured my interest very early was communicating observations. I kept science notebooks and field journals using both

visuals and science terms to describe my observations. My specific interest in vocabulary started when I lived in Germany, and I did not have a full grasp of the German language. I knew the concepts being discussed but could not communicate clearly because I didn't have the language skills. I survived by "reading" pictures and interpreting gestures to describe the words. My interest in understanding the mechanisms for learning vocabulary continued when I was a classroom teacher and had a high proportion of second language learners in my classes. The opportunity to learn about a variety of methods for vocabulary instruction was made possible through the reading of multiple experts prior to conducting my record of study. I needed to recognize my personal experiences with learning terms might influence my methods and, therefore, read many studies on vocabulary instruction in order to learn from experts in the field and to keep personal experiences in check.

Definition of Terms

Many of the key terms used in this Record of Study have multiple connotations in the literature. The following definitions are provided to ensure uniformity and understanding of these terms throughout the study.

Academic Vocabulary- The language used in instruction, textbooks and exams. It includes common vocabulary used in all disciplines as well as technical vocabulary specific to an individual discipline, such as science (Baumann & Graves, 2010). Snow (2010) describes academic vocabulary as the terms critical to students' understanding of the concepts and labels of the content taught in schools.

Concept – The organizing principle or unifying classification of information. Concepts are "mental constructions representing categories of information that contain defining attributes" (Walker & Avant, 1988).

Content – The information or knowledge students should know and understand (National Research Council, 1996).

Explicit Instruction – The intentional design and systematic, sequential delivery of information by the teacher to the students (U.S. Department of Education, 2002).

Incidental Exposure – Situations in which children informally experience unknown words. Some examples include; children hearing the words on the playground, on a television program, from a storybook, or during casual conversation (Justice & Walpole, 2005).

Reflexive Journal – A type of diary where a researcher makes regular entries during the research process. In these entries, the researcher records methodological decisions and the reasons for them, as well as a reflection upon what is happening in terms of one's own values and interests (Lincoln & Guba, 1985).

Word Wall – An organized collection of words used as an interactive tool of learning for students. It may provide a visual to help students remember connections between words and concepts. It may also assist students when writing (Cronsberry, 2004).

Summary

The purpose of this record of study was to determine the effectiveness of a professional development model I designed and employed to increase elementary teachers' effectiveness in teaching academic science vocabulary. I chose to focus the record of study on learning academic vocabulary in science because major challenges exist for science learners to understand and use the academic language of science appropriately. Students need help in learning and processing academic vocabulary if they are to become independent learners of science (Snow, 2010). The overarching question for this record of study was: What do the findings of this research study suggest about the benefits of professional development training and coaching on a small set of kindergarten and second-grade teachers' abilities to implement vocabulary instruction in their classrooms?

The remainder of the study is organized by chapters. Chapter II contains the review of related literature and research related to the problem in the record of study. This chapter includes historical perspectives of vocabulary instruction, the research base surrounding effective vocabulary instruction, and instructional techniques to learn vocabulary. Chapter III describes the methods and procedures used to gather and analyze data to support conclusions about the effectiveness of the professional development model I designed and employed to increase elementary teachers' effectiveness in teaching academic science vocabulary. Six research questions guided the collection and analysis of the data. Chapter IV details the findings and analysis of data collected to answer the research questions. Chapter V presents conclusions about the effectiveness of

the professional development in which I use the results of my data analyses to support my overall conclusions. This chapter also makes recommendations for further study and for general practice regarding the use of vocabulary instruction in science teaching.

CHAPTER II

LITERATURE REVIEW

Vocabulary knowledge is important for reading comprehension (Biemiller, 2003; Stahl & Nagy, 2006). Students' knowledge of vocabulary influences their comprehension of reading materials. Several studies (Cunningham & Stanovich, 1997; Scarborough, 1998; Senechal, Oulette, & Rodney, 2006) showed that a strong predictor of reading achievement is early vocabulary knowledge. In the literature, three connections exist between vocabulary and educational success:

1. The relationship between vocabulary and reading comprehension (Beck, McKeown, and Omanson, 1987; Nagy & Herman, 1987)
2. The relationship between quantity of academic vocabulary and content comprehension (Graves, 2004; Nagy & Anderson, 1984)
3. The difference in the number of vocabulary words acquired at an early age and different socioeconomic background (Biemiller & Slonim, 2001; Beck & McKeown, 2007).

This review of the literature examined these three connections through the following perspectives: historical perspectives of vocabulary instruction, research base surrounding effective vocabulary instruction, and instructional techniques to learn vocabulary. In addition, I also examined the design of professional development for adult learners.

Historical Perspectives of Vocabulary Instruction

In 1921, Thorndike wrote *The Teacher's Word Book*, one of the first studies done to organize vocabulary into classifications for teaching. Words were sorted by the range of sources in which the word appeared, as well as the frequency of usage in literature. Thorndike (1921) noted the list was not meant to be a spelling list, but rather a guide for the most frequently encountered words students should know. Methods for teaching the words were not discussed. Much of the research during the early part of the 20th century was related to vocabulary size (Biemiller, 2003; Nagy & Herman, 1987). The research focused on establishing a list of words to master for each grade level (Beck & McKeown, 2007) and on the identification of useful words.

Looking up words in the dictionary, the most frequent independent learning task from the 1970s through the 1990s resulted in limited word learning (Miller & Gildea, 1987). Using words in sentences, memorizing definitions, and completing word searches are still used as traditional vocabulary instruction. These methods still do not effectively help students grow their vocabulary (Lubliner, 2005). Limited studies in the 1980s and 1990s started to focus on cognitive learning principles as the focus for vocabulary instruction (Anderson & Nagy, 1991; Beck & McKeown, 1991). Blachowicz (1985) reviewed studies yielding different outcomes. While some studies offered evidence that vocabulary training improved comprehension, other studies reported no effects of vocabulary training on reading comprehension. Blachowicz (1985) suggested differences in results may have been a function of how vocabulary was taught. In the 1990s the study of vocabulary instruction was the focus of several research papers (Beck &

McKeown, 1991; Kuhn & Stahl, 1998). Nation's (1990) discussion of classroom applications for teaching vocabulary introduced the idea of most commonly used words. The two enduring ideas from Nation's research included 1.The most commonly used words will need to be learned in the course of a student's education; and 2. Most commonly used words were usually learned incidentally through exposure and through written and oral language.

There was an exception to the idea of learning vocabulary incidentally. Language in academic text, such as text found in science classes, needs to be taught in a systematic fashion (Nation, 1990) and is not learned incidentally. Marzano (2004) demonstrated the use of a combination of two approaches to help children learn subject-specific vocabulary. He recommended a combination of sustained silent reading and direct vocabulary instruction through a six-step process.

1. Provide a description, explanation, or example of the new term.
2. Ask students to restate the description, explanation, or example in their own words.
3. Ask students to construct a picture, pictograph, or symbolic representation of the term.
4. Engage students periodically in activities that help them add to their knowledge of the terms in their vocabulary notebooks.
5. Periodically ask students to discuss the terms with one another.
6. Involve students periodically in games that enable them to play with terms (Marzano, 2004).

Research Base Surrounding Effective Vocabulary Instruction

Academic vocabulary is different from basic conversational vocabulary. Academic vocabulary carries important concepts students need to know and is essential for educational success (Kieffer & Lesaux, 2007). The average student learns

approximately 25,000 – 40,000 words by the time they graduate from high school (Nagy & Herman, 1987; Zimmerman, 1997). Some studies suggested this quantity is too large to learn through direct teaching since the average program of direct vocabulary instruction covers only a few hundred words and word parts per year (Cunningham, 2005; Marzano & Pickering, 2005; Sternberg, 1987). Other studies suggested academic vocabulary must be taught explicitly (Kieffer & Lesaux, 2007). Research shows a more robust vocabulary prepares students to perform at a higher level and become more successful in academics (Lubliner, 2005). Keeping this in mind, educators must focus carefully on the words they choose to teach in order for students to learn a large quantity of new academic terms (Kieffer & Lesaux, 2007).

In addition to learning general vocabulary, students also face an additional challenge of learning the complex academic vocabulary found in content classes, such as science (Snow, 2010). Carr, Sexton & Lagunoff (2006) stated the importance of explicitly teaching specific content words. Zimmerman (1997) suggested using a combination of direct instruction and incidental learning to increase academic vocabulary. One issue arising in incidental learning is how new vocabulary is introduced. In many classrooms, the teacher used information in the teacher's edition of the textbook to introduce the vocabulary associated with the content (Herman & Dole, 1988). Students with limited background knowledge rarely benefited from this method of instruction. Telling students the meaning of the words, having them look up the meaning in a dictionary, or asking the student to figure out the meaning through the use of context clues were all ineffective methods for attaining new vocabulary (Graves,

1984).

When selecting words to teach, Ganske (2011) recommended considering what each word represents (concept or label), how often and in what contexts it occurs, whether it can be understood without being explicitly taught, what prior knowledge students might have of the word, and what type of word it is. Ganske (2011) emphasized the need for teachers to implement a comprehensive and integrated approach to vocabulary instruction, in all grades and in all content areas. This approach requires teachers to instruct students in vocabulary throughout the week, rather than providing a list of words at the beginning of each week (Blachowicz & Fisher, 2007; Lubliner, 2005). Kieffer and Lesaux (2007) pointed out the lack of instructional time devoted to building students' academic vocabulary. Educators were not providing enough structured time and planned opportunities for students to learn and use oral language. Taboada and Rutherford (2011) asserted that the success of mastering academic content is dependent on students' mastery of academic language. Explicit models of learning vocabulary were shown to increase the acquisition of more science terms. Slough and Rupley (2010) pointed out a pivotal time in students' learning: the end of third grade and the beginning of fourth grade. The span between these two grades was when students transitioned from *learning-to-read*, to *reading-to-learn*. These researchers provided evidence that explicit models of learning vocabulary increased students' acquisition of more science terms. Despite information on the cause of potential learning gaps, Kieffer and Lesaux (2007) discovered deliberate, sustained instruction to develop students' academic vocabulary occurred infrequently.

Another gap exposed in studies on vocabulary learning concerned the difference the quantity of words known between different socioeconomic groups (Spencer & Guillaume, 2006).Students who were exposed to a greater quantity of words (both before starting school and as they progress through school) comprehended more and acquired more vocabulary associated with content taught. A greater understanding of words lead to better reading comprehension, and greater reading comprehension lead to a better understanding of more terms (Spencer & Guillaume, 2006). Spycher (2009) focused on the acquisition of academic vocabulary by kindergarteners from low socio-economic backgrounds. Explicit instruction for targeted science terms demonstrated students learned more target words and expressed their knowledge of science content more effectively. Olson and Mokhtari (2010) examined a spectrum of learning methods to understand both science vocabulary and texts. Concrete representations, such as hands-on experiences, models, photos and diagrams should be introduced before more abstract representations, such as tables, charts, graphs, and then printed words (science texts and vocabulary terms). Beauchat (2012) recommended the use of high-quality storybooks and nonfiction books during instructional lessons in all content areas as a way to develop oral language, as well as vocabulary. Other researchers have made different recommendations. For example, Carlisle, Fleming and Gudbrandsen (2000) recommended children learn words in oral contexts. Oral contexts could provide more contextual support for word learning than written contexts, particularly in the primary grades. In the primary grades, students are only beginning to learn how to write. Koeller (1981) suggested a method called hand-flip charts. Students were able to complete hand-

flip charts during class discussions, following teacher modeling. Kieffer and Lesaux (2007) recommended word-learning strategies, word practice, and lots of talking.

Marzano and Pickering (2005) suggested specific terms be taught through a specific and comprehensive method. Beck and McKeown (1991) countered this suggestion by saying a single best-method of vocabulary instruction has not been identified. The National Reading Panel (2000) concluded teachers should not rely on a single vocabulary instructional method. The National Reading Panel (2000) also emphasized learning through multi-media, word learning in context, active student participation and multiple exposures to the term. Students learn through different modalities so using only one method of instruction will not provide optimal learning for all students. Stahl and Fairbanks (1986) concurred with this approach. Experts explained that vocabulary instruction needs to be varied (Wells & Narkon, 2011; Basurto, 2004; Beck, McKeown, & Kucan, 2002; National Reading Panel, 2000; Stahl & Fairbanks, 1986) and that every word selected for instruction must be carefully chosen (Marzano, 2004). Marzano classified terms students learned as *important*, *critical* and *interesting but not useful*. Beck, McKeown, and Kucan (2002) identify and classify words into three groups: Tier 1 words are those that are basic for reading. Tier 2 words are specialized, high-utility terms often changing meaning in different contexts, for example *volume.* Tier 3 words are technical terms associated with a specific discipline. Blachowicz and Fisher (2002) state the importance of every content-area teacher taking responsibility for teaching academic vocabulary. Explicit instruction should not be relegated to the English or reading teacher (Berne & Blachowicz, 2008).

Clearly, the opinions of these researchers and practitioners indicated a multifaceted approach to vocabulary instruction provided teachers and students with the strongest possibility of attaining new words. Additionally, students should learn vocabulary through both direct and incidental exposure. Finally, this brief review indicates a solution to teaching the vast number of words that are needed for educational success is still under investigation.

Instructional Techniques to Learn Vocabulary

What does it mean to *know* a new word? Zimmerman (1997) defined knowing a word as the ability to recall a word's meaning, infer meaning, communicate orally and comprehend a text. Nagy and Herman (1987) defined word knowledge through dictionary definitions as inadequate. In order to know and use terms effectively, students need several varied encounters with the new term during vocabulary instruction. Lane & Allen (2010) described one place to start with vocabulary instruction was the use of a print-rich classroom environment. Furthermore, they recommended teachers model academic language use. Carr, Sexton & Lagunoff (2006) identified scaffolding instruction as a technique to improve the learning of science terms. Scaffolding was suggested for science terms because the academic terms used in science were not considered language encountered in everyday conversations. Many science terms described abstract ideas or concepts. Visuals, think-aloud protocols, and think-pair-share were all strategies suggested (Carr, Sexton & Lagunoff, 2006; Echevarria, Vogt, & Short, 2004). Marzano and Pickering (2005) recommended instructional techniques to learn vocabulary include explaining word meanings in student-friendly language and

providing multiple exposures. Cummins (2000) identified providing more contextual clues as a way to make science terms more accessible to students. Beck, McKeown and Omanson (1987) recommended the use of multiple contexts and an explanation of the use of the word with examples and non-examples. Furthermore, several authors (Beck, McKeown, & Kucan, 2002; National Reading Panel, 2000; Stahl & Fairbanks, 1986) recommend students having multiple exposures to words through a variety of modalities (such as games, repeated readings and discussions). Gunning (1998) recommended using words within real and meaningful content-area text. Nilsen and Nilsen (2004) suggested an approach where the student starts with a known, such as a concrete object, and move toward the unknown or abstract.

Several researchers (Beck, McKeown, & Kucan, 2002; National Reading Panel, 2000; Stahl & Fairbanks, 1986) recommend multiple exposures to academic vocabulary. Science class is one example of where students will have multiple exposures to academic vocabulary. Vocabulary is used in context both during investigations and during post-investigation discussions. Beck and McKeown (2002) and Nagy, Herman and Anderson (1985) emphasized using words in meaningful contexts. Using words in context helped the student gain a deeper understanding of the vocabulary and assisted with making connections between new vocabulary and known words. Roe, Smith and Burns (2005) recommended students have the opportunity to represent the words visually and to construct their own definitions of the words. Visualization enhanced students' understanding of content and text (Zeigler & Johns, 2004). Another aspect of successful word learning was outlined by Stahl and Nagy (2006) as word consciousness. Word

consciousness included providing time each day for word-work, which might include reading, writing, discussions, and support through a print-rich environment (Graves & Watts-Taffe, 2008). A print-rich classroom contained labeled objects around the room, robust classroom libraries, bulletin boards, and word walls, with print that is purposeful and inviting. Vocabulary learning in this environment was further enhanced when students were actively involved in the process of developing the printed words (Brabham & Villaume, 2002; Jackson, Tripp, & Cox, 2011). Coxhead (2010) stated another important aspect of vocabulary instruction was ensuring activities included design features setting up the conditions for learning. An example of this was text supported by many visuals for an emergent language learner. Students at the elementary level are primarily 'emergent language learners' because science content terms vary in complexity from basic conversational English.

In science specifically, concern for vocabulary development can be seen in textbooks emphasizing scientific terminology. In grades where students rely on textbooks, the increased readability level causes comprehension problems for many students (Groves, 1995). Stahl and Clark (1987) found elementary students learn, understand, and retain science vocabulary if the science instruction is discussion oriented. Olson and Mokhtari (2010) stated students in science classes who were presented with an opportunity to explore or observe a phenomenon prior to vocabulary instruction were better able to relate the appropriate vocabulary to the object or phenomenon. Students discussed observations during the exploration. Discussions provided the opportunity to practice speaking and listening to the new terms (Olson &

Mokhtari, 2010). Furthermore, Stahl and Clark (1987) wrote that class discussions produced better vocabulary learning than students working individually on worksheets. Clearly, discussion is one method for learning new science terms. The National Reading Panel (2000) concur discussion is one method for learning new terms. The authors also found ability levels and age differences significantly affected learning gains from vocabulary instruction methods. Additionally, both direct and indirect instruction broadened vocabulary acquisition. A variety of instructional methods needed to be used. Biemiller and Boote (2006) also agreed on using a variety of methods to teach new vocabulary terms. In the primary grades, they suggested using repeated reading of informative texts in conjunction with direct instruction of word meanings. During the progression from primary grades to middle school grades students needed to understand a greater number of new terms. Science textbooks and other science print material contained a greater variety of academic terms. Students need a variety of methods from which to choose for decoding these terms (Jacobsen, 1998). Primary students will need more methods than older students for learning technical vocabulary found in science texts (Winters, 2001). Blachowicz and Obrochta (2005) expressed the idea of vocabulary field trips for teaching new science terms. This idea is centered on read-aloud of non-fiction science texts. In addition to reading the science content, the instructor pre-engaged the student by describing words they might encounter during the reading. Furthermore, the teacher encouraged the student to add details to the story based on prior experiences. Winters (2001) suggested developing personal meaning through creating vocabulary anchors. Additionally, using group discussion to verbalize the connections

between the new science terms and prior knowledge helped to learn new terms. To support long-term retention and application of vocabulary words and concepts Young, Righeimer, and Montbriand (2002) suggested a strategy they called Personal Clue Cards. In this method, students developed a personal clue they associated with the term. Students were encouraged to create a mental image for the science term.

Vocabulary acquisition is important for both reading comprehension and understanding content. Many methods have been suggested in the literature. Whenever possible, the method of vocabulary instruction should be tailored for the individual teacher's students. Teachers should consider a variety of instructional methods so that all students will have the opportunity to learn vocabulary.

Design of Professional Development for Adult Learners

Knowledge and methodology in education are constantly changing. Educators, like those in other professions, must keep up with changes by upgrading their skills regularly (Roeser, Skinner, Beers, & Jennings, 2012). With accountability standards rising, teachers are expected to engage in continuous improvement of knowledge and skills. In most schools, teacher learning is expected to occur outside of the regular school day, at night, on weekends, or in the summer (Kwakman, 2003). Teacher knowledge and skills were most often developed through attending professional development sessions. Professional development is the name given to activities that are designed, in some way, to increase the skill and knowledge of the participants (National Staff Development Council (NSDC), 1995). The Texas Education Agency (2010) has identified professional development as one of three key components of the Student

Success Initiative. The Agency continued their support of educators' learning by advocating development and implementation of professional development at several levels: statewide level, regional level (professional development offered through the Regional Service Centers), and local level (school district or campus). Professional development sessions are not always designed effectively. Several researchers (Avalos, 2011; Birman, Desimone, Porter, & Garet, 2000; Gusky & Yoon, 2009; Loucks-Horsley, Stiles, Mundry, Love & Hewson, 2009; Roeser, Skinner, Beers, & Jennings, 2012) have determined common features of effective sessions. The NSDC (2011) created a list of the primary features of effective professional development. This list included features such as focusing on a clear purpose (centered on student learning), using research-based theory of adult learning for specific issues of pedagogy, modeling effective practice, and active participation of instructional leaders and classroom teachers. Loucks-Horsley, Hewson, Love, & Stiles (1998) highlighted the features of effective professional development from the work of the Institute for Science Education. Some of the features of an effective professional development included building a learning community, teachers learning and mirroring methods to be used by students, and a focus on student learning, academic content, and instructional practice.

Gusky and Yoon (2009) analyzed findings from over 1,300 studies on effective professional development. Nine studies demonstrating standards of credible evidence, as set by the U.S. Department of Education, exhibited the emergence of common characteristics for effective professional development. The characteristics of effective professional development highlighted in Gusky and Yoon's (2009) work included time,

follow-up, activities, and content. Loucks-Horsley et al. (2009) also found adequate time, follow up, and active research-based learning as features of an effective professional development. Furthermore, clear and challenging goals, coherence, critical reflection on practice and evaluation of results were included in the analysis of effective professional development by Loucks-Horsley, et al. (2009). Birman, Desimone, Porter and Garet (2000) identified duration, participation, content focus and active learning as features to include in an effective professional development.

Professional development may look different from one place to another. The forms of professional development offered to educators often included workshops, outside experts, summer institutes, conferences, teacher action research, or reflective practices. Workshops were the most common form of professional development offered to teachers. A workshop is generally a session presented outside the teacher's classroom. Garet, Porter, Desimone, Birman, & Yoon (2001) suggested workshops as the least effective model of professional development. Gusky and Yoon (2009) agreed that many workshops, such as short-term, episodic, and disconnected professional learning, were wasteful. A lack of sustained support and follow-up were cited as factors of an ineffective workshop. Gusky and Yoon (2009) suggested workshops that focused on implementation of research-based instructional practices could be effective. Other characteristics, such as active learning and adaptability to the teacher's classroom situation were also present in an effective professional development workshop. Another approach for effective professional development was using an outside expert (Gusky and Yoon, 2009). Outside experts included program authors and researchers. The

effectiveness of outside experts was connected to the facilitation of implementation and ideas presented directly to teachers. Trainer-of-trainer sessions, peer coaching, and other forms of school-based professional learning were not as effective as using an outside expert (Gusky and Yoon, 2009). Darling-Hammond and Richardson (2009) were in favor of professional development through summer institutes. Summer institutes are generally five-day sessions held in the summer. To increase effectiveness and implementation of the learning from summer institutes, teachers were encouraged to meet regularly throughout the school year. The meetings were held to discuss classroom practice, review student work, and problem solve as a team.

Professional development sustained over time is more likely to improve student learning than one-time sessions (Loucks-Horsley, et al., 2009). Birman, Desimone, Porter & Garet (2000) agreed duration was an important aspect of professional learning. Duration, or time, included both the number of hours participants' spent in the session as well as the span of time included in the professional learning. Extended time learning allowed participants to build knowledge, translate knowledge into practice, and reflect on practice (Loucks-Horsley, et al., 2009). Teachers, who were provided time to practice new skills, were more likely to develop ownership of the new content or skill (Garet, et al., 2001).

Professional learning focused on enhancing teachers' content knowledge and pedagogic practices was applied in classrooms more often than when no connections to content were made (Gusky and Yoon, 2009). Loucks-Horsley, et al. (2009) explained professional development sessions in science were using assessment of teachers' content

and pedagogical content knowledge as methods for demonstrating how teachers' ideas, perceptions and practices changed. Content and evaluation of results were important components of a professional development. Roeser, Skinner, Beers and Jennings (2012) identified content knowledge, pedagogical knowledge (how and when to teach content), and developmental knowledge as important components of professional development. Birman, Desimone, Porter and Garet (2000) emphasized both content knowledge and active participation.

Effective science professional development engaged teachers with opportunities to practice activities and instructional strategies (Chval, Abell, Pareja, Musikul and Ritzka, 2008). Science teachers preferred professional development with activities and pedagogy aligned to state standards, district curriculum and state assessments (Chval et al., 2008). Researchers (Birman, Desimone, Porter and Garet, 2000; Loucks-Horsley et al., 2009) identified the need to include content knowledge and skills along with active learning as components of effective science professional development.

The National Staff Development Council (2001) concluded the most effective professional development is one adapting various best practices to specific content, processes and context. Loucks-Horsley et al., (2009) identified outstanding professional development as an environment combining different elements, instructional strategies, and content at different times. The effective professional development evolved and changed to meet participants' needs and provided time to practice new methods and materials (National Staff Development Council, 2011). Darling-Hammond and Richardson (2009) identified the qualities of an effective professional development as a

session providing active, hands-on learning, enabling teachers to acquire new knowledge and apply it to their individual teaching context, connected to standards and assessment, and sustained over time.

CHAPTER III

METHODOLOGY

This study employed a four-phase mixed sequential-concurrent parallel design to answer research questions regarding changes in primary teachers' inclusion of vocabulary instruction in their science lessons. Six research questions guided the study:

1. What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons? (Before Intervention - QUAN)
2. What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons? (Before Intervention – QUAN/QUAL)
3. How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention? (During Intervention –QUAN/ QUAL)
4. How did participating teachers' incoming perceptions change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAN)
5. How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAL)

6. In what ways do quantitative and qualitative analyses agree? (Post-Intervention – MIXED).

Mixed methods allowed me to collect and analyze both qualitative and quantitative data. My choice of the mixed methods design for my research required me to consider the following: (a) the relative importance of qualitative and quantitative data, (b) the sequence of data collection, (c) the methods for analyzing the data, and (d) the point at which I would "mix" the data. The concurrent parallel design allowed me to collect both qualitative and quantitative data simultaneously and merge them in order to understand the problem (Creswell, 2012). In this design, one type of data supplied strengths to offset the weaknesses of the other. Johnson, Onwuegbuzie, and Turner (2007) described mixed methods research as a way to use both qualitative and quantitative data collection, analysis, viewpoints and inference techniques to achieve breadth and depth of understanding and corroboration. Green (2007) described mixed methods research as a method for developing methods for both data collection and analysis using multiple ways of seeing, hearing and making sense of the study. Diverse views and perspectives are allowed to emerge from both qualitative and quantitative data sources providing a more in-depth understanding of the research problem.

Research Design

All researchers need a philosophical framework as a guide for planning and implementing their work. Creswell (2007) writes a researcher's intentions for pursuing a research project are deeply rooted in personal experiences and cultural experiences. To conduct an effective research study, researchers should combine their philosophical

assumptions with strategies and specific procedures. I considered four questions when designing the study: what theory about knowledge I would use to inform the research; what theoretical perspective would guide the methodology; what methodology would direct my choice and use of methods; and what methods and procedures would I use to collect data (Creswell, 2007).

For this study, a four-phase mixed sequential-concurrent parallel design was used (Figure 3-1). Concurrent parallel design occurs when data collection is conducted concurrently; each method is given equal weight, data is analyzed independently, and finally findings from both sets of data are merged for greater interpretation (Creswell & Clark, 2010). This approach blends qualitative and quantitative data to provide a thorough analysis of the study's problem.

Context

The context for this Record of Study was a rural primary school in a school district 25 miles outside of San Antonio, Texas. According the 2010-2011 Academic Excellence Indicator System (AEIS), the school has a student population that is African American: 1.4%, Anglo American: 75 %, Latino: 22.8%, Native American: 0.6%. Twenty-nine percent of the students are economically disadvantaged, and about three % are considered limited English proficient. The primary school serves approximately 600 students; there are ten classes of second-grade students, twelve classes of first grade students, and eleven classes of kindergarten students.

The research site was chosen for several reasons. First, I have worked with these teachers in the past and have already developed relationships with them. Second, in 2012

the district adopted a new curriculum system and the teachers have been diligent in their efforts to implement both the curriculum and instructional lessons with fidelity.

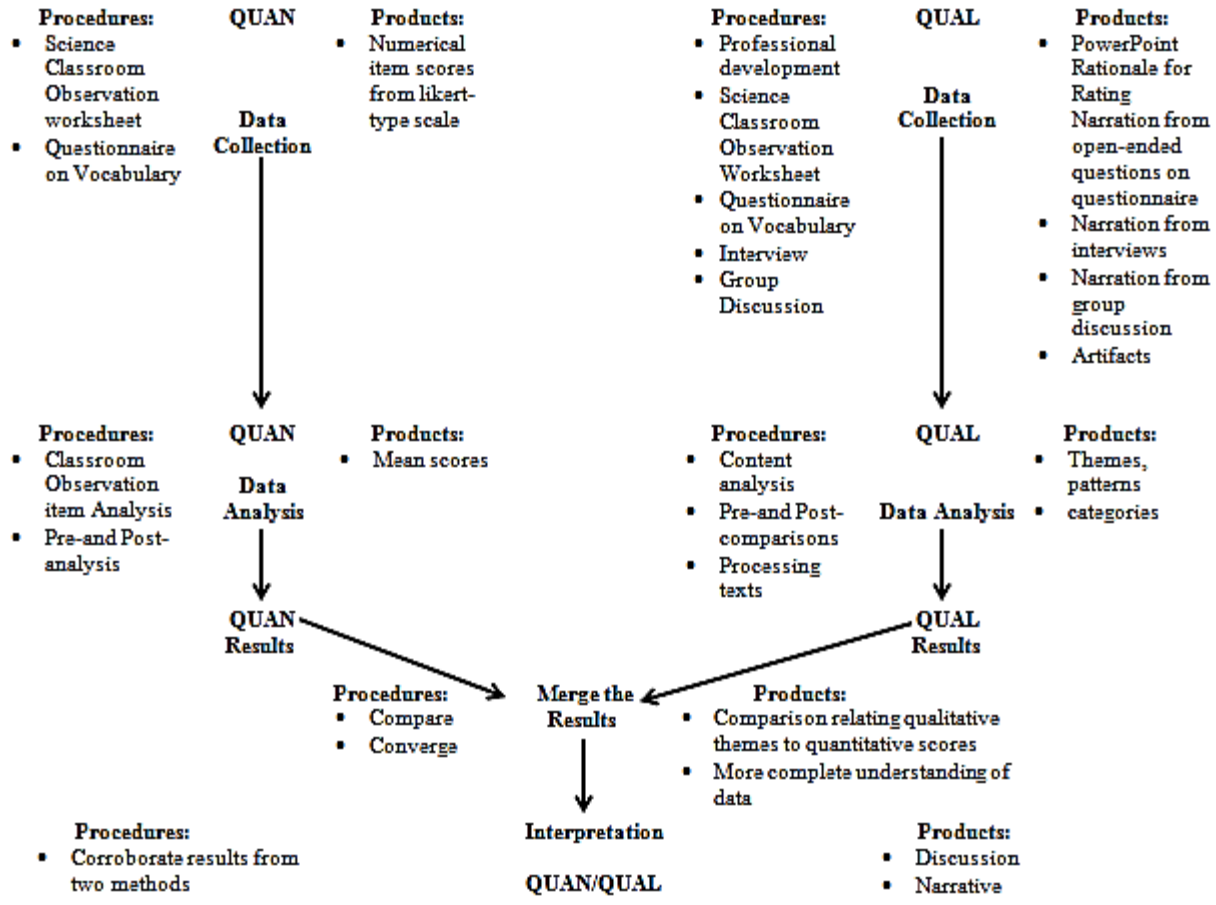

Figure 3-1. Steps for Data Analysis.

Third, the teachers have expressed concerns about the lack of time for the integration of

literacy skills with science and math and were open to learning. Fourth, although these teachers must conduct Texas Primary Reading Intervention (TPRI) tests during the year, no State of Texas Assessments of Academic Readiness (STAAR) tests occur at these grade levels. These teachers were, therefore, more open to spending time learning about ways to improve their students' understanding of both literacy skills and science content knowledge.

Participants

My decisions for working with primary teachers were informed by a study by Rosebrock (2007), revealing that the science achievement of fifth-grade students receiving systematic vocabulary instruction was statistically significantly higher than the science achievement of fifth-grade students who did not receive systematic vocabulary instruction. Additionally, some evidence does exist supporting the importance of including vocabulary instruction in the primary classroom (Blachowicz, Watts-Taff, & Fisher, 2006).

All 33 primary grade classroom teachers at the campus were invited to participate in the study. Eleven teachers volunteered to participate in the study: three second-grade teachers and eight kindergarten teachers. I used a convenience cluster sample of six teachers (three kindergarten teachers and three second-grade teachers) to keep the monthly observation schedule manageable. Although the principal provided input on the kindergarten teachers she felt would be good candidates for participation in the study, there were no other screening criteria set up to ensure that the sample had specific characteristics (Huck, 2008).

Teacher T1 was a Caucasian female. This school-year was her third year of teaching. Her first two years were in grade one; she is currently a second-grade teacher. She had twenty-two students in her classroom at the time of the study. T1 completed her teacher education through a traditional four-year program. Her major was interdisciplinary studies, and she had both biology and chemistry. T1's recollections about learning vocabulary as a student include defining words and having quizzes. "Writing down words and memorizing them for a quiz was not effective."

Teacher T2 was a Caucasian female who identified with both German and British cultures. She had been a teacher for ten years; two years in third grade, two years in fourth grade, and six years in second-grade. She had 21 students in her classroom at the time of the study. T2 completed her degree in interdisciplinary studies and a traditional route for her teaching credential. She recently completed a Master's degree in Curriculum and Instruction. T2's recollections about learning vocabulary as a student include looking the words up in a dictionary and writing the definition. She stated, "During my years of education I did not experience a more effective way to develop vocabulary."

Teacher T3 was a Caucasian female. She has been a teacher for 24 years. Her experience includes teaching at grades kindergarten through grade three. She had 21 students in her classroom at the time of this study. T3 completed her teacher education through a traditional teacher preparation program. Her background in science was developed through a class she took in college and through district professional development. T3's recollections about learning vocabulary as a student include looking

the words up in a dictionary and writing the definition. She believed this was the least effective method she was taught, and the most effective was picture matching.

Teacher T4 was a Caucasian kindergarten teacher with ten years' experience. All her teaching had been at the kindergarten level. She completed her teacher education through a traditional four-year program. Her classroom had twenty-two students at the time she was observed. T4's experiences with science professional development (PD) as a classroom teacher included five years of instruction with me during my role as the Regional Science specialist. Under my direction, she created a scope and sequence and gathered exemplar science lessons for her grade level. Her only recollections about learning vocabulary as a student were that she learned vocabulary by memorization.

Teacher T5 was a "Caucasian Texas rancher" with eighteen years' experience. She taught grade six math for five years and special education for thirteen years. Her experiences in special education included pull-out programs at grade six and inclusion classes for both kindergarten and grade three students. I observed this teacher during her first year as a full-time kindergarten teacher. She also had 22 students in her class. T5 was an education major and math/science minor in college. She was certified to teach math and science through eighth grade. Her experience and background with elementary science included attending AIMS (Activities to Integrate Math and Science) workshops. T5's recollections about learning vocabulary as a student included writing definitions from the textbook.

Teacher T6 defined herself as Anglo American. She had sixteen years' experience of teaching at the kindergarten level at the time of the study. At the time of classroom

observation, she had twenty-two students in her classroom. T6 recalled "always wanting to be a teacher" and "playing school" as a youngster. She completed her teacher education through a traditional four-year program. Her experience and background with science education includes college courses in Biology and Geology. She does not recall ever taking a science methods course. T6's recollections about learning vocabulary as a student include using flashcards. It was "repetitive and not fun."

Data Sources

Details of the data sources, types of data, and how frequently data were collected is provided in Table 3-1.

Table 3-1
Data Sources, Types, and Frequency of Data Collection

Data Source	Type of Data	Frequency of Data Collection
SVQ, adapted from the *Teacher Questionnaire* (International Association for the Evaluation of Educational Achievement, 2006). [Appendix B]	Teachers' written responses to open-ended questions on vocabulary and a Likert-type rating scale regarding teachers' perceptions about the importance of vocabulary.	Pre- and post- intervention.
Reflexive Journal. [Appendix G]	Observational data from classroom observations, interviews, and the group discussion,	Observations for each of six teachers during the months of September, October, November, and December. One group discussion in December.
SCOW, adapted (RMC Research Corporation, LASER leadership, Regional Alliance, & Washington State Science Coordinators, 2010). [Appendix E]	Researcher's written observational notes in the rationale for the rubric-based, scaled-score section of the *SCOW*.	Observations for each of six teachers during the months of September, October, November, and December. One group discussion in December.
Interview Form. [Appendix J]	Hand-written responses by the researcher to open-ended questions on the interview form.	One interview per participant (total of six).

Qualitative Data

Teachers' Written Responses on the *Science Vocabulary Questionnaire* (*SVQ*)

During the initial whole group overview held in August, eleven kindergarten, twelve first grade, and ten second-grade teachers were asked to complete the *SVQ* (Appendix B). The teachers coded their questionnaires with their initials and grade level. The purpose of this instrument was to provide information about teachers' initial classroom practices related to teaching science vocabulary. In developing the questions on the *SVQ*, I used Biemiller's (2003) research as a reference as well as the *Teacher Questionnaire* developed by the International Association for the Evaluation of Educational Achievement (2006) for the Progress in International Reading Literacy Study. I wanted to establish the participants' *initial* perceptions about teaching and learning vocabulary. The open-ended written responses also revealed teachers' estimates of the time they spent teaching vocabulary each week and the methods they most frequently used. All classroom teachers on the campus completed the initial questionnaire prior to the selection of the specific participants in my research. At the end of the study in December 2012, the six teachers in the study completed the same *SVQ* they had completed in September. My comparison of teachers' responses on the pre- and post-test was used to estimate changes in teachers' conceptions *after* they received professional development training in teaching science vocabulary.

Researcher's Written Accounts of Teachers' Use of Academic Vocabulary in Science Classroom Observations

The *Science Classroom Observation Worksheet (SCOW)* (Appendix E) in my study provided the format for my written representations of the observed lessons. I completed a *SCOW* each time I observed a teacher's science lesson. Analysis of the *SCOW*s for one teacher over four months of PD experiences allowed me to monitor the teacher's progress from month to month as well as to make comparisons between teachers. The *SCOW* identified four dimensions and eleven objectives of what occurred in the science classroom: Dimension 1: Learning Objectives (Objective 1: Alignment of Lesson Activities and Objective 2: Understanding of Purpose); Dimension 2: Developing Understanding (Objective 3: Elicitation of Prior Understanding, Objective 4: Intellectual Engagement, Objective 5: Use of Evidence, Objective 6: Application of Methodologies, and Objective 7: Formative Assessment); Dimension 3: Sense-Making (Objective 8: Making Connections and Objective 9: Reflection and Meta- cognition) and; Dimension 4: Classroom Culture (Objective 10: Classroom Discourse and Objective 11: Motivation). The *SCOW* focused my observations of the participants' science vocabulary teaching during the observations held in the months of September, October, November and December by cuing me to answer three questions:

1. To what extent is vocabulary being covered in an observed science lesson?
2. Is there more attention to vocabulary instruction in the science lessons observed after the PD than there was in the observation before the PD? (Did teachers actually implement the information they learned during the hour-

long group professional development as well as the three half-hour individual sessions?)

3. What new strategies did the teacher employ? (Did the teacher use either the method modeled for them, or another method?)

I wrote a narrative for each class observed in my reflexive journal. These notes provided the rationale for my rating scores on the *SCOW* as well as observational information on the teacher's practice during science lessons. I described vocabulary methods, if used, along with student engagement, and evidence of student learning. The written narrative allowed me to engage fully in what I was seeing and hearing during the observation. The written narrative was instrumental allowing me to assign a valid Likert-type rating score on the *SCOW.*

Interview Data

I used the same interview protocol for each participant during the month of November. I conducted these interviews in a one-on-one setting using the Interview Form (Appendix J) to guide my questioning. Each participant responded to the same eight questions. The questions focused on the participant's views on science and vocabulary instruction and their own experiences with learning vocabulary. I used the same process to elicit information from the six participants. First, I provided each participant with a copy of the Interview Form. I then read each question to the participant and asked the participant to write their response in narrative form on their copy of the Interview Form. Narrative writing allowed respondents to provide details about their experiences and their teaching without the limitations of a scaled response.

Data from Teachers' Focus Group Discussion

The group discussion was held in the afternoon after the end of the school day during the month of December. All six participating teachers met with me in the school library. The group discussion focused on vocabulary instruction using questions number 2, 3, 4, 5, and 7 on the Interview Form as a guide. The group discussion encouraged interaction among the six teachers regarding their views on the least and most effective methods of vocabulary instruction, the importance learning science vocabulary, and how the formal professional development sessions, the lesson modeling, and the in-class coaching may have changed their views. The data from the group discussion was recorded in the reflexive journal. I gathered additional information from participants during informal discussions in the individual debriefing sessions after observations.

Quantitative Data

Teachers' Likert-type Scale Responses

The *SVQ* included three Likert-type scale responses. The levels of agreement included strongly agree, agree, disagree, and strongly disagree. I chose to not include a neutral response on the advice of Dr. Linerode, my former statistics professor at Our Lady of the Lake University. Dr. Linerode said in his many years of conducting research, neutral responses were often chosen on a form when a participant did not want to make a firm choice, and therefore added no real information to a study. I requested that participants answer only three questions using a scaled score, although there was space for additional comments. No participant chose to elaborate on these questions.

Classroom Observation Ratings

The *SCOW* included a rating scale from 0-6 in each of the eleven learning objectives. *The SCOW Rubric* provided detailed information for observable attributes associated with ratings of 0, 2, 4, and 6. After each observation, I read my written observational notes in my reflexive journal and transferred information from the reflexive journal into the appropriate rationale section on the *SCOW*. I compared the notes in the rationale section against each of the holistic ratings on the *SCOW Rubric* before deciding on a score for each learning objective.

I observed the classrooms of all six participating teachers in early September, prior to the one-hour whole group professional development I provided later in the month. I also observed teachers after each individualized professional development intervention I provided in October, November and December. During these observations I observed classroom lessons as unobtrusively as possible, and focused on taking detailed observational notes in the reflexive journal. After I completed the observation, I filled in the *SCOW* using the *SCOW Rubric* as a guide.

Timeline

The professional learning opportunities included in my plan for the Record of Study included two hours of face-to-face professional development occurring in the summer of 2012; follow-up sessions during three months in the fall of 2012, including one hour of whole group professional development in September and three half-hour sessions of individualized professional development during the months of October,

November and December. I provided a total of four-and-a-half hours of professional development for the participants. I provided coaching during the debriefing sessions after classroom observations. Only three participants (T1, T4, and T5) had debriefing/coaching sessions. In addition, I held an informal individual follow-up interview with each participant in November and a group discussion in December.

Procedures

Table 3-2 provides a summary of the five-step process for pre-intervention, intervention, and post-intervention research activities for the Record of Study.

Table 3-2
The Five-step Process for Collecting and Analyzing Data for the Record of Study

Research Questions	Instrument	Data Collection and Analysis
STEP I. (Pre-Intervention) Present PD on vocabulary instruction. Explain record of study. Distribute consent forms, allow time for completion of the forms, and then collect the forms.		
1. What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons?	*SVQ*	Administer SVQ to kindergarten and second-grade teachers in PD session. Analyze Likert scale data.
STEP II. (Pre-Intervention) Make preliminary observations of participating teachers' classrooms.		
2. What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons?	*SVQ, SCOW*	Observe classrooms during science instruction of teachers agreeing to participate in the Record of Study. Analyze qualitative data from *SCOW.*

Table 3-2 Continued

Research Questions	Instrument	Data Collection and Analysis
STEP III. (Pre-Intervention) Use data from Step I and Step II to guide the development of the PD intervention. Merge data from pre-tests and preliminary observations and information from the literature to design the intervention.		
STEP IV. (Intervention) Administer a one-hour, whole-group PD and three half-hour individualized PD sessions. Observe participant teachers' classrooms during science instruction in October, November and December. Conduct individual interviews in November and whole group discussion in December.		
3. How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention?	*SCOW, Interviews, Group discussions*	Use the *SCOW* to record scores and the rationale for the rating score. Use the interview form to gather data on teachers' perceptions of learning vocabulary.
STEP V. (Post-Intervention) Analyze qualitative and quantitative data to determine the changes in vocabulary instruction.		
4. How did participating teachers' incoming perceptions change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons?	*SVQ, Interviews, Group discussions*	Administer the *SVQ* to participating teachers.
5. How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons?	*SCOW*	Use the *SCOW* to track changes in participants' scores.
6. In what ways do quantitative and qualitative analyses agree?	*SVQ, SCOW, Interviews, Group discussions*	Quantitative data are transformed into summaries and included with qualitative data in pattern analysis.

**Note. Abbreviations: Professional development: PD; Science Vocabulary Questionnaire: SVQ; Science Classroom Observation Worksheet: SCOW*

Step 1 – Initial Professional Development

Initial Session (August, 2012). The first professional development session was a two- hour session held in August, a week before school started. This session included all 33 primary classroom teachers from the school and included an overview of the methods of vocabulary instruction to be presented over the course of the study as well as an overview of the record of study. This initial professional development session was mandatory for teachers to attend. During this session the 33 teachers were also asked to complete the *SVQ*. Before returning the questionnaire I asked teachers to code their forms by writing their first and last initials as well as the grade taught in the top corner of the form. I distributed and explained the consent form for the record of study. Each of the 33 teachers was asked to complete a consent form, indicating whether or not they wished to be part of the study. Three second-grade teachers and eight kindergarten teachers indicated a willingness to participate in the study. No grade one teachers indicated a willingness to participate in the study.

Participant Selection (August, 2012). I met with the principal on the day after the professional development to receive input on which of the kindergarten teachers she felt were best suited to the study. The principal recommended choosing only three teachers to make a total of six in the study. We agreed that keeping the sample size to six would make the observations and professional development sessions more manageable. Reasons for excluding particular kindergarten teachers included recent deaths in the family, recent births in the family, and teachers who were new to the school during 2012-2013.

After choosing the six teachers (three from second-grade and three from kindergarten) I pulled their *SVQ* and collated it with the consent forms. At this time each participant was given a code: T1, T2, T3, T4, T5, and T6. All forms were kept secure in order to protect confidentially.

Contacting Participants (August, 2012). I contacted the six participating teachers by e-mail to schedule an initial classroom observation.

Step II- Preliminary Classroom Observations

Classroom Observations (September, 2012). Observations were 30 minutes long and scheduled for the teacher's regular science class period. I used the *SCOW*, the *SCOW Rubric* and the reflexive journal during each observation. In September classroom observations were conducted to collect data on teachers' classroom practice. The observations were prior to the intervention of professional development to instruct the teachers on methods of vocabulary instruction. The *SCOW* was the instrument used to collect the data for the second research question. There is both a rating scale and a rationale for rating on the *SCOW* instrument. The teachers provided me with the times during the week science was taught; I scheduled the observations to ensure I would observe a science lesson. Four of the six teachers taught a science lesson when I observed the class in September. One kindergarten teacher (T5) taught a lesson on 'how to recognize a sentence' rather than her planned science lesson and another kindergarten teacher (T6) started teaching a lesson on magnets and then switched to Constitution Day activities because she was informed the morning of her observation it was her class's

turn to rotate through Constitution Day activities set up in a learning lab. Learning objectives were rated on a scale of 0-6 on the *SCOW Rubric*.

Step III- Intervention Design

To design the intervention, I compared *initial* classroom practices and initial *perceptions* related teaching science vocabulary to what the literature recommended as best practice for students in kindergarten and second-grade. I analyzed the teachers' open-ended responses on the *SVQ*, highlighting the most common themes. These themes, along with the rating scores and observational notes on the rationale for rating on the *SCOW* were used to determine methods of vocabulary instruction with which to start. The participants' responds on the SVQ indicated vocabulary was important, must be taught in order to understand concepts, and was necessary for clear communication. Participants used discussions and picture cards as effective methods of teaching vocabulary. These responses demonstrated participants acknowledged the importance of, but used limited methods in, the teaching of science vocabulary.

In the initial classroom observations I noted teachers using elicitation of prior knowledge as a primary method of vocabulary instruction. Teachers used the information gathered from elicitation of prior knowledge to guide their instruction. This method of instruction was a strength in the initial observation for two of the participants and used by two other participants. My review of the literature indicated that teachers should have a *variety* of methods for teaching science vocabulary based on the methods established in the literature. Since the language of science varies from known and familiar language (basic interpersonal communication), teachers needed to provide

instruction in a variety of ways in order to address the scientific terms in the classroom. Additionally, the Texas science standards have complex process skill verbs not typically used in everyday conversations, such as analyze, demonstrate, describe, discuss and identify that also need to be modeled and taught. With the consideration of teachers' entry-level understandings and practices and these additional sources of information, I designed a one-hour whole group professional development training for the six participants. A detailed sequence of activities for the training is displayed in Appendix H.

Step IV – Delivery of Intervention

After my initial observations in early September, I delivered a one-hour, whole group professional development session for the six participating teachers (Appendix I). Methods emphasized during this session were Verbal/Visual, Word sorts (open and closed), Draw it!, What's the Connection, The Important Word, Word Walls, Word Bingo, and Alphabet Books. I chose these methods because they aligned to recommendations from the literature. I provided teachers with the opportunity to view each method and to choose two methods for more in-depth instruction.

The October Professional Development. I sent an e-mail to each of the six participating teachers as a follow-up to the whole-group professional development session. The information included an article on the critical components of an effective vocabulary program, vocabulary instruction as part of the learning cycle (5-E model), and examples of the methods of vocabulary instruction demonstrated in the professional development: word sorts, verbal/visual, draw it, and word banks/word walls. The

information on vocabulary instruction as part of the 5-E learning cycle was distributed at the request of the principal. The principal wanted teachers to see where vocabulary instruction could be used in the course of a unit or lesson. Each participating teacher was asked to select: (a) the words they wanted students to focus on during their October science lesson observation and (b) the method of vocabulary instruction they wanted to learn during their individualized professional development sessions. Four of the six participant teachers responded with specific requests before their October observation. T4 sent a list of words she had chosen for the entire first nine weeks. Her specific request was to learn more about "The Important Word" method. Although it was not one of the methods mentioned in the preview material, it was one of the methods introduced during the second whole group professional development. T5 wanted to learn about designing and using a science word wall. T1 sent a list of words she had chosen for the entire first nine weeks. Her specific request was to learn more about using the method Draw It! T6 wanted to learn about using word sorts. T2 and T3 did not respond to the email. I met with each of the four teachers (who had responded to the e-mail) individually before their scheduled October observation. Each teacher (T1, T4, T5 and T6) was provided a 30- minute individualized professional development specific to the method of vocabulary instruction they wanted to use during the October observation. The specific method of instruction requested by the teachers was modeled by the researcher during the participant's planning time, prior to the observation. The teachers asked clarifying questions about the method when necessary and, in some cases, asked for a debriefing session after the observation. While on the campus in October for the

individualized professional development sessions with T1, T4, T5 and T6, I contacted T2 and T3 to inquire about the method of instruction they wanted to learn more about or modeled in the classroom. T2 and T3 both responded that "anything" would be acceptable. I distributed handouts with picture cards in the event these two teachers needed resources for their vocabulary lessons.

After the October observation, each of the six teachers debriefed with me through e-mail correspondence. During this correspondence teachers asked if we could continue having the individualized PD sessions during their planning period, before or after school. I agreed meeting individually for 30 minutes was more efficient and beneficial than group PD sessions because the specific needs of each teacher were specifically met.

The November Professional Development. I followed October's procedures before the November observation, which included: (1) Participating teachers sent specific requests for the method they wanted to use with students; (2) I met with the teacher individually; (3) I modeled the specific method of instruction requested by the teacher during the 30-minute individualized PD session; (4) the teacher asked for clarification when necessary; and (5) debriefing and coaching after the observation, when requested.

After the November observations three teachers made requests for individual instruction before the December observation. Time was arranged to meet each of these three teachers individually in December to model the chosen vocabulary method. Three teachers did not respond, despite additional contact from me. The three non-responding

teachers said their schedules were too full with holiday activities to set aside time to learn about vocabulary activities. However, the teachers said they would still schedule an observation with me.

I also conducted individual interviews with the six teachers during the month of November. Interviews on the average lasted about 25 minutes. Teachers reflected on the least and most effective ways they learned new vocabulary, how they had taught vocabulary, and the importance of learning science vocabulary.

The December Professional Development. The PD intervention in December followed the same pattern as the previous two months. I met with the individual teacher to model the vocabulary method of instruction requested. The classroom teacher had the opportunity to request clarification on the method of instruction or ask questions about the procedure as necessary. Only three of the six participating teachers requested to learn about another method of teaching vocabulary. However, all six teachers scheduled a December science lesson observation. The three teachers who modeled a specific method of vocabulary instruction received input during an informal discussion after school on the same day as the observation. The group discussion was held in December after the completion of all the observations. We met as a group and discussed the most and least effective ways to learn and teach science vocabulary.

Data Collection

I observed each teacher four times. Each observation was scheduled for 30-minutes during a science lesson. During the observations I wrote observational notes in the reflexive journal. The notes included the topic of the lesson, the physical

environment of the classroom, and a running record of what the teacher and students said and did. After each observation I transferred information from the reflexive journal to the appropriate learning objective on the *SCOW*. Next I used the *SCOW rubric* to assign a score for each of the learning objectives. Once the *SCOW* was completed I used the information to assess teacher implementation of vocabulary instruction during the period in which I provided the individualized professional development. I collected the teacher responses on the Interview Forms in November. During the December group discussion I wrote teachers' comments on the questions in the reflexive journal. I used the information from the interviews and group discussion to compare teachers' perceptions about the least and most effective ways they had learned vocabulary as a student to the ways they learned to teach vocabulary during the PD. Loughran (2010) stated that individual experiences often shaped what teachers did in the classroom. Additionally, learning new teaching practices and translating the new ideas into teaching practices in the classroom took time and repeated effort. The data from the *SCOW, Interview Form,* and group discussion helped me compare what teachers said was effective teaching to what they did in the classroom.

Step V – Analysis of Post-Intervention Data

The fifth and final stage of the research involved answering the three final research questions. Question 4 addressed changes in teachers' perceptions about their teaching of vocabulary in science, requiring a comparison of pre- and post-test scores on the *SVQ*. Question 5 addressed changes in teachers' practices as a result of the professional development. Question 6 required a comparison of quantitative and

qualitative data sources from the *SCOW, Interview Form, SVQ*, and group discussion to assess agreement between the two different types of data.

Analysis of Quantitative Data Regarding Teachers' Perceptions. The data from the *SVQ* and *the SCOW* was combined and analyzed holistically. The initial analysis involved several steps:

1. Gathering all the Likert-type scores from each of the six participants on the *SVQ* and aggregating the responses onto one form. I placed the teacher code (T1, T2, etc.) under the response indicated on the individual's questionnaire, for example under "strongly agree" I wrote T1, T2, T4, T5 and T6.
2. Reading all open-ended responses from the *SVQ* and rewriting the participants' responses for each question order to analyze for themes.

Analysis of Qualitative Data Regarding Classroom Observations.

3. I constructed a chart to record the scores from the *SCOW* for each participant's initial observation for each of the eleven categories. My choice for analyzing my pre-intervention data was based on the suggested ten steps for data collection and analysis by Bogden and Biklen (2003), in which they suggest the use of visual devices to see themes and patterns more clearly. I looked for patterns and trends in the data by comparing each of the six participating teachers' scores for the eleven learning objectives. I wanted to see if the data revealed any common practices of instruction between the teachers or identified strengths and weaknesses of individual teachers.

4. I also read all the narrative from the *SCOW* for each participant's initial observation for each of the eleven categories. I highlighted each participant's worksheet as I saw themes and connections. For example, similar narrative notes in category 11 were highlighted in one color whereas similar narrative notes in category 2 were highlighted in another. I marked my data in this way because I am a visual learner, and I can see patterns more easily when in color.
5. I compared answers on the *Interview Forms* and *SVQ* to what I observed in the classroom (*SCOW)*. I looked for alignment between what teachers said was effective for their own learning of vocabulary (*Interview Form*), what they said were effective methods for teaching science vocabulary to students in their classroom (*SVQ*), and what they actually did during science class vocabulary lessons (*SCOW*).
6. I compared responses of each participant during the group discussion to their individual responses on the *Interview Form* and their open ended responses on the pre- and post *SVQ*. The group discussion was the final meeting between the participants and me. I wanted to assess if the changes in methods of teaching vocabulary could be linked to both the individualized PD sessions and a change in perception of what constituted a "best method" or practice.

Agreement between Quantitative and Qualitative Data.

7. I looked for trends, themes and patterns. The teachers' initial perceptions and initial practices were analyzed to find gaps in either content knowledge or pedagogy. The review of the literature provided guidance for planning the agenda for the professional development sessions as well as the methods of vocabulary chosen to model for the teachers.
8. Emerging themes from the *SVQ, SCOW* and *Interview Form* were compared to the pre-intervention data to demonstrate if the professional development sessions had improved the teachers' methods and frequency of vocabulary instruction. Had the learning of new ideas actually translated to a changed practice in the classroom?

Reliability and Validity

Reliability and validity are viewed differently by quantitative researchers and qualitative researchers (Golafshani, 2003). Reliability refers to whether or not the research can be replicated, or reproduced using a similar methodology. In qualitative research validity and reliability are focused more on precision, credibility and transferability (Golafshani 2003).

Reliability

Stuhlman, Hamre, Downer, & Pianta (2010) describe a tool as reliable if it ensures that anyone who is trained to use the tool, or instrument, will use it consistently and fairly in observations of any teacher or classroom. Before choosing the *Science Classroom Observation Protocol* I reviewed it using two questions. 1) Is the instrument standardized in terms of administration procedures? 2) Does it offer clear directions for

conducting observations and assigning scores?

I read the procedure manual for the *Science Classroom Observation Protocol,* and there are clear instructions for using the worksheet and the rubric. The instrument is standardized and has been used in Washington State as an observational tool since its development.

Validity

In order to ensure validity of the study, I chose instruments previously used in several other research studies. The original instrument (*Science Classroom Observation Protocol*) (*SCOP*) was designed for observations in a science classroom. Researchers conducted 79 observations using the instrument. The reliability alpha was .91. The instrument evolved from previous research on the characteristics of effective science instructions and the rubric was developed by a team of science education experts. Therefore the validity is primary face validity (Dave Weaver, RMC Research Corporation, personal communication). I adapted the instrument to make it specific to vocabulary instruction. The original instrument, on which the *SVQ* was based, was extensive and included many questions about reading. I modeled my questions after the questions specific to vocabulary. The Interview form was designed from a model used in the Online Executive Ed.D Program at Texas A & M. The data on the participants' years of teaching and previous trainings were included to allow other researchers to conduct similar studies using similar demographics.

Ethical Considerations

Several potential ethical issues needed to be considered during this Record of

Study. Included in these potential issues were: obtaining permission, protecting the anonymity of respondents, communicating the purposes of the study, respecting vulnerable populations and not disclosing sensitive information. In order to address ethical concerns when using human subjects, an IRB proposal for research was submitted to and approved by the Office of Research Compliance Institutional Review Board at Texas A&M University prior to the start of the study. The IRB process assured that a conscientious effort was made to minimize the risk to participants in the study.

As part of the IRB protocol, each participant in the study read and signed a Participant Consent Form (Appendix A), which outlined the purpose of the record of study. The protocol also provided assurances that participants were permitted to withhold information for any reason and to withdraw from the study at any time. I also verbally explained how I would ensure the confidentially of all information I recorded. Information was coded for each participant and the code connecting the participant to the data was known only to me. Furthermore, participants were notified that all written records were stored in a locked place, and all electronic data was stored on a password-protected personal computer. No audio recordings were made during the research.

Limitations

The outcomes of this study may be influenced by a variety of limitations. One limitation of this study was related to the issue of generalizability because of the small number (six) of participants. The sample size of six teachers limited the opportunity to have diverse ethnicities, years of experience, and genders. It will not be possible to

generalize from this study to all kindergarten and second-grade teachers in the same school, other schools, or school districts. Other limitations in this study included:

- The participants did not agree to video or audio recording. Every aspect of the classroom setting and the discussions and actions of the teacher and students may not have been fully captured by the researcher in the reflexive journal.
- The use of the test-retest method with the *SVQ* may have sensitized the teachers to the questions being asked, and therefore may have influenced their responses.
- Individual teachers had different instructional preferences and pedagogical knowledge and brought unique experiences, instructional strategies, and perceptions about teaching into the classroom.
- The small number of classroom observations could be problematic. The instruction I observed may not reflect the teachers' practice in general and the limited observations may not have been representative of the instruction of the participants in the study.
- Some of the research was conducted in December. This affected attitude and motivation for three participants in the study.

Summary

This chapter described the methodology of the mixed-methods study, for this Record of Study, used to describe the effectiveness of a professional development model I developed to increase primary teachers' expertise in teaching kindergarten and second-

grade teachers in teaching academic science vocabulary. Specifically, this section provided descriptions of: (1) research design; (2) context; (3) participants; (4) data sources; (5) timeline; (6) procedures; (7) reliability and validity; (8) ethical considerations; (9) limitations; and (10) a summary.

CHAPTER IV

FINDINGS AND RESULTS

In my position as a professional development provider, I am often asked to develop methods for providing professional development leading to improved classroom practice. In this particular study, I sought answers to questions about a method of professional development requiring intensive classroom follow-up and individualized instruction. As vocabulary instruction has been found by many researchers to provide an essential foundation for learning science in older learners, I decided to extend the results of previous research to include the professional development of teachers who teach science in the primary grades. In my initial meeting with the district curriculum superintendent and science curriculum specialist we discussed science data from fifth-grade assessments. The data suggested vocabulary was a weakness. The lack of a comprehensive science-based vocabulary hindered the understanding of science content. The administrator of the Primary Grade (K-2) campus expressed interest in building a stronger vocabulary program for her teachers. She felt building a strong foundation in science vocabulary in the primary grades would benefit students as they progressed in school.

I posed six questions for this record of study regarding my new model of professional development. These questions centered on primary teachers' pre-intervention perceptions and practices of vocabulary instruction in their science lessons, classroom practices while engaged in on-going professional development, and changes

in their perceptions and practices after the professional development experience had ended.

1. What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons? (Before Intervention - QUAN)
2. What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons? (Before Intervention – QUAN/QUAL)
3. How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention? (During Intervention –QUAN/ QUAL)
4. How did participating teachers' incoming perceptions change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAN)
5. How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAL)
6. In what ways do quantitative and qualitative analyses agree? (Post-Intervention – MIXED).

Before-Intervention Findings

Question 1

What Were Participant Primary Teachers' Incoming Perceptions Related to the Inclusion of Vocabulary Instruction in Science Lessons? The six teachers completed the *Science Vocabulary Questionnaire* prior to receiving any instruction or professional development. The *SVQ* had two sections: Likert-type score response statements (quantitative), as well as open-ended questions (qualitative). The Likert-type responses asked teachers to state their level of agreement on three statements about the importance of vocabulary as it related to comprehension of content students read or heard. The information from the pre-intervention *SVQ* provided base-line information on teachers' initial perceptions on the *importance* of vocabulary. The open-ended questions focused on the teacher's initial perceptions about vocabulary *instruction*, such as how, when, and why teach academic vocabulary. The question on academic vocabulary was included because teachers in the primary grades focus on Tier 1 words. Tier 1 words are the commonly known words used in everyday conversation. Academic vocabulary is classified as Tier 3 words. These are the domain specific words needed to comprehend specific content and concepts. The questions about amount of time spent teaching vocabulary and when it was taught were included to have initial data on current teacher practice.

The summary of the teachers' entry-level responses to the Likert-type score questions is shown in Table 4-1. The results from the Likert-type scaled responses of the six participants on the *SVQ* revealed they all strongly agreed or agreed that

understanding vocabulary was critical for comprehension. They also agreed simply decoding a word was not the same as understanding the meaning. Finally, all participants agreed or strongly agreed vocabulary is acquired both through direct and indirect experiences (Table 4-1). To summarize, the data showed teachers' initial perceptions indicated vocabulary instruction was important.

Table 4-1
Summary of Six Participating Teachers' Responses on the Science Vocabulary Questionnaire

Statement	Participant's Responses (Percent)			
	Strongly Agree	Agree	Disagree	Strongly Disagree
Vocabulary is critically important to readers who use the words they speak and hear to make sense of the words they see in print. Decoding without understanding what words mean is not reading meaningfully.	83	17	0	0
Vocabulary is critical to reading comprehension throughout the grades. A reader cannot comprehend what is read if he or she doesn't know the meanings of most of the words. As children advance in reading, they encounter words that are not part of their oral vocabularies, which they need to learn in order to understand what they are reading.	100	0	0	0
Most vocabulary is learned indirectly through everyday experience with oral and written language, but some words representing complex concepts that are not part of everyday experience must be taught directly.	83	17	0	0

I analyzed the open-ended responses from the *SVQ* to find emerging themes and patterns. Emerging themes were identified when half or more participants responded with the same or similar comments (Table 4-2). Initial perceptions about vocabulary instruction included:

- Vocabulary was important and must be taught.
- Discussions and using picture cards were effective strategies for teaching vocabulary.
- Academic vocabulary was needed for making sense of (science) concepts.
- Academic vocabulary was helpful for communication, organization, and application of new content.

No trends emerged regarding the amount of time dedicated weekly to the teaching of academic vocabulary. Additionally, no trends emerged regarding the best time to incorporate teaching academic vocabulary in the day.

The results from this data suggested teachers' initial perceptions about effective vocabulary instruction methods were limited to a few strategies. Additionally, only half the teachers were clear on the definition of academic vocabulary. Academic vocabulary was defined by the other three teachers in much broader terms, including words more commonly classified as Tier 1 words. The data also suggested teachers currently do not focus on academic vocabulary instruction on a weekly basis. Vocabulary was taught as a routine procedure when introducing a new lesson, but not as a focused activity. Furthermore, teacher responses suggested a difference in language experiences among

incoming students in kindergarten and second-grade contributed to the challenge of teaching academic vocabulary.

Table 4-2

Summary of the Science Vocabulary Questionnaire: Open-ended question responses

Open-ended Questions	Emerging Themes	Example Statements
What instructional strategies do effective teachers use to teach vocabulary development?	Class discussions Using picture cards Using visuals Asking questions Anchor charts	"I use formal and informal discussion, listening, speaking activities, writing (formal and informal)." "I use anchor charts, discussion, context clues, picture cards, questioning."
Which instructional strategies are most often used by effective teachers?	Speaking Discussions	"I use listening and speaking, writing and using vocabulary in question/answer activities, and labeling." "Students practice during classroom discussions."
What does the term 'academic vocabulary' mean to you?	Vocabulary needed for understanding a specific subject.	"Vocabulary key to the understanding of a subject area and used to relate to the subject area." "Words that "go" with weekly lessons." "Vocabulary used by each grade level."
In what ways is teaching academic vocabulary important?	It is needed to understand concepts and to communicate.	"It's needed for students to fully understand concepts." "It provides the framework for all learning in the content areas."
Please estimate how much time you spend each week, on average, teaching vocabulary development.	No trend was apparent.	"About one hour." "About 10-15 minutes daily." "About 30-45 minutes."
Are there any challenges when faced with teaching academic vocabulary? Please include any examples.	Second language learners. Differences in language or background experiences.	"Language barriers." "Learners who haven't had experiential opportunities." "ELLs."
During what part of the instructional day would the teaching of academic vocabulary be most effective?	No trend was apparent.	"Introduction of content." "Morning." "All day."

Question 2

What Were Participant Primary Teachers' Incoming Classroom Practices Related to the Inclusion of Vocabulary Instruction in Science Lessons? The *Science Classroom Observation Worksheet (SCOW)* was used to describe the teachers' use of vocabulary instruction during the science lessons observed. This instrument provided a checklist for documenting evidence of teachers' completion of eleven objectives within four dimensions of vocabulary instrument, along with a section for narratives related to each objective. Table 4-3 summarizes teachers' scores (low = 1 to high = 6) related to their use of vocabulary instruction prior to the first PD session. Written narratives provide a synthesis of the observer's written notes about the classroom observed.

In summary, the results summarized in Table 4-3 indicate more objectives with lower scores than objectives with higher scores; and more teachers with lower total scores than higher total scores. Teachers' total scores on the 11 vocabulary instruction objectives ranged from 8 to 43 points. Low total scores (i.e., scores of 8, 14, 14, and 16) were calculated for four teachers, and two much higher scores (i.e., 28 and 43) were calculated for the two additional teachers.

The two teachers with the higher scores taught kindergarten and second-grade, while two teachers in kindergarten and two teachers in second-grade represented those in the lower group. In terms of total scores on individual objectives, objectives 8 and 10 (*Making Connections* and *Classroom Discourse*) received highest overall scores, while lowest scores were awarded to objectives 5, 6, and 9 (*Use of Evidence, Application of Methodologies*, and *Reflection and Metacognition*, respectively).

Table 4-3

Summary of Primary Teachers' Pre-intervention Ratings from the September Classroom Observation

Teacher	Dimensions of Vocabulary Instruction and Their Objectives												
	Learning Objectives		Developing Understanding					Sense Making		Classroom Culture			
	*1	2	3	4	5	6	7	8	9	10	11	Tot	Av
T1	2	0	2	1	0	1	4	6	4	4	4	28	2.6
T2	2	2	1	2	1	0	1	2	0	2	1	14	1.3
T3	0	2	0	2	2	3	1	3	0	3	0	16	1.5
T4	4	4	5	4	4	2	5	2	4	4	5	43	3.9
T5	4	2	0	2	0	2	0	2	0	2	0	14	1.3
T6	0	0	4	0	1	1	0	2	0	0	0	8	0.7
Tot	12	10	12	11	8	9	11	17	8	15	10	123	11.2
Av	2.0	1.7	2.0	1.8	1.3	1.5	1.8	2.8	1.3	2.5	1.7	20.5	1.9
**High scoring (n)	0	0	1	0	0	0	2	1	0	0	1		
**Low-scoring (n)	2	2	3	2	4	3	4	0	4	1	4		

*Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

Table 4.4 lists objectives placed in two groups with group membership determined on the basis of their total numbers of high and low scores. Five objectives were placed in the low-scoring group with three or four teachers scoring either 0 or 1 on each of the five individual objectives. In contrast, four objectives were initially placed in the high-scoring group, even though only two or one teachers scored either 5 or 6 on the individual objective. Table 4.4 identifies objectives 3, 5, 6, 9, and 11 as those receiving highest numbers of low scores. (Table 4.3 indicates that five other objectives received either 2 or 1 low score, and only Objective 8 received no low scores.) In contrast, four objectives were placed in the group receiving highest numbers of high scores. The numbers for high scores for these objectives were lower than those for low scores, however. Objectives 3, 7, 8, and 11 had a count of one high score. (Again, refer to Table 4.3 to count 7 objectives as receiving no high scores of 5 or 6.) Interesting were objectives 3, 7, and 11, which were originally placed in both high-scoring (with counts of 1 or 2 teachers) and low-scoring (with counts of 3 or 4 teachers). In every case, however, these three objectives received more low scores than high scores, therefore resulting in a final placement of all three objectives in the low-scoring group. Objective 8, *Making Connections*, remained to stand alone as the only objective receiving more high-ranking scores (n=1) than low-ranking (n=0) scores. It is sufficient at this time to point out that a classroom observation protocol such as the one employed for this study can be a useful way to determine specific needs of teachers to be addressed by focused professional development experiences. The identification of objectives as low-scoring

could have been used for designing large-group professional experiences with the potential of high impact on improving classroom instruction.

Table 4-4

Objectives Initially Grouped by Highest and Lowest Total Scores in Six Teachers' Science Lessons before Professional Development on Vocabulary Instruction

Lowest Scoring Objectives (Dimension)	Number (n)	Highest Scoring Objectives (Dimension)	Number (n)
		Making Connections, Objective 8. (Sense Making)	1
Use of Evidence, Objective 5. (Developing Understanding)	4		
Reflection and Metacognition, Objective 9. (Sense Making)	4		
Formative Assessment, Objective 7. (Developing Understanding)	4	*Formative Assessment, Objective 7. (Developing Understanding)	2
Motivation, Objective 11. (Classroom Culture)	4	*Motivation, Objective 11. (Classroom Culture)	1
Elicitation of Prior Understanding, Objective 3. (Developing Understanding)	3	*Elicitation of Prior Understanding, Objective 3. (Developing Understanding)	1

* Note. These three objectives were initially placed in both low- and high-scoring groups. As numbers for these three objectives indicated more low scores than high scores, these objectives were ultimately placed in the low-scoring group.

The following narrative recounts my initial classroom observations of six science lessons, including the teacher's classroom practices, descriptions of the teacher's engagement with students, and the teacher's use of science terms within the lesson. I also

describe opportunities for students to connect the content of the lesson with language. I conclude each narrative by identifying the teachers' strengths and weaknesses in vocabulary instruction, which were determined by my assessment of the teacher's performance on the *SCOW* objectives.

Teacher T1. T 1's science lesson for the September observation was about vocabulary relating to "the scientific method." The terms/phrases *ask a question, make a hypothesis, experiment, record data/make observations,* and *draw conclusion* were written in an upward diagonal pattern across the whiteboard at the front of the classroom. Students were seated within a 12' X 12' taped-off area on the carpeted classroom floor in the top right corner of the classroom. T1 stood in front of the class. T1 said, "I want you to remind me what we learned yesterday. What did we do yesterday?" Students' hands waved above their heads. One student called out, "Method." T1 corrected the student, "Scientific Method." She continued, "What are some of the steps? What has to happen first?" A student suggested, "Test it?" T1 responded, "Hmmmm." Another student called out, "Ask a question?" T1 prompted the student further, "Then they have to do what?" The student continued, "Hypothesis?" T1 asked the whole class, "What is a hypothesis? What does this mean?" A student suggested, "A question?" T1 prompted the class again, "A hypothesis is…" The students were silent. Some looked around the room; others wiggled in their sitting area. T1 played a three minute segment from a Brain Pop® video. The segment reviewed the steps in "the scientific method." T1 asked again, "What is a hypothesis?" A student said, "A guess." T1 validated the student's response, "Yes, a guess, a prediction. What's next?" A student shouted out,

"Doing the experiment!" T1 sighed and returned to the computer to restart the video. The computer had frozen, and the clip would not play. A student said, "Technology doesn't like you at all." T1 smiled, walked away from the computer and picked up a dry-erase marker from the whiteboard tray. She asked the students, "What do we do in our notebooks?" Students collectively responded, "Data." T1 continued, "Yes, data or observations. Then what do we do?" Students did not respond. T1 answered her own question, "They draw conclusions." One student hand is raised. T1 called on the student. "Is it like when they figured out not everything can stick to a magnet? Some metal does, but not all? It has to be iron, and …I forget the other stuff." T1 responded, "Yes." She then went on to review the scientific method. During the review, students called out with questions: "What does make observations mean?" "Is that the color or the weight?" T1 explained color and weight are properties. She reminded students they had recorded properties in their journals. She next directed students to go to their tables, take out a pencil, and write their names on the paper she was distributing. She asked students, "What are the properties of your object. What do we mean by properties?" This question was puzzling as students had no objects in their possession. A student responded to the question by saying, "Size." T1 asked, "Give me a size word." Several students called out with the words *large* and *humongous.* T1 told students if they wanted to be more scientific they could measure an object. She continued the discussion by asking, "What is another category?" A student called out, "Color." T1 asked for students to name some colors and students responded with a variety of colors. One student suggested the word *texture.*T1 explained texture was another property. Students were asked to provide terms

describing texture. Students provided textures such as rough, soft, fluffy, and bumpy. T1then instructed students, "Go around the room and pick one object. You're going to bring it back to your desk. You have one minute." Students rose from their seats and briskly walked around the room. After choosing an object, the students returned to their seats. During this time, there was minimal conversation. T1 said to the class, "You are going to describe your object and complete your chart. You need to fill in all parts. A good scientist looks at everything. Ideally we should be using a hand lens." Students begin work on the chart. As students work, questions were called out such as, "What does mass mean?" "What does length mean?" T1 answered each question. During this time several of the same questions were repeated. T1 suggested students work cooperatively and ask each other. After 5-10 minutes of work time, T1 stopped the class. About eight students were leaving for a special class and were disrupting class. T1 told the remaining students to put their objects back exactly where they got them.

In the initial September observation, T1 scored the lowest in the *Understanding of Purpose* (Obj. 2) and *Use of Evidence* (Obj.5), and the highest in *Making Connections* (Obj. 8). The teacher's average for the scores on all objectives for the month of September was 2.5. During the lesson, I did not know what the learning objective was because the terms on the whiteboard (scientific method) did not match the content of the lesson (properties of matter). I assumed that the learning objective for the lesson was a review of science process skills. Students began the lesson with recalling information from a video they had watched the previous day. An example for *Understanding of Purpose* (Objective 2), T1 had no alignment of vocabulary instruction with the learning

objective in that students followed a prescribed set of instructions rather than relating the review of the information from the video to the learning of new science terms. The teacher's performance on *Use of Evidence* (Objective 5) also was ranked as a 0. While a few students shared what they currently understood about the terms relating to "the scientific method," only the students who spoke were actively engaged. Many other students demonstrated off-task behavior. There was no evidence that students used justifications to explain their thinking. During the discussion, the teacher prompted students continually to assist students in applying the new terms. The students demonstrated their understanding through the completion of a handout on physical properties of an object. The handout had several science terms (size, color, texture, length, and mass). However, the terms had limited connection to the topic of the lesson. T1 had the highest rating in the objective *Making Connections* (Objective 8). Students made connections between the physical property terms on the handout and objects in the classroom. Students discussed the terms with group members and used scientific tools to measure and describe the objects. T1 encouraged cooperation and discourse between group members, including speaking, listening, reading, and writing.

T1's total score (28) on vocabulary instruction indicated much room for improvement. The score was second from the highest of the six classrooms observed initially. T1's vocabulary instruction received five high scores ranging from 4 to 6 on *Formative Assessment* (Obj. 7), *Making Connections* (Obj. 8), *Reflection and Metacognition* (Obj. 9), *Classroom Discourse* (Obj. 10) and *Motivation* (Obj. 11). She received four low scores of 1 or 2 for her implementation of one of two Learning

Objective Dimensions (*Understanding of Purpose*, Obj. 2) and three of the five Developing Understanding Dimensions (*Intellectual Engagement*, Obj. 4; *Use of Evidence*, Obj. 5; *Application of Methodologies*, Obj. 6). The low scores associated with this dimension indicated an area where T1 could show the most improvement in vocabulary instruction.

Teacher T2.T 2's science lesson for the September observation was about *properties of matter*. Students were seated on the carpet facing the whiteboard at the front of the room. The left of the room had bookshelves with genre baskets as well as reference materials such as dictionaries. The center-left room, along the wall, had a student reading area with pillows and reading lamps. Student desks were arranged in groups of four or five in the back half of the classroom. T2 stood in front of the class. She asked, "What are properties you already know?" Several students raised their hands, and T2 called on them one-at-a-time. Suggested responses included *bumpy, sticky, pokey, hairy, sharp, string, heavy, light, rough, soft, round hard,* and *fragile*. After the word fragile had been suggested, one student asked what it meant. T2 told the student to look the word up in the dictionary. The teacher did not classify the examples students provided into the physical properties of matter second-grade students should learn, such as size, shape, mass, color, texture, or flexibility. She continued the lesson by asking, "If it's not light it's …" A student responded, "Heavy." Another student shouted out, "The dictionary ripped!" T2 responded, "Well, I'm excited you want to look words up!" She continued talking with the rest of the class, "Are you ready to do your project?" Students nodded but did not say anything. T2 explained the rules for the investigation, "You are

going to describe the" she points to the word, "what's this?" The students collectively respond, "Properties." The student who had been looking up the word fragile called out, "I found it!" The student spelled the word for the teacher. T2 asked for the definition. The student responded with, "It's very, very breakable." T2 doesn't respond to the student's definition, but instead continued with instructions. "When you get your item you will write down as many adjectives as you can to describe your object." T2 instructed students to go to their table groups and distributed chart paper to each table group. Each member of the table group wrote their name on the paper. T2 distributed an object to each group. The objects included a mirror with a magnetic backing, a napkin, a wrapping bow, a wood craft stick, and a paper cup. Students were provided about seven minutes to write their adjectives. Not all students in each group were engaged in the task. Some were writing and re-writing their name, some were drawing pictures around their name, and some were writing words associated with the object.T2 called the class back to order, "Each group is now going to present their properties. I will hold the object and two members of your group will talk. The rest of you need to put your pencils and markers down and sit in your chairs." Students began following instructions. T2 spoke again, "A better idea- all of you come and sit here." She pointed to the rug area. T2 called the first group up. One student began, "We had a tissue. It is a rectangle, light, smooth, smelly, foldable, fragile, soft, white and rip." While this student was speaking to the class, another student interrupted with, "I didn't write anything!" Another chimed in with, "We need one paper for the girls and one paper for the boys." T2 gave no response to the group's list of properties or the side conversations. She asked the group to sit

down, and called on the next group. The spokesperson for the group said, "We had a mirror. The properties are hard, clear, rubber, gravity, magnetic, magnet, smooth…" T2 interrupted the student and said, "I noticed you wrote some sentences." No further elaboration was asked of the students. T2 also did not comment on the terms that had no relation to the physical properties of the mirror: clear, rubber or gravity. She asked the group to sit, and called up group three. One student held the bow, two held the poster, and the fourth read the terms. The student reading began, "pull-y, rip-y, smelly, paper, bumpy, presents, metal, glittery, gold, sharp, shiny, soft, pokey, sticky, bendy…" T2 asked, "Can you show me what you mean by *bendy*?" The student holding the bow moved the edges up and down. T2 asked, "Is there another word for bendy?" One of the students in the class responded, "Flexible." As the group was instructed to sit down, the reader for the group said, "And stretchable." Group four stood up and walked to the front. The boys told the girls they didn't want to share. The two girls held the poster and took turns reading the words. The girls read, "We had a cup. It is smooth. It's breakable. It's flexible. It's fragile. It's tear-able. It's round." The two boys walked over to the girls and said they wanted to share. The boys said, "It's tear-able, like it can tear. Not terrible, like Grrrrrr." T2 showed no reaction to the boys' response. She asked the group to sit, and called up the last group. This group spent more time writing their names on the paper than writing words to describe their object. Only one student in the group presented. She held the poster and said, "Our object was smooth, breakable, pokey, woody and smelly." She did not mention the object was the wood craft stick. T2 asked the group to sit. She continued the lesson, "We did background knowledge so you could

share what you already knew. We will talk, listen and see about properties." T2 walked to her computer to start a video. As she worked she said, "After the movie I will ask you some questions, so I need you to think like a scientist and begin to think of 'I wonder' questions." A student spoke out, "Maybe we should have a piece of paper for ourselves and you give us a topic and then we write all the properties." T2 responded, "That might be a good suggestion." While the teacher continued working to start the video the class became very talkative. T2 responded to the students, "I'm teaching you a very important skill. Do you know what it is? Patience!" Finally, T2 got the video to play.

The learning objective of the lesson was a review of *properties of matter*. The teacher began by eliciting prior knowledge of properties of matter. Students responded with many terms, but only one was a property of matter. The rest were words to describe the property. For example, *bumpy, smooth, sticky, hairy, rough, soft* and *hard* were all in the property category "texture." Light and heavy were in the property category "(relative) mass." Students completed a project: writing all the *adjectives* to describing an object, but had little time to relate the activity with the learning of the new term *properties*. T2 had groups read their list of adjectives, but did not ask for clarification or justification. Several terms in each groups' lists were not physical properties, but T2 did not assess for understanding. In addition, the teacher focused on students' reading ability, rather than on the accurate use of the terms. The terms students used to describe their objects did not align with the terms the teacher had written on the board. During the group work, few students discussed the science concepts with their peers. In four of the five groups I observed, a dominant student made the decisions for the group as a whole.

In this observation, T2 had scores ranging from 0 to 2. The teacher's average of all rating scores for the month of September was 1.27. T2 had no strengths in any objectives. Her scores in the dimension *Learning Objectives* were more consistent than in any other dimension. Scores of zero were awarded for the objectives *Application of Methodologies* (Obj.6) and *Reflection and Metacognition (*Obj. 9) as there was no evidence to support a higher rating. Five objectives were scored as a 2 and four objectives were scored as a 1. Students did not apply what they learned in the lesson to a new context. T2 did not provide opportunities for students to make sense of the new vocabulary (properties of matter). Students listed words both verbally and in writing, but not in the context of properties of matter.

T2's total score (14) on vocabulary instruction indicated much room for improvement, and the low scores associated with *Application of Methodologies* (Obj.6) and *Reflection and Metacognition (*Obj. 9) indicated areas where T2 could show the most improvement in vocabulary instruction.

Teacher T3. The learning objective of the September lesson was science lesson was *classifying physical properties*. Students were sitting at their desks in table groups. One student sat at a desk in the back of the room facing the wall. He did not participate in the science lesson while I was there. T3 had a computer set up to show a video. She was standing next to the computer and began the lesson, "Today we are going to watch a video on properties of materials." Students focused their attention on the whiteboard where the picture was projected. The video began, and I noticed it was made in Scotland. The accent, use of language, mode of dress, and the countryside views were all

indicative of a foreign film. As the video played, T3 distributed a blank piece of paper on each student's desk. As the video progressed, a student called out, "What's a 'cinema'?" T3 did not respond, but another student called out, "It's a T.V.!" T3 did not respond to give the correction: a "cinema" was the same as "the movies." The actors in the video displayed a variety of objects with different physical properties. As each object was shown I could hear students whispering the properties of the object. For example when ball was shown, students whispered "round," "green," and "solid." These responses indicated students knew some information about properties. Ten minutes into the lesson, the teacher stopped the video. She asked her students, "What is something you have learned from the film?" Several students responded with a variety of answers such as, "It can be magnetic," "metal," "springy," "sharp," "A magnet can have two sides: north and south," and "plastic." T3 made no comments to student responses. She had no interaction with her students during the video. Furthermore, T3 had no engagement with students and the use of new terms when the video was paused. T3 walked back to the computer and started the video again. An actor talked about texture, and asked the audience, "How do you think my jumper feels?" Students looked toward the teacher and asked why the actor didn't call it a sweater. T3 didn't respond. The video played for a few more minutes before the teacher turned it off. She looked at her class and said, "I have a question for you. Why is it important to know the properties of an object?" One student raised her hand and replied, "If you don't know the properties then you don't know how to answer the question." T3 prompted students again, "But why is it important in our everyday life?" A student responded, "Then you know what it does."

T3 asked no further questions. She directed students' attention to the paper on their desk and said, "You're going to do an activity." Students did not start the activity because the end-of-school bell was just minutes away.

In this initial observation, T3 had scores ranging from 0 to 3. The average of all rating scores for this teacher for the month of September was 1.27. Four of the eleven objectives scored a zero, one in each of the dimensions of *Learning Objectives, Developing Understanding, Sense-Making* and *Classroom Culture*. During the lesson students watched a video on properties of matter. The video featured actors from Scotland, and several students commented they could not understand the words. Students were unable to develop a deeper understanding of the concept *physical properties* because terms used in Scotland varied from those used in the United States. In addition, T3 rarely assessed the depth of student understanding. T3 would ask questions, and even when students provided incorrect responses or off-track responses, T3 conducted no further probing to assess student understanding of the term. T3 engaged her students only when telling them what they were going to do (watch a video, do an activity). Students did not use *new* terms because T3 didn't provide any new terms. Students connected with terms to describe objects when the video prompted them. *Alignment of Lesson Activities* (Obj.1), *Elicitation of Prior Knowledge* (Obj.3), *Reflection and Metacognition* (Obj. 9), and *Motivation* (Obj.11) were all ranked as a zero. The lesson did not lead to a deeper understanding of the science concept *classifying physical properties*. A few students could identify some physical properties of a single object. T3 provided no opportunity for students to classify objects by physical properties. T3 started

the lesson with the video. There was no evidence of elicitation of prior knowledge. Students watched the video but couldn't understand many of the terms. The miscommunication was partly because terms are different in the United States than they are in Scotland. Additionally, the accent of the actors made understanding the content challenging. Since the lesson ended abruptly, I did not observe if students had a chance to work with new terms. There was no encouragement to discuss or work with new terms during the observation. T3 scored a 3 for *Application of Methodologies* (Obj.6). This score was awarded because the rubric stated "*A few students applied something they learned in the lesson to a new context."* This was demonstrated when students described physical properties of an object during the video. The teacher did not engage students in the discussion. T3 had a score of 3 in *Making Connections*. This score was awarded for the same reason as Objective 6. Although T3 scored a 3 on three objectives, I would not consider the objectives as *strengths*. Overall I observed no introduction of new terms, no engagement with discussing science terms, and no opportunity for students to make sense of new terms. The low overall score for T3 demonstrates many areas could be improved in vocabulary instruction.

Teacher T4. T4's science lesson for the September observation was focused on *staying safe: washing hands*. A whiteboard had a two-column T chart with the headings of *staying safe* and *not staying safe.* A rocking chair was situated just to the left of the board. A large, colorful carpet was placed in front of the chair. Tape divided the carpet into twenty-five sections. Each student sat in one square, legs crossed with hands in their laps. T4 sat in the chair and began the science lesson by reading a story. The story was

Wash Your Hands! by Margaret McNamara. T4 previewed the book by showing the cover and the title page. She asked, "What do you think this story is going to be about?" Students waved their hands in the air. T4 called on one student. "Using the bathroom," was the response. T4 looked at the cover of the book again and agreed that it did look as though students were in the bathroom. She asked, "What does it look like the children are doing?" Several students replied, "Washing their hands!" T4 turned to the first page and read the text. She held the book up for students to see the illustration. Students asked questions about the illustrations and T4 described the children's' actions in the illustrations. As each page is read, T4 asked guiding questions. When students responded, she prompted for more information using phrases such as, "tell me more," "where would you see this," and "how do you think." T4 continually assessed students' understanding of the science concept (*staying safe by washing hands*) in this way. Her instruction was guided by student responses. For example, if a student provided an off-track answer, T4 rephrased her question to clarify the concept on the page. Nearly all students stated what they knew about washing hands during the reading of the story. It appeared the layout of the sitting area (one child per square) provided a scheme for T4 to call on every student.

After the story, T4 presented picture cards representing ways to stay safe or not stay safe. The cards focused on the concept washing hands. T4 held up a card of a child coughing and asked, "Is this student staying safe or not staying safe?" Students gave two different responses. Some thought the student should "cough into their sleeve." Others thought the child would be safe if they washed their hands after coughing. The teacher

validated both responses, but asked student to place the card in a column using only what they saw in the picture. This activity continued until all eight cards were placed on the whiteboard. T4 next held up a poster called "Wash, Wash, Wash Your Hands." She told the students, "We are going to learn a song about washing hands. If you sing this song each time you wash your hands you will know you have spent just the right amount of time cleaning off all the germs." T4 explained there were actions with each line to make it easier to remember. She said each line and demonstrated the motion. Students repeated the words and actions. Finally, the class sang and motioned the whole song to the tune *row, row, row your boat*: "Wash, wash, wash your hands (rub palms together in a circular motion). Wash to get them clean (rub hands together in a circular motion).Wash on the bottom and on top (rub palms together and tops of hands). Wash fingers in-between (rub in-between fingers)." T4 concluded the lesson, "Now that we know how to wash our hands correctly, let's go practice."

In the initial observation during September the average of all rating scores for T4 was 3.91. The scores ranged between 2 and 5. During this observation students learned about staying safe and the importance of washing hands. T4 opened the lesson by reading a story. She mentioned reading a book was a typical practice to introduce science content to her students. During the reading, questioning and discussion she was able to assess what her students already understood about the new concept or terms. T4 demonstrated a strong ability in this objective. Additionally, T4 encouraged her students to work with the new terms through the picture card activity and the singing with kinesthetic actions. T4's total score (43) was the highest of the six classrooms

observed. T4 scored the highest in the objectives *Elicitation of Prior Understanding* (Obj. 3), *Formative Assessment* (Obj. 7), and *Motivation* (Obj. 11). Each of these had a score of 5. T4 scored the lowest in the objectives *Application of Methodologies* (Obj. 6) and Making *Connections* (Obj. 8). T4 earned a score of 2 in *Making Connections* (Obj. 8) because many students needed considerable prompting to make connections. *Application of Methodologies* (Obj.6) was also scored as a 2. Students applied what they learned in the lesson to the same context (washing hands), not a new context. The Learning Dimension *Sense Making* had the lowest average score (3). This average was still the second highest of the six classrooms observed.

Teacher T5. T5's lesson for September was *How to recognize a sentence*.T5 explained she had not finished her reading lesson for the day. I decided to observe the lesson to watch for methods of teaching vocabulary even though it was not a science lesson. A whiteboard was at the front of the class. A large carpet was directly in front of the board. Student desks, in clusters of four, were situated in the back half of the room. The walls lacked print material; the bare walls were in stark contrast to other classrooms I had observed. Students were seated at their desks. Each student had a blank sheet of paper and one 4" X 4" sheet each of orange and green construction paper. T5 stood to the right of the student desks. The lesson began, "Find your orange paper and hold it up." Students showed no hesitation, reached for their orange paper square, and held it in the air. T5 continued, "Good. Now I want you to cut a large triangle." Students hesitated before cutting their paper. T5 noticed and responded, "If you don't know what to do, ask your neighbor or look at the sample. The sample shows you what to do." T5 modeled

cutting a triangle from her orange paper. She then taped the triangle on the whiteboard. She drew a box around her triangle and told students, “See how I have placed my triangle at the bottom of my paper? Glue your triangle to the bottom of your paper.” Students referred to the teacher’s example before gluing their pieces down. T5 held up a green square, “You will need to measure the top of your orange triangle before cutting this green piece.” She walked to the whiteboard and held the green square above the triangle. “See, I will need to make a rectangle this long so it will fit on my orange piece.” T5 demonstrated how to measure and cut the green rectangle. Students assisted each other when measuring the green rectangle. Students spoke respectfully in their groups, staying on-topic of cutting a green rectangle. T5 scanned the room, and when she saw most students had cut the green rectangle, she continued the lesson. “Next we are going to cut a fringe on our green rectangle. The fringe represents the green part we see on a carrot.” A student raised his hand and asked, “What’s *fringe*?” T5 held her example up and brushed her fingers across the top of the cut paper. “See how the cut paper has lots of loose pieces? That is called a fringe.” Students repeated the word *fringe* several times as they cut their paper. The teacher demonstrated how the green rectangle needed to be placed above the orange triangle, with the fringe at the top. Students copied her sample. As students finished their gluing, T5 distributed a sentence strip to each student. There were four words: is, the, orange, and carrot. T5 instructed students to cut out each word and place them on their paper to make a sentence. She provided cues such as “Which word starts with a capital letter?” As students manipulated their words, T5 completed her example on the whiteboard. Many students looked at her sample to either complete

or correct their papers. Students glued the words above the carrot and then took their papers to T5. She looked at each paper and drew a smiley face at the top. Students whose paper was checked walked to the cubby area and placed their paper inside.

In the initial observation during September, T5 scored the lowest (zero) on five of the eleven objectives: *Elicitation of Prior Understanding* (Obj.3), *Use of Evidence* (Obj. 5), *Formative Assessment* (Obj.7), *Reflection and Metacognition* (Obj.9), and *Motivation* (Obj.11). Three objectives were in the dimension *Developing Understanding* and one objective in each of the dimensions *Sense-Making* and *Classroom Culture*. The teacher's average for all rating scores for the month of September was 1.27. During the activity students cut an orange triangle and a green rectangle in order to construct a carrot. As both colors and shapes were terms used when learning about physical properties, I rated the lesson with the *SCOW* as if it were a science lesson. The teacher scored the highest on *Alignment of Lesson Activities* (Obj. 1). She used the terms *color, shape, orange, green, triangle* and *rectangle* several times, and in a variety of contexts. Many students used the terms color, green and orange in their discussions when building their carrots, indicating a deeper understanding of the terms. However, students were not as familiar with the terms triangle and rectangle. T5 never directly related the activity with the terms. She said the word (such as triangle) and pointed to the shape. Students didn't relate the activity to learning new terms. After showing the completed work to the teacher, students received no feedback. T5 checked the word order of the sentence, but not the accuracy of the shapes or measurement. Students repeated the terms after the teacher said them, but were not motivated to work with the terms in another context.

T5's total score (14) on vocabulary instruction indicated much room for improvement. The low scores in the dimension *Developing Understanding* indicated an area where T5 could show the most improvement in vocabulary instruction. During the debriefing of the lesson, T5 told me this school-year was her first year as a kindergarten teacher. She indicated she would appreciate some assistance to improve her teaching of vocabulary. Some of her requests included ways to use sorting cards for a word wall and the use of verbal/visual posters to make her science center more interactive.

Teacher T6. T6's science lesson for September was on *physical properties of matter***.** Work centers were at four locations around the classroom. The whiteboard was the front of the classroom. A carpeted area was in front of the whiteboard. The teacher had a rocking chair to the left of the whiteboard, and an easel for placing Big Books was next to the chair. When I walked in students were at the centers completing "morning work." T5 called students to the rug area and began the science lesson, "We've been talking about properties of matter. What can you tell me about properties of matter?" Several students called out, "Springy," "Hard," "Purple," and "Bendy." T5 replied, "Yes, those are some words we can use to describe properties of matter." She picked up a magnet from the tray under the whiteboard. She held it up and asked, "What is this used for?" A student suggested, "To pick stuff up." T5 prompts the student to explain more, "What kind of stuff?" Students are talking quietly to each other, but initially none has offered an answer. A student called out loudly, "Metal stuff!" T5 exclaimed, "Yes! Let's see a short film about magnetism." She walked over to her computer and started a Brain Pop® Junior video on magnets. As the video plays, three or four students attempt to

answer the questions asked by the hosts on the show. The remaining students demonstrated off-task behavior. As T6 turns off the video, the intercom system had an announcement. It was time for T6's class to visit the science lab to complete Constitution Day activities. She instructed the class to line up, and then students walked to the science lab. When the class was outside the door, T6 gave instructions for the activities. She explained there were six activities and groups would rotate to each activity. She divided the class into groups and directed each group to a station. There was limited engagement between the students and the teacher during this time.

In the initial September observation, T6 scored the highest in the objective *Elicitation of Prior Knowledge* (Obj. 3). She had a total of seven scores of 0, two scores of 1, and one score each of 2 and 4. Her average was 0.7. Initially I thought the lesson was about *properties of matter* since the questions T6 used to elicit prior knowledge focused on this concept. After asking about properties of matter, T6 switched the conversation to magnets. Students made no connections between magnets and properties of matter. When T6 asked questions about the magnet, only three to four students engaged in the discussion. As I listened to the class discussion, I noticed the teacher didn't have the content knowledge to teach the lesson. Students answered questions directly asked of them, but were not asked to justify or expand on their responses. The lack of discourse was evident in both the classroom and the science lab. While students completed the Constitution Day activities T6 did not encourage discussion or use of new terms.

T6's total score (8) was the lowest of the six classrooms observed. She scored a 0 on seven objectives: two in the dimension of *Learning Objectives*, including *Alignment of Lesson Activities* (Obj.1) and *Understanding of Purpose* (Obj.2); two in the dimension of *Developing Understanding*, including *Intellectual Engagement* (Obj. 4) and *Formative Assessment* (Obj.7); one in the dimension *Sense-Making*, including *Reflection and Metacognition (Obj. 9)*; and two in the dimension *Classroom Culture*, including *Classroom Discourse* (Obj.10) and *Motivation* (Obj.11). The overall low average, and the scores of 0 and 1 indicated T6 has room for improvement in ten of the eleven objectives.

Summary of Pre-intervention Classroom Observations

As a whole, kindergarten and second-grade teachers' *initial* classroom practices in teaching science vocabulary was limited to *discussing* the words. Four out of the six teachers wrote science terms on the whiteboard and used the written words as a visual for learning. None of the teachers provided any direct instruction of the science vocabulary. Science vocabulary was covered only to a limited extent in the initial observation of science lessons. There was no explicit science vocabulary focus initiated by any of the teachers or the students.

During-Intervention Data Collection

Question 3

How Did Participant Primary Teachers Implement Vocabulary Instruction During the Period in Which I Provided the Individualized Professional Development/Coaching Intervention? I answer this question by observing the teachers' implementation of vocabulary instruction during science lessons I used the *SCOW* and the *SCOW* rubric to score teachers on eleven objectives about classroom practices focused on science lessons. Vocabulary instruction was supposed to be part of the science lessons I observed during the months of October, November and December. The narrative that follows describes the method of instruction each participating teacher chose for the months' observation along with what I actually observed during each lesson (the implementation of vocabulary instruction).

Teacher T1. The topic of the science lesson for October was *force and motion: rolls, slides and spins*. Some students were sitting at their desks, and others were sitting on the floor. T1 stood in front of the classroom and began the lesson. She pushed her arms out in front of her torso and said, "A push" then pulled her arms back in towards her and said, "or a pull changes the position of an object." A student inquired, "Where something is?" T1 clarified, "The location of something." She continued, "If an apple is in a bowl, and it falls out and rolls, it changes position." T1 repeats the word *push*, accompanied by a pushing action, and *pull*, accompanied by a pulling action. She asked students to follow with her. The students say the words *push* and *pull* with the arm movements. T1 walked over to the computer, turned it on, and projected the PowerPoint

"How Things Move" onto the whiteboard. She showed the first slide. It is a picture of children kicking a soccer ball. T1 pointed to the soccer ball and spoke to the students, "Describe how this object moves." One student replied, "A push." Another responded with, "It rolls…" "If you push it with your foot," said a student, completing the previous sentence. T1 nodded her head. She changed the slide and the picture showed a merry-go-round. The teacher again said, "Describe how this object moves." A student suggested, "It spins?" T1 prompted the student to elaborate on their answer, "Can you tell me more?" The student paused, looking at the picture again. She clarified her response, "It changes position. It gets pushed." T1 walked to the whiteboard. She picked up a marker and drew a corkscrew-shaped line. Next to the line she wrote, "spinning-staying in one spot. Turning." T1 walked back to the computer and changed the slide. The picture showed a see-saw. The class didn't wait for the teacher to ask them to describe the movement of the object. Students began talking, "Give it a push to go up." "Two people push it to go to different sides." "They have to be heavy and light." T1 interrupted the student's call-outs. She held her arms out straight from her shoulders and raised and lowered her arms in an opposing action. "What is this? What am I doing?" she asked. A quiet voice said, "You're wiggling." Another replied, "You're going back and forth." A third student said, "It's going up and down." T1 moved her arms again and emphasized the terms *up and down* and *back and forth.* The next picture was a playground slide. T1 asked, "How would something move on this?" "It would slide real fast," said one student. "You'd have to push it to go," said another. T1 inquired, "So, what is the force?" Several students answered one-after-the-other, "Gravity." T1 encouraged

students to explain further, “Gravity is doing what?” Several students responded in unison, “Pulling!” T1 changed the picture on the PowerPoint. A swing was pictured on the board. T1 asked, “How do we move on a swing?” A student answered, “A push AND a pull.” T1 inquired, “What is the movement?” “It’s back and forth,” said one student. Another student continued the thought, “You have to push and pull your feet. They have to go back and forth.” T1 projected another picture and said, “This is the last one. How does it move?” “Hold the handle and it moves,” offered one student. T1 responded, “Oh? How?” The student continued, “The wheels roll.” Another student added, “Like a car.” One student replied, “A wagon is really good because you can put in all your toys and pull it.” T1 nodded and walked to the light switch. She turned on the lights and said, “We have just reviewed ways that objects move. We saw pushes and pulls, a roll, slide, and spin.” As T1 reviewed each of the terms, she modeled using a kinesthetic motion. Arms out then in for *push and pull*, moving her hands in a tumbling action for *roll*, a whooshing downward movement for *slide,* and twirling her hand in a circular motion for *spin*. T1 walked to the whiteboard and wrote some terms in a column, including back and forth, up and down, round and round, zigzag, slide, roll and spin. She called on students to draw a line to illustrate each term. As students drew the lines, T1 asked students for any observations. One student noticed the lines for *zigzag* and *back and forth* were similar. Another student remarked the line for *round and round* and *spin* were similar. The term *roll* caused some discussion. Students couldn’t decide if a roll should be shown as a swirly line or as a straight line. T1 held a paper up for students to see and said, “Let’s read a booklet together.” She placed the paper under the

document camera. The book was called *Forces Cause Change.* T1 and the class read three pages together. The last page had three blank boxes on it. T1 instructed students to sit at their table groups. She distributed one booklet to each student. T1 walked to the front of the class and held up the booklet. She demonstrated how to fold the book. One student asked, "So we're cutting it?" The majority of the class responded, "No! Just fold it." As students folded their booklets, T1 distributed a plastic penny to each child. She walked back to the document camera and pointed to the page with the words spin, slide, and roll. She said to the class, "An object could do all three of these things." She removed the paper from the screen and continued, "Describe to me how the penny is moving." As she said this, she slid the penny across the surface of the projector. "It's a slide!" replied several students. "Yes, it is a slide. What I want you to do now is to use the penny to demonstrate a slide a roll and a spin." The students began reaching for the pennies, but T1 stopped them. "Before we begin, let's review some safety rules." Students discussed behaviors such as not throwing the pennies, not putting them in their mouths, and working together respectfully. After the conversation concluded, T1 said, "Pay attention to how the penny is moving." Students are provided ten minutes to investigate the motions slide, spin and roll with their pennies. I can hear students discussing a variety of movements and how these movements could be drawn. T1 walked around and monitored the students as they worked, but did not assist with the activity. T1 provided the next set of instructions, "you need to draw a line that would show the motion of the penny as a roll, a spin, and a slide. There is one box for each of

these three motions. Make sure you label the boxes." T1 continued walking around. She observed the student responses and wrote notes on paper she carried with her.

T1 chose verbal-visual as the method for teaching vocabulary in October. T1 created a PowerPoint to elicit prior knowledge, to guide the lesson, and to assess student understanding. Instead of using picture cards as a visual, T1 presented visuals on the PowerPoint. T1 started the lesson by eliciting prior knowledge of the terms roll, slide and spin. She continued by tying these new terms to previous learning. She modeled the new terms in written print on the whiteboard and used kinesthetic motions for each word. Students were asked to identify motions of objects. After responding, T1 asked students to justify their thinking. After viewing all the pictures on the PowerPoint, students were provided a small fold book to read, entitled *Force Causes Change*. Within the fold book was an interactive page where students were instructed to draw the motion of a roll, a slide and a spin. The teacher assisted students in completing this page by providing a hands-on activity to facilitate students' abilities to make connections between the new terms and the concept. In the activity, students had multiple opportunities to discuss and use the terms with their peers. Within this lesson, T1 also modeled several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, instruction in specific words, creating relationships among words, and creating a verbal/visual relationship for the new terms. T1 had no weaknesses during this lesson. *Use of Evidence* (Obj.5) earned a score of 4. This (*Use of Evidence)* was the lowest of all objectives. All other objectives scored a 5 or 6.

T1's science lesson for the November observation was about vocabulary relating to *heat as energy.* Prior to the November observation, T1 requested professional development in the method *Draw It!* (Some researchers called this method of instruction "creating a visual." T1 called it "Pictionary.") T1 met with me before the lesson and gave me some background on what she taught prior to this lesson. Students watched a Brain POP® video on heat the previous day. Students worked with new science terms using kinesthetic motions as word associations. For example, when saying the word *friction* students rubbed their hands together quickly. Before students entered the room, T1 wrote words from the video on the whiteboard including *heat, fuel, thermometer, friction*, and *energy*. Students entered the classroom from recess when the observation began. T1 spoke to her class, "Come in quickly and have a seat on the carpet." Nineteen students walked in and sat down on the carpet, in rows facing the whiteboard. "Who can tell me what we talked about yesterday?" she asked. A student replied, "Heat." T1 acknowledged the answer, "Yes. Who knows what heat is?" Another student said, "Energy." T1 expanded on this answer, "It is a *type* of energy. What else? How do we measure heat?" A student fanned himself and sighed, "Heat gets you sweaty." A girl replied, "A thermometer tells us how hot something is." T1 nodded her head. She paused a moment and then asked, "What are some sources of heat?" Students answered with rapid-fire responses, "fuel," "sun," "fire," and "thermometer." T1 looked at the student who had responded with *thermometer*, "Is a thermometer a heat source?" The student looked down and nodded his head no. T1 continued eliciting background knowledge, "What are some examples of fuel?" A student responded, "Charcoal." T1 said, "Ok,

coal." Another student said, "Gas." T1 clarified, "On the stove *or* in a car." A boy suggested, "Logs" and T1 did not react or respond to this suggestion. T1 pointed to a word on the whiteboard, "What is temperature?" A boy responded, "Measuring the heat." "Give me more," replied T1. "It's how hot or how cold something is," the student explained. "And this word?" asked T1, pointing to the whiteboard. The students collectively replied, "Friction." "How would you show me friction?" asked T1. Some students rubbed their hands together, while others rubbed their hands quickly back and forth on the carpet. The teacher explained, "Friction slows many things down." She walked to a spot in front of the whiteboard where there was a clean space. She wrote two words on the board: *cool* and *warm*. She asked students to think-pair-share why an object might be classified as either *warm* or *cool*. Without waiting for a question, a student proclaimed, "You could put water in an ice cube tray and put it in the freezer, and then it would be ice. It would be colder." "Ah," said T1, "That is a change of state. A liquid to a solid. We are taking away heat." She continued, "What is *warm*?" Several students replied, "a firecracker," "this room," and "sparks." T1 addressed the whole class, "You have a good understanding of these terms. Now you are going to show me how well you *really* know all these words. Who knows the game Pictionary?" About half the class raised their hands. Others just nodded their heads 'yes.' The teacher explained the rules for the activity, "You will get a piece of paper to draw an illustration of the word. First, I'm going to give you a folded paper. Do not show anyone what is written on the paper. It will be one of the words on the whiteboard. When you get your folded paper, I'll say…" A student finished her sentence, "1, 2, 3 look!" T1 laughed and

began distributing the small folded papers. A student questioned, “So this is a non-talking game?” T1 nodded her head. After the teacher distributed all the papers, she said, “1, 2, 3, look!” Most of the students quietly opened their paper, hiding the word from their neighbor. A few students shouted out the word on their paper. T1 looked disappointed with them. She continued the lesson, “You have about three minutes to draw and color a representation of your word. Get to work.” Some students went to their desks to work. Others stayed on the floor and began the task. As students worked, T1 said, “When you are done, roll up your paper to hide the picture. Don’t blow in the rolled paper or bonk your neighbor with it. If you do, you will not participate in the rest of the activity.” Students began rolling their papers. The teacher gave the next direction, “Come and sit in a horseshoe on the carpet.” She chooses the first student to stand in front of the class and display the illustration. The student was instructed to pick three students to guess the word the picture represented. The first student chosen to respond said, “A car going fast.” The presenting student nodded his head no. He chose another student to guess. “And you step on the gas to go,” said the second guesser. The presenting student seemed exasperated. He sighed and said, “No, it’s friction!” T1 replied, “Let’s review friction. It is when you go faster or slower.” A student added to the teacher’s statement, “It’s when you slow down.” T1 gave no further clarification of the term, and students didn’t ask any further questions. T1 called on another student to present. The student unrolled the paper and called on a student to guess. The first guesser said, “Fuel.” The presenting student seemed disappointed that the word was guessed on the first try. T1 exclaimed, “Your picture must be a great way to represent the term!”

The student smiled as T1collected the paper from her. The teacher called on the next student. A girl stood before the class and unrolled her paper. She called on two students whom both guessed incorrectly. The third student she chose guessed the picture represented the word *cool.* After the correct guess the girl looked at the two who missed the word and said, "Can't you see it's ice tea?" After students presented their drawing T1 asked each one to explain *why* they had chosen the illustration to represent the term. Some students wanted to be clever; they wanted to "be tricky." Other students wanted to show they understood the term. I observed only five student presentations because T1 stopped the lesson. She explained later to me that several students did not "support respectful discourse." I had noticed several boys became wiggly during the presentation. Two were students with special needs. The other boys, in my experience as a second-grade teacher, just had much energy-making sitting still a challenge.

T1 chose Draw it! as the method for teaching vocabulary in November. She used information from the Brain POP® video to guide the science lesson. The video mentioned several sources of heat and the teacher used these terms as the basis of her vocabulary lesson. During the activity, students made connections between the new terms and the concept *warm* and *cool*. Some of the time the teacher initiated the discussion. At other times, the students' directed the discussion using understandings of similar terms as a focus. Students also discussed and used the terms with their peers several times within the lesson. During the lesson, T1 modeled several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, instruction in specific words,

creating relationships among words, and creating an illustration for the new terms. T1 scored a 4 in *Reflection and Metacognition* (Obj.9) and *Classroom Discourse* (Obj.10). These were her lowest scores. All other objectives scored a 5 or 6.

The topic of the science lesson for December was *weather***.** Students were at recess when I entered the classroom. T1 explained she wanted to use *What's the Connection?* as a weather word review. As I took my seat in the front corner of the classroom, the teacher was drawing simple illustrations on small squares of paper. She looked up at me and said, "I didn't have time to print the pictures you sent." We could hear student voices outside the door. T1 asked, "Could you let them inside?" I walked to the door, opened it, and gave permission for the students to enter. T1 did not look from her task and said, "Hang your jackets up, then have a seat on the carpet." Students followed the directions and within three minutes students were ready for the lesson. T1 took a deep breath, walked to the front of the class and began, "Today we are going to try something new. It's a group game where you will show me all you remember about our weather words." She scanned her class and then continued, "Before we begin *What's the Connection?* I want to review the terms. When I hold up a picture, I want you to tell me what term it represents. I also want you to tell me what you remember about the term." T1 held up a picture of a cloud. Several students raised their hands. T1 called on one student. "It's a cloud," replied the student. T1 prompted, "And a cloud…?" She called on another student. The student responded, "A cloud can create rain or snow." Another added, "Precipitation comes from clouds." T1 held up another card. A student asked, "Is that supposed to be wind?" T1 replied, "Yes, this card represents wind." A

student suggested, “When the wind blows the flag moves.” T1 nodded. She repeated the procedure for the picture cards representing *rain, snow, sun (or sunny)* and *temperature*. After reviewing the terms she said, “You are going to work in groups of four. You’ll start out by choosing two terms and finding the connection between them. Then think of a sentence that describes the connection.” She paused and looked at her class. Many students had their heads tilted, noses scrunched up, and lips pursed together. T1 said, “I guess that was confusing.” She continued, “Okay, let’s try this.” She picked two of the picture cards and held them up for students to see. The pictures were of the Sun and rain. She taped the pictures to the whiteboard. “Pretend the board is my large piece of paper. I have placed two pictures for my group to see. You are my group right now. I’m wondering, how these two pictures go together. How do they relate? Hmmmm.” A student called out, “It can rain even if it’s sunny outside!” T1 said, “Yes! That’s one connection. What else?” Another student said, “The Sun evaporates the water, and then it rains.” The teacher replied, “Now you’re getting the idea. After your group decides on a connection between the two pictures, you will draw a line from one picture to the second one.” T1 demonstrated drawing an arrow from the rain to the Sun. Above the line she wrote, “It can rain even if it’s sunny outside.” She continued the explanation, “You see I drew an arrow from the rain to the Sun? That’s because my sentence starts with the term *rain* and ends with Sun.” She scanned her class again. Students were smiling. She held up the other picture cards. “Do any of these pictures have anything to do with what’s on the board?” she asked. Several hands went up. “We are not going to talk about it as a whole class. When you are in your group, you will decide which terms relate to

the others. Every time you make a connection, there should be an arrow and a sentence. I should see four different handwritings on the paper because everyone in the group needs to participate. Are there any questions?" The class was quiet. "There is a large piece of paper and a set of picture cards at your tables. Walk to your table groups and get started," she directed. Students went to their table groups and began working on the activity. I noticed all the students wrote their names on the paper before beginning the task. As students completed the task, T1 walked around the class and observed their work. She refrained from making any comments about the task. When students asked, "Is this good?" she replied, "You are working well with your group." or "I see everyone is participating." Students were discussing the terms and possible connections. I detected excitement each time a connection was made. As I listened, I could hear groups expressing the need to "make a connection for every word." As the teacher saw groups finishing the task she said, "In just a moment each group will share their poster." Students completed the task and walked to the carpeted area. They sat with their table group members. T1 called the first group up. She asked all four members to stand behind their poster. As the students gathered behind the poster, T1 picked up her digital camera and photographed the group. Students read the connecting sentence they wrote. During this time T1 listened to the students and took notes on the presentation. Each group was called up to present, and T1 photographed their posters. Each group had similar connections, but no two posters were the same. As the lesson wrapped up one student inquired, "Could we do this again with other words we learn? It was fun."

Within this lesson, T1 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, instruction in specific words, creating relationships among words, and using the game Connect Two (called *What's the Connection* in this research study). T1 had no weaknesses in this lesson. All her *SCOW rubric* scores were either a 5 or 6.

Teacher T2. The topic of the science lesson for October was *force and motion.* T2 chose an open word sort as the method for vocabulary instruction. Students sat on the carpeted area in the front of the room. T2 stood at the door, keeping one eye on her class while talking with a student in the hall. She noticed I was sitting in the back of the classroom, closed the classroom door, and walked to the front of the class. She started, "We are going to turn our minds on. Close your eyes." A student blurted out, "Force and motion!" T2 responded, "What do you already know?" The student said, "Things go back and forth." Another added, "Pushes and pulls." A third said, "Side to side." T2 asked, "Can you tell me more?" A boy replied, "A push goes away from you and a pull comes toward you." T2 asked him, "What else?" The boy did not answer. Instead, another student said, "A force and motion is something that moves." It sounded as though the student thought *force and motion* was a single word. At this point several students began calling out. "Forces slow you down, motion goes faster." "A rubber band can stretch." "If you run it's a motion." T2 picked a book off the bookshelf and sat down in a chair near the whiteboard in front of the carpeted area. She said, "I'm going to read you a story. It is a non-fiction book." She held up the book so all the students could see

the cover. She read the title, *Pushes and Pulls*, and showed the title page. T2 paused when an example of a push or pull was described in the book. She placed the book on her lap and demonstrated a motion for the example shown. A push was demonstrated by thrusting the palms of her hands away from her body. A pull was demonstrated by turning her palms up, closing her hands into a fist, and then bending her elbows to bring her arms quickly next to her body. The book mentioned a great variety of pushes, such as ringing a door bell, kicking a ball, moving a stroller, and throwing a ball. Several pulls were shown, including taking a book from a shelf, raising a flag up a flagpole, closing a zipper, and playing tug-of-war. The book also modeled examples of movements that could be a push *and* a pull, such as swinging on a swing, opening and closing a door, or sweeping a floor. T2 finished reading the book and set the book back on the shelf. She stood up and said, "Turn to your neighbor and show me the push and pull of using a saw." The students partnered up and pretended to saw a log. (I was surprised students in grade two knew about using a saw.) She continued with the lesson, "You are going to work with a partner to complete an activity about pushes and pulls. I will give you a large sheet of construction paper and some vocabulary cards. You need to cut the cards out carefully. Then you will create a graphic organizer to sort the card." A student interrupted, "Can we pick our own partner?" T2 didn't answer the student, but continued with instructions, "Are there any questions about what you are going to do?" Students remained quiet. T2 said, "Okay, pick a partner and when I see you're ready I'll give you the materials." Students picked partners with minimal confusion. One student did not want to work with a partner. He is a high-functioning student with autism.

(Information from T2 after September observation.) Students retrieved scissors from material boxes at their tables and began to work immediately. I could hear students discussing the actions depicted in the pictures and determining if it showed a push or a pull. Some students were creating a third pile of cards. The classroom door opened and the teacher was motioned to leave the room. A paraprofessional stepped into the room to supervise the students. The paraprofessional walked around the class once and the said, "You all need to look up here." Students stopped their work and turned to her. She continued, "You need to fold your paper in half and put a heading on each side. One side should say *pushes* and the other should say *pulls*." Students followed the instructions. They folded their papers and added the headings. Several students started gluing their picture cards onto the large paper. Students continued to discuss the motions shown on the picture cards. They made the connection between the picture and the terms push and pull. During the gluing phase of the activity I heard one student exclaim, "Pushes and pulls are motions!" T2 entered the classroom and spoke with the paraprofessional. All I heard was T2 saying, "Oh, I had wanted them to do the activity on their own." The paraprofessional left the class and T2 came over to me. She said, "I'm so disappointed. I had wanted to see the categories the students would come up with- what kind of organizer they would create." She turned and observed her students working on the activity. T2 walked to the front of the class and finished the lesson, "When you and your partner have finished, bring your posters up to me."

Within this lesson, T2 modeled several of the methods for vocabulary instruction aligned with the literature, including read alouds, asking questions and making

comments, open word sorts, and graphic organizers. The weaknesses in this lesson included *Alignment of Lesson Activities* (Obj.1) and *Use of Evidence* (Obj.5). T2's intent was to teach the terms *force* and *motion*. All discussion, reading, and activities were aligned to the terms *push* and *pull*. During the lesson students did not back their claims with evidence. The strengths in this lesson were *Elicitation of Prior Knowledge* (Obj. 3), *Application of Methodologies* (Obj.6), *Classroom Discourse* (Obj.10), and *Motivation* (Obj. 11).

The topic of the science lesson for November was *rolls, slides, and spins.* T2 chose Draw it! as the method for vocabulary instruction. In the previous science lesson students had been introduced to the motions of roll, slide and spin and had heard a story about the motion *rolling*. Students sat in their chairs at their table groups. T2 stood near the center of the room, close to the groups of student desks.T2 began the lesson "Close your eyes and turn your minds on." She continued, "I'm going to read you a book about the motion *spinning*. Look up here as we preview the book." Students turned to face the teacher. T2 showed the students the cover of the book and read the title, *Spinning*. She read each page and held up the book when there was an illustration. During the reading of the story she did not interact with her students. After the completion of the story, T2 placed the book down and asked, "What did you learn from this book?" Initially students were quiet. T2 scanned the classroom and finally one student spoke, "A spin is one way things can move." T2 pressed for more details, "Such as?" Another student responded, "Like when an ice skater spins." T2 inquired further, "Can you think of other examples?" A boy said, "I saw a guy spin a basketball on his finger once." T2 asked the

class, “Have you seen a top spin?” The students did not raise their hands to show they had seen this. The teacher continued, “You know, it’s kind of a cone shaped toy and you take it between your fingers and…” She made the twisting motion with her fingers that it would take to spin a top. A few students responded, “Oh, yah…I’ve seen that.” T2 walked to the whiteboard and drew a large rectangle. She divided it into three evenly spaced vertical columns. She continued talking to the class, “You’re going to create a graphic organizer to show me that you understand rolls, slides and spins. You will get a piece of construction paper and draw three columns like I did here.” She pointed to the drawing on the whiteboard and said, “Each column will need a title.” As she wrote the title for each column she said, “The columns should be *spin, slide,* and *roll*.” She paused for a moment and then continued. “I want you to draw three to four pictures in each column to illustrate each of these motions.” T2 walked around the table groups and distributed a piece of paper to each student. She asked, “Are there any questions about the activity?” Only one student had a question, “Can we work on the floor?” T2 allowed the student to work on the floor. Students began their illustrations. Several raised their hands and asked how to spell the name of the object they had drawn. T2 responded each time with, “Look for the word in the dictionary.” At this point in the lesson the teacher focused on the spelling of words. She didn’t ask any clarifying questions about student illustrations. Students did not justify why they were drawing an object under a specific heading. Students completed the task quietly.

Within this lesson, T2 modeled some of the methods for vocabulary instruction aligned with the literature, including read alouds, using graphic organizers and creating

illustrations. T2 had no strengths during the observation of this lesson. All objectives scored either a 2 or 3. T2 engaged students superficially. She asked questions, and chose students to answer, but rarely allowed students to expand on their thinking. Students don't relate activities to the learning of new terms. The majority of classwork was procedural.

The topic of the science lesson for December was *light energy.* T2 chose verbal-visual as the method for vocabulary instruction. A few days before the observation T2 asked if I could create a handout with the terms she wanted students to illustrate including *light, sources of light, bright, dim, increase* and *decrease*. The teacher specifically wanted these terms because students in grade two are expected to" investigate the effects on an object by increasing or decreasing amounts of light energy such as how the color of an object appears differently in dimmer light" (Texas Education Agency, 2010). The previous science lesson covered heat energy. Students sat on the carpeted area but were not facing the whiteboard. They were turned toward the reading corner of the classroom. T2 began the lesson by eliciting prior knowledge. She asked, "We are going to think about light. What gives us light?" A student called out, "The Sun is natural light." Another said, "A lamp is a light" T2 responded, "What kind?" The student replied, "Man-made." A student suggested, "Lightning is natural light." One student offered, "Candles are natural light." T2 corrected her, "No, candles are man-made." A student repeated, "Sun gives us light." To which T2 replied, "Yes." A student said, "The moon gives us light." T2 hesitated a moment and said, "Yes, sort of…Explain?" The student continued, "The Sun gives the moon light." Another student

added, “The Sun points at it and makes it light up.” A student (with autism) said, “The Arctic is melting. We’re using too much electricity. It’s the energy that’s causing it.” Several students mumbled responses to this comment. Only one was audible, “That’s not right!” I couldn’t hear other comments, but the tone became argumentative. T2 said, “We’re sharing ideas right now.” A boy continued the discussion about the moon, “The moon goes behind the Sun and that’s why light goes away.” Another boy commented, “The rainbow is natural light.” T2 regained the students’ focus by holding up a storybook titled *The House in the Night.* T2 suggested to the class, “Study the front of this book. What do you think this story is going to be about?” She did not allow time for responses. She said, “After I read it, you’ll tell me why I chose this book.” She began reading the book. T2 read each page and showed students each illustration and asked, “What do you notice?” Students “oohed” over the illustrations, but asked no questions. One line in the story was, “On the moon’s face is the Sun’s light.” When this line was read, several students smiled and nodded their heads. I listened to the story for information on “*What gives us light?”* and only heard about a key, a bed, a book, a bird, and the moon. After reading the story the teacher walked around the room and turned off several small table lamps, one at a time. When she reached the third lamp she asked, “What is happening?” A student called out, “Light helps us see.” T2 responded, “Raise your hand to answer my question.” She then pointed to a piece of paper on the wall and asked, “What happened when I turned out the light?” Students responded, “It’s too dark to read.” The teacher agreed with them by saying, “The amount of light depends on how much we see.” [It would have been more accurate to say “How much we can see

depends on the amount of light present."] One student observed, "There is still light in the window." T2 continued turning on and off lamps in the classroom. She asked, "Is the light in the room increasing or decreasing?" Most students responded, "Decreasing." T2 walked to each lamp and turned it on again. She asked, "What am I doing now?" A student replied, "Creasing light." T2 said, "What?" The student corrected herself, "Increasing light." T2 continued her questioning, "Why is it important to increase light?" Several students responded one after the other, "So you can see. Like when you're writing," "When you're cooking," "So you won't bump into anything." T2 continued, "What do you use if it's dark at home?" A student replied, "A night light." Another added, "A candle." A third student said, "A lamp." T2 walked over to a chart paper easel that was in front of where students were sitting. She picked up a marker and remarked, "What we're going to do today…" she paused for a moment and then continued, "is give you some vocabulary." She drew a large rectangle on the chart paper. She divided the rectangle into two vertical columns, and then divided the columns into six rows. T2 walked to the bookcase and picked up a piece of paper from a small stack. She scanned it and then walked back to the easel. In the left column she wrote a word in each row: *light, sources of light, bright, dim, increasing* and *decreasing.* She turned to the class and asked, "What visual could we draw to represent the term *light*?" A student suggested, "The Sun." T2 drew a Sun in the box to the right of the term. Next she asked about an example for *sources of light*. A student replied, "Electricity." T2 asked, "Could you clarify?" The student clarified, "A lamp." T2 drew a lamp in the box across from the term *sources of light*. When she asked for suggestions for the term *bright*, a boy said, "A

bright light." T2 again asked for clarification. The boy responded with, "Stars." T2 asked, "What about *dim*?" A girl asked, "What does that mean?" A student next to her replied, "It's when one light is on and, one light is off. When both are off, it means dim." T2 gave no reaction to this explanation. She continued with the next term, "What would you draw for this?" She pointed to the word *increase*. A student responded, "A person turning on a light." T2 did not draw an illustration for this term. She asked about the next term, "What would you draw for *decrease*?" A student sighed and said, "A person turning *off* a light." T2 only took responses from one student per word. She didn't assess for understanding by asking for evidence or justifications. The teacher walked back to the bookcase and picked up the stack of papers and said to the students, "I'm going to give you each a paper, and I want you to draw a picture to represent each term. Return to your desks, and then we can begin." Students walked to their desks and waited for the handout. T2 distributed the handouts, went to her desk, and sat down while students worked. Students began completing the handout. I observed several students looking at the teacher's example and drawing similar pictures. Only one or two students applied the new content from the lesson to an original illustration. Many students were not applying what they learned to a new context. T2 glanced up from her desk and said to the students, "Once you finish your drawings I want you to turn your paper over. On the back you need to write either three questions or one "I wonder" statement about light. Students now focused on writing and spelling, rather than a reflection on their understanding of light.

Within this lesson, T2 modeled some of the methods for vocabulary instruction aligned with the literature, including using a read aloud and creating illustrations. Students rarely exhibited a deeper understanding of the science concept after the science lesson; completion of activities was more procedural. T2 scored a 4 in *Elicitation of Prior Knowledge* (Obj.3). This was her highest score. She had several weaknesses, including *Alignment of Lesson Activities* (Obj. 1), *Application of Methodologies* (Obj. 6), *Formative Assessment* (Obj. 7), *Reflection and Metacognition* (Obj. 9), and *Motivation* (Obj. 11). T2's scores in December were the lowest of the observations during the intervention period.

Teacher T3. The topic of the science lesson for the October observation was *position and location*. Previous science lessons focused on *properties of matter*. When I began the observation, students sat at their desks in table groups. Several words, including *motion, speed, position, friction* and *force* were printed on the whiteboard. [Of these terms, only *motion, position* and *force* are in the science TEKS for this grade.] T3 stood next to a rolling cart which held a computer. The students were watching a BrainPOP® video projected on the whiteboard. T3 paused the computer and asked, "What does position mean?" Students looked at T3 silently. She continued, "Position is your L…L…L…" A student called out, "Location!" T3 restarted the computer and students listened to Tim and Moby (the hosts on the video) talk about motion. Tim asked, "What id motion?" T3 paused the video and asked the same question, "The word motion means?" A student suggested, "The position is changing." T3 did not respond to the student's reply. She restarted the video. Tim said, "I put the ball in motion, and it

changes location." Tim continued to provide information, "The ball travels, or moves around. Objects can go back and forth, side to side, up and down, and diagonal. They can twist and turn, make loops and circles." Moby, the robot-like character, asked a question. Tim "translated" the question for the viewers, "What is speed? Speed is how fast something goes." T3 paused the video again. She moved closer to the front of the class, turned and faced the students. She spoke, "Let's name some types of motion." A student responded, "Movement." T3 replied, "Okay, but what kind?" Another student suggested, "Running." A third student said, "A grandfather clock." T3 corrected, "Yes, back and forth." Several students suggested more movements, "walking," "bike," and "rollercoaster." T3 asked again, "But what kind of motion?" This time a student replied, "turns and twists." Another continued with, "A swing goes back and forth." T3 walked back to the computer and restarted the video. Tim continued, "Some things go fast and far. What is a push or pull?" T3 stopped the video and said, "We're going to stop here. This is a very important word. Let's read the definition together." The word *force* is projected on the whiteboard, along with the definition. The class read the definition with the teacher, "Force means a push or a pull that can change the way something moves." T3 said nothing more about the term. She restarted the video. Tim explained, "A push or pull can change the location." Tim provided many examples of pushes and pulls. He concluded the segment on pushes and pulls with, "It is easier to move lighter things." In the next segment Tim introduces the term *friction*, "Friction is a force that slows down moving things." T3 paused the video and asked the class, "If something is heavier, does it take a bigger or smaller push to get it in motion?" A student replied, "Bigger." T3

continued, “Yes, bigger things take bigger pushes.” I noted this comment was not accurate. Bigger things do not necessarily take bigger pushes. T3’s comments, if repeated or reinforced, may lead to student misconceptions. T3 said to the class, “Let’s read the definition together.” The class, collectively, read, “Friction is a force that slows down moving things.” She restarted the video. Students saw an example of a skateboard moving on a sidewalk. Tim spoke again, “Skateboarding on a sidewalk is easy. Skating on grass…” The video demonstrated the difficulty of skateboarding on grass. Tim continued, “There is more friction between the squishy grass and the wheels. Friction pushes against something to slow you down.” Five students rose from their seats and began walking from the classroom. T3 said, “Those of you leaving will finish the movie tomorrow.” She turned to the rest of the class and said, “Before we go on, what are two examples of friction you saw in the movie?” Students mumbled responses. None was clear enough to understand. T3 heard the student response and said, “But what are examples from the *movie*?” The intercom came on and interrupted the lesson. T3 waited for the message to finish and then asked again, “What are examples from the movie?” One student said, “Skateboard.” Another responded with, “Sliding.” T3 offered no affirmation of these responses. She said, “Sand provides friction. Dragging your feet slows you down.” The video ended and T3 turned the computer off. She walked to the whiteboard and pointed to the terms printed on the board. She said, “We’re going to go to the word wall and preview the words from BrainPOP®.” She held a paper in her hand and read the definitions for motion, speed, position, friction, and force. She continued, “You’re going to choose two words. You will fold your paper like a hamburger. You

will draw a picture and one sentence telling us what the word means. You also need to write the word." T3 distributed a plain piece of paper to each student, repeating the directions as she wove between the desks. Students started drawing and writing. The teacher looked up at the clock. The end-of-school bell was ready to ring. The teacher reminded students to put their work in their desks. Students compliantly placed the folded pieces of paper in their desks.

During the video the classroom was dimly lit. Although a few students were engaged with the story, the majority of students exhibited off-task behavior such as fidgeting with items in their desk, whispering with their neighbor, and wiggling in their seats while looking around the classroom. When T3 asked questions, she rarely allowed students time to respond. When students responded, they were not asked to elaborate or justify their answers. T3 chose *developing word walls* as the method for teaching vocabulary in October. I did not observe a word wall in her classroom. She had terms written on the whiteboard. The words likely will not be left there for the duration of the year or unit. T3 used the "word wall" only once in the lesson. T3 said she was going to "preview the terms," but she had already gone over each terms during the lesson. When she did read the definitions, students still didn't make connections between the terms and what they had viewed. Students needed considerable prompting when asked to remember terms or visuals from the video. Within this lesson, T3 modeled a limited number of the methods for vocabulary instruction aligned with the literature, including asking questions and making comments. She did not display any strengths with respect to teaching vocabulary. Her instructions often did not match her actions. Weaknesses

included *Use of Evidence* (Obj.5), *Classroom Discourse* (Obj.10), and *Motivation* (Obj.11). *Elicitation of Prior Knowledge* (Obj.3) earned a score of 4. T3 exhibited no strengths in this lesson.

Although T3 requested no new methods to learn in November, she did schedule an observation. The topic of the science lesson during the November observation was *sources of heat*. Students were seated in their chairs at their table groups. A list of words, including *heat, fuel, friction, energy,* and *thermometer*, were written on the whiteboard. T3 stood in front of the class and began the lesson by eliciting prior knowledge of the terms. She asked, "Where have you seen these terms before?" She pointed to the terms on the whiteboard. The students looked at the board. Some fidgeted in their seats. T3 scanned the students. The students remained silent. T3 said, "Okay, we're going to watch a video today about *heat*." She started a BrainPOP® Jr. video on *heat*. As the video played, T3 walked to her work table and sat down. In the video, Annie and Moby taught concepts about heat. They discussed heat is a source of energy that warms people and things. They moved onto sources of heat, such as wood, coal and oil. They introduced the term *fuel*. Annie explained heat could be measured using a thermometer. The video next discussed the term *friction.* Finally the video focused on how heat changed matter. As the video played, five or six students came into or left the classroom. T3 continued working at her table. At the conclusion of the video T3 rose and picked up a stack of paper. She distributed a piece of paper to each student. She said, "I want you to illustrate at least two of the terms on the board. You learned about these words in the video." T3 continued with the instructions, "I want you to write the term at the top of the

page, draw an illustration in the middle, and write a one-sentence definition below the illustration." Students began the assignment. They followed a prescribed set of instructions rather than relating the review of the information from the video to the learning of new science terms. Many students did not understand the meaning of the terms. Several raised their hand and asked, "What does fuel mean again?" This question was repeated for the terms *friction* and *energy*. As I observed students at work, I saw several drew a thermometer. I looked up and noticed the time. The science lesson was again conducted at the end of the day, so I did not observe the end product of this activity.

T3 was weakest in *Application of Methodologies* (Obj. 6). T3 directed students to write the terms, define them, and draw a picture. Students were unable to apply the term to this context; many still did not grasp the meaning of the new terms. T3 was also weak in the dimension *Developing Understanding*. During this lesson she rarely interacted with the students. She attempted to elicit prior knowledge, but when students were unresponsive, she turned on the video. Scores in the dimension *Sense-Making* were the highest (both objectives were scored a two). I would not consider this area a strength. Her use of science terms included writing the terms on the whiteboard, asking what the terms meant, and providing instructions for an activity. Students lacked engagement with the terms and with the lesson overall. The teacher also lacked engagement.

The science lesson in December focused on *weather*. T3 wrote the word *weather* on the whiteboard and underlined it. Students sat at their desks in table groups. T3 sat on a stool to the right of the whiteboard in front of the class. T3 began the lesson, "Today

we started a new unit in science. We watched a BrainPOP® video." A student interrupted, "We're going to learn about winter?" T3 continued, "More than that." Another student chimed in, "Weather." T3 resumed, "You watched a video on weather, so we're going to review about weather words. If we're learning about weather and we saw about winter weather, what is winter weather?" A student responded, "winter and summer?" T3 replied, "Those are seasons." Another student suggested, "Snowy?" T3 affirmed, "Yes, we can have snowy." She wrote the word *snowy* on the whiteboard. A girl questioned, "sleet?" A student asked, "What's that?" T3 said, "We'll describe these later." She then wrote *sleet* on the whiteboard. Several students now responded suggesting the terms *hail, rain, thunder and lightning.* As students called out the terms, T3 wrote the terms on the whiteboard under the word *weather*. It became quiet. T3 said again, "You watched the Brain POP® video on the topic of weather earlier today." Nearly three-fourths of the students raised their hands and told T3 they had not been to the video listening center. T3 appeared to ignore the students' comments and continued with the lesson. A student suggested *ice,* and another suggested *icicles* as weather terms. When the term icicles was suggested, T3 paused. She looked at the class and said, "I need to get the dictionary." (She was stuck on the spelling of the word icicles.) She walked to a bookshelf near the classroom door and picked up a dictionary. As she walked back to her stool she asked, "What letter do I need to go to?" Students collectively responded. "I." T3 turned several pages in the dictionary. Without looking up she asked, "Next?" A few students suggested, "c." T3 finished writing the word. She turned to her students and said, "These are some of the words we are going to work with.

Let's do a "what do we already know?" game. Did any of you use the word wall today?" Students shook their heads "no." I looked around the classroom and could not find a word wall. T3 continued, "What was the definition that BrainPOP® gave for the word snowy? Will it match the dictionary?" A student replied, "Snow is white and cold, and if you go out with no jacket it will freeze you." T3 read from the dictionary, "Soft white flakes that form from water, freeze in the air, and falls to the ground." A student told T3 she didn't remember that part of the film. T3 responded with, "What do you know about sleet?" A student responded, "When snow falls to the ground it melts and turns to icicles." T3 flipped several pages in the dictionary and then read, "Sleet is rain that is partially frozen and mixed with hail." She continued, "A definition for hail?" A boy said, "The little snowflakes turn to water and then to ice." Another student added, "Little ice cubes that fall fast from the sky." T3 again looked down at the dictionary and read, "Round pieces of ice that fall during a thunderstorm." T3 put the dictionary down and said to her students, "I have a really funny story to tell you about my dog and a hail storm." She proceeded to tell about a time about five years ago when her dog was caught in a hailstorm. The story took nearly ten minutes to tell. When T3 finished the story, the end-of-day release bell was ready to ring.

Within this lesson, T3 modeled only one of the methods for vocabulary instruction aligned with the literature: asking questions and making comments. Students had no time to work with the words or reflect upon the lesson. T3 made minimal effort to engage her students. She relied on the video to 'teach' the vocabulary. T3 didn't encourage student to work with the new terms. She only asked if they remembered the

definition from the video. *Elicitation of Prior Knowledge* (Obj.3) earned a score of 4 and *Reflection and Metacognition* (Obj.9) scored a 3. Neither of these was a strength. All other objectives scored between 0-2. In the four observations of science lessons in T3's classroom, I only ever saw students watching BrainPOP® videos or discussing the videos. There was little effort on the part of the teacher to deepen students' understanding of the science vocabulary. Furthermore, the teacher made little effort to use any of the methods modeled during the PD to teach vocabulary.

Teacher T4. T4 chose *The Important Word* as the method for teaching vocabulary in October. Previous science lessons covered the concepts of heat, light and sound. The topic of the observed science lesson in October was *magnetic and not magnetic*. A whiteboard had several books about magnets propped up on the lower edge. T4 had also posted two signs on the whiteboard: *magnetic* and *nonmagnetic*. A rocking chair was situated just to the left of the board. An easel was to the right. The big book *Magnets* rested on the easel. Students each sat in one square on the large, colorful carpet. Students had legs crossed and hands in their laps. T4 sat in the chair and began the science lesson by eliciting prior knowledge, "Do we remember what magnets do?" A student answered, "They stick stuff together." T4 asked, "What kind of stuff." Another student replied, "Iron." T4 asked another question, "What are on the ends of a magnet?" A student said, "North and east." Another student corrected him, "South." T4 said, "Yes, north and south." She continued, "What have you used that is magnetic?" A student answered, "Magnetic letters. They stick on a fridge." T4 picked up the big book from the easel. She held up the cover of the book, "What do you think this book is going to be

about?" Several students said, "Magnets!" T4 began reading the book to the class, "A magnet contains a force that attracts a certain metal." She paused, setting the book on her lap. She leaned toward the students, "What was the metal?" Students collectively said, "Iron!" The teacher continued, "Long ago people discovered that some objects stuck to a rock. What is sticking to the rock?" The students responded, "Paperclips." T4 encouraged students to look more closely, "Anything else?" One student said, "A key." Another added, "A ring." (Specifically, it was a washer.) T4 turned the page, "Today people make their own." She asked, "What was ours made from?" She held up a u-shaped magnet. The students replied, "Plastic." T4 continued, "What is the shape?" The students answer, "It's a U." T4 acknowledged the reply, "Yes, one of these here (in the book) is a U, but ours is a horseshoe." She placed the book on her lap and asked, "Do you think some magnets are stronger? How could we test this?" A student suggested, "Use magnets." T4 asked a student to bring her the box of magnets from the science center. She removed two bar magnets from the box and said, "What's happening here?" One student said, "They stick." Another added, "They must have iron." T4 held up a plastic spoon. She asked, "Is this magnetic?" The students said, "No, it's plastic." T4 tested the spoon to verify it was not magnetic. A student peered into the box and questioned, "Why are your scissors in there?" T4 held up the pair of scissors and asked, "Are these magnetic?" She tested the plastic handle by placing it against the magnet. Next she tested the metal blades of the scissors. Students agreed the plastic was not magnetic, but the metal part was magnetic. T4 held up two bar magnets, "How about these?" She placed the North side of one magnet across from the North side of the other.

A student remarked, “They don’t stick. They are the same color.” T4 encouraged the student to think some more, “Well, it’s not the color…” The student stared at the two magnets and then exclaimed, “It’s the letter N and S!” T4 stood up and placed the box of magnets on the rocking chair. She said, “You are going to explore magnetism with a discovery bottle.” She divided the class into groups of three. Each group was provided with a wand magnet and a discovery bottle. The discovery bottle was a clear plastic half-liter bottle with a variety of magnetic and nonmagnetic objects inside. Rice was added to the bottle to hide the objects. T4 instructed students, “Move the magnetic wand across the bottle and observe what happens.” After seven minutes of discovery time, T4 called the students back to the group area rug. She focused their attention on the two columns on the whiteboard. The teacher held up a picture card and asked, “In which column does this picture belong?” She chose a student to point to the correct column on the board. This procedure, holding up a card and then choosing a student to place the card, continued for all ten picture cards. It was evident the students understood the concept of *magnetic* and *nonmagnetic*. For example, when T4 displayed the pictures of paper and plastic items, every group agreed they were nonmagnetic. When T4 displayed a picture of a key, four groups said it was nonmagnetic, and one group said it was magnetic. The group who declared keys were magnetic retrieved their discovery bottle. The group demonstrated to the teacher, “When we move the wand over the bottle, the key “sticks” to the magnet.” This discovery prompted several students to explain, “things that stuck to a magnet had to have iron in them, so the key in the one discovery bottle had iron in it.” Students verbally classified all the terms by *magnetic, nonmagnetic*, or the newly

formed column of *both*. T4 then told students, "I want you to think about the "most important thing" about a magnet." Several students responded. The teacher charted student responses to this question. After all students responded, the teacher revealed the template for the *Important Word* book. She told students, "You will need to work together to decide THE most important quality of a magnet." Students turned to the person closest to them and began a discussion. Students demonstrated they knew when to talk and when not to interrupt. T4 called the class back together and asked for a vote. Which characteristic of a magnet is the most important?" she asked. The class voted for "it picks up iron." T4 next asked the class to choose three supporting characteristics. T4 worked with students to create their class poem. The final *Important Word* poem read: "The important thing about a magnet is that it picks up iron. It sticks to stuff, it can stick to a fridge, and it can have different shapes. But, the important thing about a magnet is that it picks up iron."

Within this lesson, T4 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, read alouds and storybooks, asking questions and making comments, creating relationships among words, using graphic organizers, and using vocabulary games (the Important Word book).While reading, the teacher paused on every page. T4 asked guiding questions and listened to student responses. In addition to asking questions, T4 displayed magnets to the students that corresponded to the pictures in the book. After reading the story, T4 asked some review questions. During this discussion, students responded to questions and justified their responses. Students consistently connected the new terms with the

concept of magnetism.T4's strengths included *Elicitation of Prior Knowledge* and *Classroom Discourse.* The dimension with the lowest scores was *Sense-Making*. Both objectives in this dimension scored a four, so I would not consider this a weakness, but rather an area with room for improvement.

T4 chose an open word sort as the method for teaching vocabulary in November. Previous science lessons covered the concept of *natural resources: water*. The topic of this science lesson was *natural resources: water, rocks and soil*. Students worked in groups at several centers around the room. T4 called the students to the carpeted area. She started the lesson by reviewing what students had learned about water. The shared writing chart was propped on the easel. T4 said, "Let's review what we discussed yesterday." She pointed to the chart. She continued, "We will choral read the chart together." T4 picked up a pointer and began reading the chart on *Ways We Use Water.* The teacher then divided the class into four groups. T4 explained to the class, "Each group will receive a set of picture cards." She continued, "Your job is to put the cards in groups. The groups will be to demonstrate how they are the same. I will expect each group to justify the card classifications." T4 spread the student groups around the room. Groups had their own floor space in which to work. T4 distributed the picture cards, and students began their sorting. The teacher monitored student work but offered no assistance on the task. Students began to talk with their group members and collaborated to create the groups. Twice students raised their hands to ask about the picture on the card. T4 clarified the object in the picture. Students showed some frustration when a group member challenged the placement of a picture card. T4 reminded students, "There

is no "correct" answer, but remember I expect you to explain your thinking for creating the groups." Student groups completed the activity. T4 instructed students, "Sit together near your work. I'm going to come by, and I want you to explain your groups to me. After you explain your groups, you will get a large sheet of paper along with two glue sticks. You will glue your pictures onto the paper in their groups." Students moved closer together. T4 walked to the first group. She said, "Tell me about your groups." A girl in the group said, "We have water, a tower, plants and rocks." T4 asked, "Why are these three in the plant group?" Another member of the group said, "She's planting a seed, and they are holding a plant, and you need dirt to grow plants." T4 said, "Hmmm, what about these two?" as she pointed to the category "tower." A third student said, "Well that one is a tower and we didn't know what that was, so we put it here." T4 probed further, "Do you know what that is?" All four students said, "No." She handed the group a large piece of paper and glue sticks and walked to the next group. She said, "Tell me about your groups." One member of the group replied, "We have water, plants and seeds, a bench, and rocks." T4 asked, "Why is the bench by itself?" A student responded, "'Cause it's not water, or rocks or plants and seeds." T4 handed the group a large piece of paper and glue sticks and walked to the next group. She said, "Tell me about your groups." One boy spoke for the group, "There's rocks, and there's plants, and water. Because plants need water." T4 examined the groups and then asked, "Could you show me which pictures have water?" Another member of the group pointed to the six pictures at the left of the group. T4 noticed the bench was with the rocks and asked, "Can you tell me about this picture?" Another boy remarked, "It's a bench like at the

park. It's not a plant or dirt so we put it with rocks. It might be made from rocks." T4 nodded her head, handed the group a large piece of paper and glue sticks and walked to the last group. She said, "Tell me about your groups." A girl replied, "The first group is soil and gardening." Another member said, "These are water and washing." A boy from the group said, "These are rocks and boulders." T4 asked about the first group, "Why are these four together?" The girl replied again, "First you need soil, then you put it in a pot, then you put the plant in…" She looked at her group and then continued, "And you can put seeds in the garden." T4 handed this group a large piece of paper and the glue sticks. She walked to the front of the room near the whiteboard. When you're done gluing, leave your paper to dry and come sit up here." The groups started filtering to the carpeted area. When all students were seated, T4 asked, "Could any of the pictures go in more than one group?" Several students responded, "Yes." A member from the third group said, "We had all the soil cards together and then decided to place all soil cards with the water because plants need water." T4 acknowledged this and asked, "Could any cards from your group be moved to the rock group?" A member of the group walked back to the paper. He showed it to T4, pointed to a picture (the fountain) and said, "Um, maybe this one?" T4 said, "Yes, sometimes fountains are made from rocks. We see rocks in different places. What is made from rocks?" Several students answered with responses such as, roads, driveways, houses, volcanoes, mountains, Earth's crust, the beach and bricks. T4 continued, "What makes the roads?" A student said, "Concrete, water, soil and gravel." The teacher concluded the lesson by telling students tomorrow's lesson would be all about rocks.

Within this lesson, T4 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, creating relationships among words, and using vocabulary games (open word sort). Her strength was in the dimensions of *Developing Understanding* and *Classroom Culture*. T4 consistently provided students with opportunities to connect the terms with the content. Her weakness according to her *SCOW* score is in *Understanding of Purpose* (Obj.2). T4 purposefully did not tell students what to do or why they were doing it. She wanted to use the activity as a formative assessment to guide her next lessons.

T4 chose *Draw It!* as the method for teaching vocabulary in December. Previous science lessons covered the concepts of *natural resources: water and rocks*. The topic of the science lesson was *soil*. T4 had read two books about soil during the reading lesson: *Digging on Dirt* by Rena Korb and *Dig In!* by Pamela Hall. She started the science lesson using the anchor chart created during shared writing. The chart listed words students already knew. T4 stood next to the easel where the chart was hung. The students were seated at the carpeted area. T4 said, "We are going to review the words from this morning before we begin today's activity." She pointed to the chart and continued, "Let's read these words together so we can get focused." The teacher and students read the words on the chart including, soil, rocks, roots, worms, bugs, and dig. T4 next instructed students, "I want you to quietly stand up and get your science notebooks and a pencil." The class was divided into pairs or groups of three and told to line up. T4 gave each group a plastic spoon and a small plastic resealable bag. T4 stood at the front of the

line, near the door. She reviewed safety concerns for the outdoor exploration of soil, "When we are outside you will stay with your partner or group. You will share the spoon. I don't expect to see any objects thrown in the air or at someone." T4 and the students walked outside. As the group walked T4 said, "Today you are going to be soil scientists. You will investigate the soil and record anything you find IN the soil. Do not include objects *on top of* the soil. If you find something interesting, place it inside the little bag." T4 pointed to the area where digging was approved, and students squatted close to the ground. The teacher modeled her expectations of digging in the soil as well as appropriate communication. She said, "What have you found? I have found a rock." T4 had one student model a similar sentence with her and then directed students to begin. Students were immediately engaged in the soil investigation. As one student dug in the soil, the partner recorded the object or organism found. Students took turns being the digging investigator. I could hear a variety of conversations, "I found an ant." "We found sticks." "I found twigs and roots." "We found a really light colored bug." As students made discoveries, the object (or organism) was placed in the plastic bag. After about ten minutes T4 said, "We need to line up to go inside." Once inside the teacher gave directions, "Take your notebook, pencil, spoon and plastic bag and sit on the carpet." T4 sat down in her chair and called on each pair to report one object or organism that was found in soil. She labeled a new page on the chart, "What did we find in the soil?" T4 recorded student discoveries on the chart. Some of the student discoveries included rocks, pebbles, an ant, a root, a worm, a dead spider, a stick, and a flower. The teacher asked the student who discovered a flower IN the soil, "Could you

describe where you found the flower? Did you have to dig down in the soil to find this?" The student described her exploration of soil. Eventually the student agreed that the flower was *on top of* the soil. As students discussed their objects, one said, "I found a rock in the dirt." T4 asked, "What do we call it?" The student corrected herself and said, "Soil." T4 asked, "Why do we call it soil?" The student continued, "That's the word a scientist uses." After students shared, T4 provided more instructions, "I'd like you to draw at least three of the things listed on the chart. Label the page *soil*." A student asked, "How do you draw an ant? A classmate said, "Three circles, two antennae, and a face." T4 added another instruction, "As soon as you draw your objects, we need to put the worm and ant back outside." A student questioned, "Why?" T4 responded, "We don't want it to…" A student finished her sentence, "die." Another student added, "Worms live in the soil." The teacher concluded the lesson by instructing students to wash their hands.

Within this lesson, T4 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, read alouds, asking questions and making comments, illustrating, creating relationships among words and hands-on experiences. T4 had no weaknesses in this lesson. She focused her students with a review of the words discussed in the morning. She continued the lesson with an engaging hands-on activity. Students had multiple opportunities to connect the new terms with the content of the lesson. After a whole group discussion students drew illustrations to demonstrate what they had learned. T4 conducted a science lesson where the content, safety, and vocabulary were wrapped up in one engaging lesson.

Teacher T5. T5 chose the verbal/ visual as the method to learn and use for teaching vocabulary in October. Previous science lessons covered the concepts *objects that produce heat* and *objects that produce light*. The topic of the science lesson for the October observation was *fire safety*. Earlier in the day students had a visit from a fireman. During the science lesson, the teacher wanted to link fire safety to the previous concepts of *sense of touch* and *things that produce heat*. The students were scattered around the classroom finishing morning centers. T5 stood in the middle of the classroom. The whiteboard and carpeted area were behind her. When I walked in T5 called the students to the carpet. Three students were slow to clean up their work area so I was able to scan the classroom. T5 had two new anchor charts on the wall in her science center. One is on *Things That Produce Light*; the other is *Things That Produce Heat*. T5 sings a song about sitting properly. Some students join her. When the song is finished a student raised his hand and said, "You left out a line." T5 smiled and began the lesson. She elicited prior knowledge with a review of things that produce heat. She said, "This week in science we have been talking about things that produce heat." She continued, "Where would you see a flame? Raise your hand when you know." Students were quiet for a moment. Several looked at the word wall chart in the science center. After a minute, one student responded, "Fire." T5 continued speaking, "The flame is the yellow part." Students are still quiet. T5 said, "Let Mrs. G draw a flame." She drew a flame on the whiteboard. She repeated the question, "Where would you see a flame?" She prompted the students, "When you light a …" A student called out, "A match!" Once this student spoke out, more students responded. One suggested, "A campfire."

Another said, “In the fireplace.” A third student offered, “A barbeque pit.” The next student said, “In your oven.” T5 corrected her, “We don’t actually see a flame.” When a student said, “It’s the gas.” T5 made no comment. She continued the lesson with a statement, “Flames are dangerous.” T5 next began talking about the sense of touch, “We touch with our fingertips. We feel with our fingertips.” As she continued speaking, she touched each of the objects she mentioned, “We can touch our hair, our nose, our tooth, or our pants.” She asked the students, “How do these things feel?” Several students had their hands up. T5 called on one student who answered, “Smooth.” Another responded with, “Soft.” A third replied, “Hard.” The last student selected responded with, “Rough.” T5 switched topics again. She said, “We need to remember ways to stay safe. Being with your parents so you don’t get lost. When you don’t get hurt. Stay away from fire.” T5 then drew two columns on the board and labeled one column *safe to touch* and the other *not safe to touch*. She called students to provide examples for each column. The teacher drew name sticks to ensure every child participated. T5 called on a student. She responded, “Things that don’t cause you to get hurt,” as she pointed to the *safe to touch* column. Another student suggested, “A shoe.” T5 continued calling on students to answer. She pulled craft sticks with student names on them from a can. The next student responded, “A teddy bear,” for the *safe to touch* column. The last student chosen said, “A stove is not safe to touch. It is very hot.” T5 asked, “How do you know the stove is hot?” The student responded, “There is a red circle.” T5 held up a small stack of 5” X 7” picture cards. She explained to the students, “We have cards we’ll look at.” She held the first card up and asked, “What is this and where would you place it? Is it *safe to touch* or

not safe to touch?" A student called out, "A computer." T5 turned the card so it was facing her and looked at the picture. She then turned the card back to the student and inquired, "Have you ever seen these?" The student said, "No." T5 continued by explaining, "This is a picture of matches. It's a matchbook. When they are lit they have a flame." Another student chimed in, "Like a lighter?" T5 nodded her head yes. She held up another card. "What is this, and where does it belong?" she asked as she drew another name stick. She called the name on the stick. "A plug. It has power and electricity that can shock you," said the student, pointing to the *not safe to touch* category. The teacher held up another picture and called on a student. The student responded, "It's a toaster." The student continued, pointing to the *not safe to touch* category, "Never stick anything in!" T5 set the rest of the cards down and picked up a stack of papers. "You are going to finish this activity on your own," she said. "These cards," she continued, "have the same pictures as the one we just used in our class activity." T5 began placing the paper with the pictures on student desks. She continued her instructions, "You will color each picture and then cut it out. Next you will fold the large sheet of paper in half and draw a line down the middle to make two sections. One side is for *safe to touch* and the other side is for *not safe to touch."* Once each desk had both papers on it, T5 said, "You may walk to your table groups and begin." Students walked to their desks, sat down, and took out supplies from a box in the center of the table. As students began cutting the picture cards I noticed some cards had only a printed word. A student had his hand raised, "How come there isn't a picture here?" T5 responded, "Oh, I forgot to tell you! Some of the cards are blank; they only have a word at the bottom. I want you to draw a picture for the

word." T5 continued, "Only illustrate one or two of the blank cards." Students discussed ideas for a visual with their group peers. As students worked, T5 told me she started with only two terms because she was not yet at ease using the new method. She wanted to observe student engagement and understanding before using all six new terms in the verbal/visual activity."

Within this lesson, T5 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, using word walls, creating relationships among words, creating flash cards (verbal/visual), and graphic organizers. During discussions, she expected students to clarify their thinking. For example, the student who said a stove was not safe to touch clarified by saying they had seen a flame on the burner and knew the flame would be hot. Some students didn't understand this. The teacher clarified that some stoves produced a flame while others had an electric coil that became hot. After the initial September observation, T5 wanted to learn more about word walls. She had a science center in her classroom, but it lacked visuals and print material. It was evident that T5 had been adding to the print material in the science center. She created charts as students learned the words in the context of science lessons. The charts included both the printed word and a simple picture. T5's strengths are in *Use of Evidence* (Obj.5), *Application of Methodologies* (Obj. 6), and *Classroom Discourse* (Obj. 10). She earned a score of 6 in each of these objectives. T5 improved in student engagement with content and terms. T5 is still weak in *Understanding of Purpose* (Obj.2) and *Reflection and Metacognition* (Obj.9). Both of these objectives still earned a score of 2. T5 jumped

from topic to topic during the science lesson, discussing heat, sense of touch, and finally safety. Students initially didn't make connections between each discussion and the new terms (*safe* and *not safe*). T5 allowed minimal time during the lesson for making sense of the new terms. When students completed the cut-and-paste activity with the terms they talked with their peers about the terms.

T5 chose the word sort as the method to learn and use for teaching vocabulary in November. Previous science lessons covered the concepts heat, light, and sound energy. The topic of the science lesson for observation in November was *healthy foods*. Although this is not content in the science TEKS, T5 wanted to practice working with new terms in another content area (health). Students were sitting in their chairs at table groups. Their hands were clasped together and resting on the top of their desk. T5 stood in the back of the room facing the students. She had a book in her hand. The teacher opened the lesson by reading the story *Food for healthy teeth.*T5 read the page about milk, showed the picture, and asked, "Why should we drink milk?" A student responded, "Because it tastes good." T5 tried rephrasing the question, "Why is milk a healthy food? How does milk help our bodies stay healthy?" Another student suggested, "It helps us grow." T5 read the page about eggs, showed the picture, and asked, "Why are eggs good for our bodies?" A student replied, "Because they help us grow." T5 inquired, "Anything else?" A student responded, "I don't like eggs." T5 refocused the students, "We are discussing why foods are healthy and good for our bodies." She looked at the book again and read the page about carrots. She had not asked any questions when several students began talking. "I like carrots, "said one. Another chimed in, "My mom said they're good

for my eyes." A third one asked T5, "Do they keep us safe?" T5 clarified, "Carrots are healthy for us. They have lots of good vitamins in them." She continued reading the book and phrased her questions and comments about the terms *healthy foods* and *staying healthy* so students would make the connection between the foods and the staying healthy**.** As students responded it was evident many equated "healthy" with "staying safe." T5 distributed picture cards to students. She gave instructions, "You each have some picture cards. I want you to cut out the cards and sort them into groups." Students began cutting the cards and sorting them into two groups. Students talked with their table group members, but it was not always focused on *healthy foods*. T5 monitored the class, and when it was evident most students had sorted their cards she continued with the lesson. She called on one student, "How did you sort your cards? What are your two groups?" The student replied, pointing to the first group, "These are foods I like," and pointing to the other group, "and these are foods I don't like." T5 asked several other students about their groups, and each replied in terms of liking or not liking foods. It was the intent of the activity for students to group the cards by *healthy* and *not healthy*. During the sharing out students explained the groups as "I like it" and "I don't like it." The teacher asked the class, "Which of these foods are needed for healthy teeth or strong bones?" Two students recalled what the teacher had said earlier, and listed milk and carrots as healthy foods. Even with continued prompting, students continued grouping foods by likes and dislikes. T5 continued the lesson, "I will give you a piece of paper and I want you to glue your two groups onto it. Then I want you to label each group. Students discussed the pictures with their groups as they completed the activity, but few

students used the term *healthy*. After the lesson T5 expressed disappointment about students not grasping the meaning of the term "healthy." She had prepared healthy snacks for students and said she would continue the discussion during snack time.

T5 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, read aloud, creating relationships among words, and using a word sort. Her strengths in this lesson were in *Elicitation of Prior Knowledge* (Obj. 3), *Use of Evidence* (Obj. 5), and *Classroom Discourse* (Obj.10). Even though students didn't grasp the term *healthy foods*, T5 provided many opportunities to state what they thought they knew. Likewise, T5 provided all students the opportunity to discuss the concepts through speaking, listening, and writing. Students didn't always discuss the new terms, but T5 gave them time to engage with the terms. T5's weaknesses were more evident in this lesson than in the previous observation. She was weak in the dimensions of *Learning Objectives* and *Developing Understanding*. When T5 elicited prior knowledge on the topic of *healthy foods*, students replied with content about *being safe* and l*ikes and dislikes*. Rather than clarify or reteach, T5 continued with the lesson. *Understanding of Purpose* (Obj.2) and *Reflection and Metacognition* (Obj. 9) are two areas where T5 could improve.

For the December Observation, T5 wanted to try the *Draw It!* method of vocabulary instruction. Students had previously studied weather. The December lesson focused on a review of *weather* words. The teacher was concerned because many holiday activities had occurred during the week. She commented that keeping students

focused had been a challenge. Students were sitting in their chairs at table groups. Students faced the teacher, so some have their chairs turned away from the group. T5 stood between the whiteboard and the students. She began the lesson. She walked over to the weather calendar and asked, "How do we determine the weather?" Several students responded together, "We look outside make observations!" T5 continued, "Can we tell what the weather is if we don't look outside?" One student replied, "If it's sunny then it's hot." T5 clarified, "No…It's not always hot if it's sunny. Sunny just means the sun is shining." She continued, "Let's see what you remember about each of these terms." The terms included *sunny, windy, cloudy, rainy,* and *clear.* T5 held up a picture card with the printed word *sunny* and asked, "How do you describe sunny?" A student suggested, "When it's all bright outside, and the sun's not covered up." T5 held up the term *rainy* and asked, "This one?" A student remarked, "It's raining." T5 prompted the student for evidence, "What does it look like?" Two students responded. The first said, "Rain is water coming in drops," and the second student added, "Tiny drops and they are wet." T5 asked another question, "What are the really little drops called?" Several students called out, "Drizzle!" T5 held up another card. It had the term *windy* on it. She said, "The word is *windy*. How would you describe *windy*?" One student suggested, "Wind blowing so hard." T5 asked for evidence, "How can you tell?" Several students responded. The first replied, "You have to look for wind." Another chimed in, "The trees are bending." A third student added, "Hair is blowing." T5 held up the next card and stated, "The word is *cloudy*." A student said, "In the sky there are clouds." T5 questioned further, "And…?" Another student added, "And they cover the sun." Another

student responded with, “When clouds come down it’s called fog.” T5 flipped over another card, “What is this one?” Students do not respond immediately. Then one student suggested, “Snowy?” T5 looked at the card again and said, “This one says *clear*. What do you remember about the term *clear*?” A boy responded, “It’s when there’s nothing in the sky.” T5 asked, “Nothing?” The boy clarified, “No clouds.” The last term was *snowy*. T5 didn’t ask for any examples for this term. T5 reviewed the terms one more time by reading the printed word on each card. She then walked to the whiteboard and drew a large rectangle. She divided the rectangle in half lengthwise and by thirds widthwise. She said to the class, “You will make a chart,” and pointed to the rectangle on the board. She continued, “Make a line down the middle and two lines across.” A student called out with excitement in her voice, “It makes six…” T5 finished the sentence, “parts.” T5 walked to the cubbies in the back of the room. She instructed, “Get your science journals and a pencil.” She waited while students retrieved their supplies and were again seated. She told the students “Draw the chart like the one on the whiteboard.” Students followed instructions quickly, and within two minutes all student had drawn the divided rectangle. T5 continued, “You are going to put a picture of the weather word in each box. In the first box write *sunny*. S-u-n-n-y.” She paused as students printed the letters. T5 said, “Then think about what you picture when you hear the word *sunny*. Draw a picture.” Students work quietly. Suddenly there is a knock at the door and a costumed person entered. The students called out in unison, “It’s Zero the Hero!” Zero the Hero held up the number 70 and began singing. Students joined in and sang a song about the number 70. Just as quickly as she had entered, Zero the Hero left

and students resumed working. T5 told students, “The next word you will write is *rainy*. You can see the spelling on the whiteboard.” Students wrote the term and drew and colored an illustration for each of the six terms. T5 monitored the students as they worked, but did not correct students as they drew. The writing/drawing activity took almost 30 minutes. T5 mentioned at the start of the lesson that she wanted to use the finished product as a formative assessment to guide her instruction. T5 told me after the lesson she would revisit the terms appearing unclear to students.

T5 used several of the methods for vocabulary instruction aligned with the literature, including multiple exposures to new terms, asking questions and making comments, creating relationships among words, instruction in specific words, graphic organizers, and drawing the terms. T5 continually engaged students in the use of the science weather words. She asked students to provide evidence for each term. For example, when the term was identified as windy, students responded that trees moved, and hair blew. Students connected with the content of the lesson and the terms throughout the lesson. T5 had no weaknesses during this lesson. Every objective was scored either a 5 or 6. During the time students created their illustrations, I walked around to observe what the kindergartners drew. The level of detail in some of the illustrations was beyond what I normally see with five and six-year-old children. This was a new activity for students. As the lesson progressed, several students expressed how much fun it was to draw what they knew about weather.

Teacher T6. T6 chose the closed word sort as the method for teaching vocabulary in October. The topic of the science lesson was *(fire) safety*. The class had attended a fire

assembly earlier in the day, and the teacher felt this was an opportunity to build on that knowledge. Students had just returned from recess. Three students were with the teacher, one sat in a rocking chair, one was on the carpeted area, crying, and the rest worked at learning centers. Two boys at the computer center discussed favorite colors. One said, "Blue is my favorite color." The other replied, "Orange is my favorite color." They dumped a bucket of colored geometric blocks. The two boys picked out all the blue shapes and ordered them from lightest to darkest. T6 stood up and said to the class, "Let's all move to the carpeted area." She began a song about sitting appropriately. Students joined her as they walked to the carpet. The students sat on the carpet, legs crossed and hands in lap. T6 said, "Good job," and began the lesson. She continued, "We had a special guest today. Who was it?" Students responded in unison, "A firefighter!" One student clarified, "It was a girl here." Students began talking about jobs they might want. One student said, "I'm going to be a firefighter." T6 walked to the easel next to the whiteboard. A Big Book about firefighters rested on an easel. She picked up the book and sat in the rocking chair. She showed students the cover of the book and said, "Does this look like our guest from this morning?" Students nodded their heads yes. T6 continued, "Can girls and boys both be firefighters?" Students shouted, "Yes!" Still holding the cover toward the students, T6 asks, "What do you think the book is about?" Several students respond. The first suggested, "Save people from fire." The second guessed, "Save people." The third said, "Get the water." T6 began reading the story. Within the story was the sentence, "I want to be a firefighter." The student who had said this earlier called out, "Yes! That's what I said." Students were gazing at one of

the pictures in the book. Several asked simultaneously, “What is that baby doing?” Another student offered, “Looking at herself.” T6 made no comments as student discussed each page out loud. Students observed a picture of the tanker truck. A student asked, “Why is it a pumper truck?” Another student answered, “It pumps water.” T6 started reading the page discussing tools firefighters use when a student called out, “Nosebleed!” T6 looked at the girl and said, “Get tissue,” while pointing in the direction of the tissue box. T6 continued reading a list of tools firefighters used such as, an ax, a hose, a helmet, pants, a coat, a mask, boots, ladders, and knee pads. She said, “All his clothes are called a turnout uniform.” T6 said, “Can you guess what these girls are going to do?” Several students responded, “Play firefighter.” T6 asked while pointing to the illustrations on the page, “What do firefighters need to do their job?” At this point in the lesson, the teacher veered away from reading the book and discussing terms associated with firefighters. She instead emphasized the spelling of each word. She pointed to the first picture on the page. A student said, “Ax.” T6 spelled the word, “a-x.” She pointed to the next picture. Another student responded, “A hose.” T6 said, “h-o-s-e.” This procedure continued for the words helmet, pants, coat, mask, and boots. During the spelling lesson, all but two students raised their hands for a chance to respond to each picture. Students responded to each picture, but T6 never asked students to explain their thinking or expand on their responses. T6 looked at the picture of the boots and asked, “How many boots are there?” A student raised his hand, and T6 called on him. He didn’t say anything, so T6 responded, “We’ll come back to you.” Seconds later the student said, “Two.” She finally refocused the lesson on equipment firefighters use after

discussing an illustration in the book with a student. T6 read the sentence "The fireman coils the hose." A boy asked, "What does coil mean?" T6 responded "It means to roll it up." The boy exclaimed "Oh! So I *coil* my rope when I do calf roping!" This was a clear example of a student applying a new science term (coiling a fire hose) to a known situation (coiling a rope for calf-roping). After a final discussion of tools firefighters used, students returned to their table groups. The teacher distributed a paper with illustrations of "*safe to touch*" and "*not safe to touch*" as well as a T-chart graphic organizer. She instructed students, "Cut out the illustrations and place them in the appropriate category on your T-chart." She continued, "If you're not sure what to do I have an example," she pointed to the whiteboard, "up here." As students began the activity, T6 pulled a group of students to complete center work from the morning. The science activity now became a cut-and-paste rather than an extension of the idea *fire safety*. The picture cards had several pictures, such as matches and a candle, which related to fire safety. T6 made no connections between the content in the book and the picture cards. The activity became a procedural cut and paste. Students were not encouraged to talk about the picture cards in terms of *fire safety*.

Within this lesson, T6 modeled some of the methods for vocabulary instruction aligned with the literature, including asking questions and making comments, read aloud, and closed word sort. T6 was strongest in *Elicitation of Prior Knowledge* (Obj. 3) and *Intellectual Engagement* (Obj.4). Both of these objectives were scored as a 4. T6 provided students an opportunity to state their understanding about *the firefighters' job*. Although the discussion was not focused on *fire safety* terms, T6 engaged students in the

conversation. At least one student, when discussing the term coil, exhibited thinking at a higher cognitive level. T6 had the greatest weakness in *Understanding of Purpose* (Obj. 2), *Use of Evidence* (Obj. 5), *Application of Methodologies* (Obj. 6), *Reflection and Metacognition* (Obj. 9), *Classroom Discourse* (Obj. 10), and *Motivation* (Obj. 11). Students did not relate the activity (cut and paste) with the learning of *fire safety* terms. Students may have had instruction on the terms focused on *safe to touch* and *not safe to touch* earlier in the day. I observed no connected discussion. The student who cried loudly during the entire thirty-minute lesson may have distracted the teacher during the observation.

The topic of the science lesson for November was *sound*. Previous science lessons had covered physical properties of matter. Students sat on the carpeted area in front of the whiteboard. T6 stood in front of them and held a book. T6 began the lesson by reading a story, *The Listening Walk*. After reading the sentence, "He is an old dog and doesn't walk very fast," T6 asked, "Why doesn't the dog walk fast?" Three students responded, "Because he is old." When T6 read the sentence, "I keep still and listen, "she asked the class, "Why would the little girl keep still?" A student suggested, "So she would be quiet?" T6 didn't ask the student to clarify her response. She continued the story. T6 read the sentence, "I call this a listening walk." She asked the students, "Why do you think the walk is called *a listening walk*?" Several students responded, "Because she is listening?" Students listened to the story, but asked no questions about *sounds*. Students appeared to focus on the illustrations rather than the words. T6 completed the story with no further questions. She did not relate the story to the science content *sound*.

T6 set the book down and instructed students, “Please line up. We are going outside.” She took the students outside. The teacher continued the lesson as students walked down the hall, “We are taking a “*listening walk*. You will need to listen carefully at the outside sounds. We will talk about what we hear when we are back inside.” The class walked to the front of the school, through the playground, and back to class. Most students were quiet while walking. Some pointed to objects that produced a sound. The class returned to the hall inside the building. T6 said, “When we get into the class I want you to sit on the carpet.” Students walked into the class and sat down. T6 facilitated a discussion about the sounds heard outside. She asked, “What were the sounds you heard when we were outside?” Several students responded with single-word replies. The replies included the words yelling, wind, whispering, barking, siren, meow, stomping, and screaming. T6 created a chart of words as students mentioned the sounds heard outside. After the discussion students returned to their table groups and completed morning center work.

T6 requested to learn about the verbal-visual method of vocabulary instruction for November. However, there was no evidence of a verbal-visual activity during the observation. T6 had no strengths during this observation. All scores on the *SCOW* were between 0-2. The three weakest areas included *Intellectual Engagement* (Obj. 4), *Use of Evidence* (Obj. 5), and *Making Connections* (Obj. 8). During the lesson, T6 rarely engaged the students with the terms relating to the concept *sound*. Terms related to sound could have included *loud, soft, high*, and *loud*. T6 charted examples of sounds students heard on the walk, but she did not connect these words to the concept of *sound*.

T6 minimally used some of the methods for vocabulary instruction aligned with the literature, including read aloud, asking questions and making comments, and creating an anchor chart.

In December T6 did not request any modeling of methods for vocabulary instruction. She explained she wasn't actually doing any science because holiday activities needed to be completed. For the December observation, I sat in on a small group reading activity. I observed how vocabulary instruction was used during reading. I wanted to observe if methods of vocabulary instruction learned in the PD session transferred to other content areas. The class was divided into groups. Each group was a different table completing an activity with a parent helper. Five students sat around the large curved side of the kidney bean-shaped table.T6 sat across from the students. She distributed a small reading book *I like Christmas* to each of the five children in the group. Each page of the small reading book had a picture and three or four words to describe the picture. T6 began the lesson, "Look carefully at the cover. What do you think this book is about?" The students answered, "Christmas." T6 continued, "Look at the title. What does it say?" The students responded, "I like Christmas." T6 said, "Turn the page and look at the picture. What do we see?" One student responded, "A sleigh, with Santa." Another added, "It's like a ship. It flies." A third student replied, "The reindeer make it fly." A fourth student clarified, "Magic dust make reindeer fly." T6 spoke again, "Turn to the next page. What do you see?" One student said, "What you put on your door." Another student added, "Or a gate." A third student said, "It's a wreath." T6 continued the reading lesson, "Turn to page three. What do you see on this page?"

All the students said in unison, “Candy canes!” A girl said, “Not peppermint.” Another student said, “Blue ones, or rainbow ones.” T6 didn’t ask if students to clarify their statements. I wasn’t sure if students meant they either liked or didn’t like those flavors. T6 asked students to turn the page. She said, “How would you describe this picture?” Three students responded together, “Presents.” One of the girls in the group clarified her wishes by responding, “I want to ask for a microscope and a Barbie.” T6 instructed student to turn to page 5. She said, “I want each of you to describe the object pictured.” All students in the group recognized the picture as a candle. T6 continued, “Tell me something about the candle.” One student said, “The candle gives us light.” Another student said, “The candle heats up.” A third student said, “If the wind is blowing it will blow the candle out.” A fourth student said, “A candle can burn you.” The fifth student said, “You can put a candle on a plate with leaves and berries.” Most of the students in the group applied what they had learned in the lessons on heat and light to the object (candle) in the book. T6 asked students to turn the page. “What is on this page?” One student responded, “Lights.” Another clarified, “Christmas lights.” A third student said, “We have white ones.” A fourth student responded, “We haven’t put our lights up yet.” The last page showed a family eating a meal. T6 asked, “What is happening in this picture?” Several students said, “They are celebrating.” The students began discussing the illustration. “They are eating hot turkey,” said one student. Another added, “You can tell it’s hot because there’s steam.” Another student pointed out, “There’s a wreath.” “There are three candles,” pointed out the fourth student. T6 chimed in, “What is covering the table?” The fifth student said, “A table cloth. And the mom is wearing an

apron so she doesn't get stains on her clothes." Students closed their books. The reading lesson took nearly twenty minutes. During this lesson T6 provided multiple opportunities for students to describe the holiday terms.

Within this lesson T6 modeled some of the methods for vocabulary instruction aligned with the literature, including read aloud, asking questions and making comments, instruction in specific words, and creating relationships among words. During this lesson T6 had several strengths including *Elicitation of Prior Knowledge* (Obj. 3), *Use of Evidence* (Obj. 5), *Reflection and Metacognition* (Obj. 9), *Classroom Discourse* (Obj. 10), and *Motivation* (Obj. 11). T6 encouraged students to explain what they knew about each picture. Additionally, she ensured all students responded during the lesson. The students were familiar with all the terms in the book and discussed the terms with their peers. As the reading group progressed through the book, I made a point of listening to students in the other centers. Students used terms about light and sound while completing activities in the *color by site words* center and the *counting and coloring* center. T6 was still weak in *Understanding of Purpose* (Obj. 2), *Application of Methodologies* (Obj.6), and *Making Connections* (Obj.8). T6 has been consistently low in these three objectives.

Summary of During-Intervention Data

Following is a summary of the overall changes from the pre-intervention observations (September) to the during-intervention observations. I observed a change in instructional practices with four out of the six teachers. All three kindergarten teachers (T4, T5, and T6) and one second grade teacher (T1) changed the extent to which vocabulary was

taught in the classroom. The most dramatic change in methods for teaching vocabulary was by T1. In *Elicitation of Prior Knowledge* (*Obj.3*), all teachers' scores rose or remained steady. The scores of four out of six teachers (T1, T2, T3, and T5) rose by more than two points from September to October. In *Application of Methodologies* (*Obj.6*) the scores of four out of six teachers (T1, T2, T4, and T5) rose by two points. This change demonstrated that four of the six teachers demonstrated the use (application) of the new teaching methods. In *Formative Assessment* (*Obj. 7*) the scores of four out of six teachers (T1, T2, T5, and T6) rose by two points. The scores of the other two teachers rose slightly or remained the same. Teachers assessed student understanding more regularly during the lessons and often adjusted their instruction. From October to November all six teachers either remained steady or increased their scores in *Understanding of Purpose* (*Obj.2*). In *Use of Evidence* (*Obj. 5*), scores rose or remained steady for five out of six teachers during both November and December observations.

Some trends became apparent after the December observation. The scores of four teachers (T1, T4, T5, and T6) rose consistently for five or more objectives during the intervention period. Teachers T2 and T3 only had two objectives that rose consistently. The scores of four of the six teachers (T1, T4, T5, and T6) remained steady or rose from November to December. T1-nine of eleven objective scores remained steady or rose; T4-ten of eleven objective scores remained steady or rose; T5- eleven of eleven objective scores remained steady or rose; and T6- nine of eleven objective scores remained steady or rose. Teachers T2 (five of eleven objective scores remained steady or rose) and T3

(seven of eleven objective scores remained steady or rose) had limited progress. Both had scores that rose from September to October, but then declined during the next two months. T2 consistently reverted to using dictionary skills for teaching new words. T3 only taught through video viewing. Teachers T1, T4, T5, and T6 expressed interest in learning new methods and consistently applied the methods during lessons. Although T6 taught a *reading* lesson during one of the *science* observations, she still employed the methods of teaching vocabulary she had learned during the intervention period.

In the initial observation, T1's science lesson and instruction of vocabulary was driven by a video. After receiving each method of vocabulary instruction, T1 implemented the method as taught and modeled during the PD. During our debriefing after each lesson T1 commented her students looked forward to science and understood more content. The students became more proficient at expressing their thinking and using the terms learned in the lesson.

T4 already displayed proficiency in vocabulary instruction during the first observation. However, after the intervention she spent more time in science focusing on the *science terms* associated with the content. One example that stood out was during the soil lesson. During the lesson T4 explained the observation activity by saying, "We are going outside to look at the dirt." Her students corrected her, explaining "soil" was the term scientists used, not "dirt." This comment by students demonstrated the use of a science term "soil" in place of the more commonly used term "dirt."

T5 taught more vocabulary and more science after the intervention. She observed greater student engagement during the science vocabulary lessons and improved student

writing. Her use of word walls potentially benefitted the students as each science unit built on previous learning. Students used the charts as a resource after their placement in the science center.

Although the gains by T6 were not as great as the other kindergarten teachers, she improved in her use of vocabulary instruction across content areas. Her students expressed their thinking more clearly, and with more scientific language than before the intervention.

T3's instructional practices did not change at all. Every science lesson was based on a Brain POP® video. The vocabulary focus included terms in the video, not the terms listed in her curriculum documents or lessons.

T2 also did not improve after the intervention. She went through the motions of using the new methods, but each lesson reverted to having students look terms up in the dictionary. Furthermore, every science lesson review was extended by a writing activity. The focus was on spelling and writing conventions, not science content.

Post-Intervention Data Collection

Question 4

How Did Participating Teachers' Incoming Perceptions Change as a Result of the Professional Development Experience on the Inclusion of Vocabulary Instruction in Science Lessons? Teachers' post-intervention *SVQ* responses on perceptions about teaching science vocabulary are summarized in the description that follows. Reflections and analysis of their perceptions after the professional development

are included. The seven open-ended questions on the *SVQ* included: 1) What instructional strategies do effective teachers use to teach vocabulary development?; 2) Which instructional strategies are most often used by effective teachers?; 3) What does the term "academic vocabulary" mean to you?; 4) In what ways is teaching academic vocabulary important?; 5) How much time you spend each week, on average, teaching vocabulary development?; 6) Are there any challenges when faced with teaching academic vocabulary? Please include any examples; and 7) During what part of the instructional day would the teaching of academic vocabulary be most effective?

Teacher T1. T1 appeared to have expanded her use of different instructional strategies for teaching vocabulary from the September observation to the December observation. She included strategies learned in the individualized PD sessions. She varied methods used to meet the needs of her students. Her understanding of "academic vocabulary" changed to include "the need to build language foundations upon which additional learning and understanding could be based." She increased the time spent teaching vocabulary by thirty minutes per week. T1 also used the new strategies across other content areas. T1 discovered some methods of vocabulary instruction could clarify word meanings when associated with a visual or kinesthetic activity. Other terms, particularly abstract concepts, still presented a challenge to teach. T1 changed her perception on the best time to teach vocabulary. On the pre-intervention T1 said "all day" was best. Post-intervention, T1 focused instruction of science terms at the start of each lesson. T1 incorporated more notebook entries through students summarizing newly acquired vocabulary by writing and drawing.

Teacher T2. All strategies mentioned in the pre-questionnaire focused on writing and speaking. T2's predominant method of teaching vocabulary was through writing, even though she stated visuals were used by "effective teachers." T2 had "listening, speaking, writing and using vocabulary in question/answer activities" as instructional strategies in the pre-intervention questionnaire. T2 included vocabulary cards as an effective strategy since participating in PD. However, she still predominantly used definition activities for teaching vocabulary. T2 learned about *academic vocabulary* during the introduction of their curriculum documents three years ago. T2's initial response defined academic vocabulary as "the terms needed to communicate in the subject being taught." This definition, along with T2's response in the post-questionnaire ("Academic vocabulary allows students to build upon their prior knowledge"), aligned closely with the literature (Baumann & Graves, 2010). T2's response about the best time to teach vocabulary did not vary between the pre- and post-questionnaire. During my observations, which always occurred in the afternoon, I saw dictionary work more than vocabulary development. T2 said finding time to gather resources was her greatest obstacle to teaching vocabulary. To eliminate this obstacle, I provided verbal/ visual cards along with visuals for her lessons. She used each of the resources, but always turned the vocabulary session into either a writing or a spelling lesson. T2 initially said the best time to teach vocabulary was "all day." By the end of December, her response was more specific to the timing in the lesson cycle when learning was "most effective." Overall T2 understood the theory behind effective

methods for vocabulary instruction. T2's statements about *understanding* effective methods for vocabulary instruction did not align with her *classroom practice*.

Teacher T3. In the pre-questionnaire T3 listed "vocabulary puzzles and using content trailers" as methods used by effective teachers. In the post-questionnaire T3 said effective teachers used "daily instruction and reviews." During observations, T3 only used videos and dictionary work for vocabulary instruction. Although T3 stated she used pictures and puzzles to teach vocabulary, this was never observed. T3 explained that academic vocabulary included the terms "used by each grade level" and needed to master content, but did little to demonstrate effective teaching strategies. T3's pre and post-definition for academic vocabulary demonstrated an understanding of the term. However, what she knew about the topic, and what her classroom practice demonstrated did not align. T3's initial response listed 30-45 minutes per week for vocabulary development. On the post-questionnaire T3 wrote that she now spent two hours per week on vocabulary development. This response did not align with the classroom observations. I rarely saw more than 5-10 minutes of word work by students during each observation. T3 stated on both the pre- and post- *SVQ* that the greatest challenge for teaching vocabulary was students starting school with vastly different vocabulary levels. She didn't elaborate on *why* or *what aspect* of this issue was a challenge. Observations in T3's classroom did align with her practice of teaching vocabulary as the introduction of content. This practice did not align with research that stated *exploration of concepts* should occur before teaching terms. I observed no hands-on experiences with which

terms could be linked. Overall there was no indication that T3's perceptions or practice changed as a result of the individualized PD.

Teacher T4. T4's responses about effective methods of teaching vocabulary did not vary much between the pre- and post-*SVQ*. She already used a wide range of strategies appropriate for kindergarten including anchor charts, hands-on experiences, visuals, whole group and small group discussions. In the pre-questionnaire, T4 listed "using examples that relate to the children" as effective instructional strategies. After the intervention, she added word sorts and shared writing. T4 stated that "lots of hands-on experiences as well as opportunities for observation and discussion" were important. Each strategy T4 perceived as important was observed in the classroom. T4 already demonstrated a clear understanding of the term *academic vocabulary* in the pre-questionnaire. In the post-questionnaire T4 described academic vocabulary as "Vocabulary that is essential to help with academics. Words students should know and understand to be effective in their studies." Clarifying by using the word "essential" showed an understanding of the *importance* of teaching academic vocabulary. T4's inclusion of the words "know and understand" in her post-questionnaire indicated an understanding that simply *presenting new words* to students wasn't the same as students *knowing* new words. T4 also indicated exposure to academic vocabulary at a young age provided the foundation for learning at later grades. In the post questionnaire T4 determined she spent about seven-and-a-half hours per week teaching vocabulary. T4 spent about 10 minutes *directly* teaching a specific science word during each observation. T4 then linked content to the new terms as the lesson progressed. T4

reinforced terms continually through shared reading and writing, as well as during student-lead discussions. T4 initially perceived the lack of a strong base vocabulary with ESL students was a challenge. During one of the coaching sessions I mentioned that most kindergarten students could be called English Language Learners. Therefore, strategies identified for ESL students could be effective with all kindergarten students. T4 agreed and used a variety of methods of vocabulary development potentially to reach all her students. T4 was more specific in her pre-questionnaire response about the best time to teach terms: "During whole group, shared reading, and read aloud." In the post-questionnaire, T4 stated she taught vocabulary all day. She clarified her statement about *why* she taught all day. She wanted to provide students with multiple opportunities to use and work with the new terms. During each of the observations, T4 allowed students to respond to questions. Students demonstrated understanding of new terms through providing explanations of their thinking. T4's students had the greatest use of science academic language of the kindergarten classes observed. Students used academic language when speaking in whole groups, small groups, or one-on-one with the teacher.

Teacher T5. T5 listed "play games, oral, and visual activities" on her pre-questionnaire response as effective methods of vocabulary instruction. She added hands-on activities and visuals after the intervention. T5 relied on "reteaching" as her method of vocabulary instruction prior to the intervention. She used "hands-on activities in conjunction with visuals and written labels for the visuals" during her science lessons after the PD. Her classroom became more visual and print rich. T5 made gains in her understanding of the term "academic vocabulary." Initially, she believed it was "all

words." After the PD, she wrote that academic vocabulary was "Vocabulary that is tied to an academic concept." Prior to the intervention, T5 predominantly taught Tier 1words as vocabulary. During two of my observations, she demonstrated direct teaching of terms associated with the *science concept* being studied. T5 showed limited understanding in either the pre- or post- *SVQ* response for *why* teaching academic vocabulary in science was essential for student success. Her classroom practice demonstrated limited use of academic vocabulary. She still predominantly focused on Tier 1 words. T5 initially perceived "45 minutes and during centers" as the amount of time spent developing vocabulary. During observations, I saw T5 teach vocabulary after hands-on activities. Her students applied the terms in new situations such as small group and class discussions. T5 said learning centers were used to review terms. The teacher explained the instructions for each center and then students worked independently on their word work. During my observations, the center activities appeared as procedural application of cut-and-paste activities instead of word review. Since my observations were limited to thirty minutes in three different months, I did not see the estimated four hours per week T5 said she now spent on vocabulary development. T5 responded on the pre-intervention questionnaire "ELL's often have a difficult time with learning terms." The teacher perceived this as an obstacle to teaching science vocabulary. Before the October observation, T5 and I discussed that most kindergarteners are still learning the English language. Most students were "emerging English learners." We discussed using a variety of methods, along with a print rich classroom as ways to support student learning. T5 applied her learning of new instructional methods to her whole class. After

the December observation T5 indicated that abstract concepts, as opposed to concrete ideas, were still challenging to teach. T5 initially said she taught new terms "all day." After the PD intervention, she said her students were more attentive in the morning. The observations made during afternoon science classes would align with the teacher's perception. I did not observe the direct teaching of science vocabulary in any afternoon lessons. Overall T5 appeared to change her perceptions about teaching vocabulary. Her classroom environment became more print-rich with science terms after the PD intervention. Students demonstrated greater science content knowledge through using terms appropriately in discussions.

Teacher T6. T6 expanded her perception about effective teaching methods after the PD intervention. She had previously only listed "hands-on and lots of examples" as effective methods. After the PD intervention, she listed "using picture cards, asking questions, reading stories, having discussions, and using anchor charts" as effective methods. T6 listed "speaking and reading" as an effective instructional strategy she currently used. This aligned with what I saw during the observations. T6 read several books during the observations but did not provide ways for students to demonstrate their understanding of new words. T6 attempted to use different methods of instruction within her lessons. She had several students with special needs to accommodate and these students had frequent outbursts. Lessons were interrupted many times and lessons often lacked continuity. T6 did not change her understanding of academic vocabulary. She initially thought the definition was "things that teach about a skill, and that they will be able to understand what they are talking about." She was unable to clarify her

thinking to me. In the post-questionnaire T6 did not identify academic vocabulary as terms specifically tied to a concept or content. She perceived academic vocabulary as "words taught at school." Her post-intervention response implied students were exposed to academic vocabulary primarily in the school setting. T6 had several students with limited exposure to words (reading or speaking) at home (information from the interview and discussion). This was perceived as a challenge by T6. In addition to having students with delayed language acquisition, she also had two autistic students. It was a challenge for T6 to find methods of vocabulary instruction to meet their needs. During my observations students worked in centers for about half the time; they completed tasks independently, but the tasks were not specifically focused on vocabulary development. Parent helpers spent their time in the classroom assisting with cutting and gluing skills rather than word recognition. T6 tried to spend10-15 minutes daily during different lessons to teach vocabulary. She also tried to reinforce terms throughout the day. I saw about ten minutes of vocabulary development during each observation. However, I did not have the opportunity to observe how the teacher reinforced the terms. T6 stated frustration with the time needed for vocabulary development. She said the high-stakes testing started in third grade, and some students would need a considerable amount of time and intervention to learn terms and content. Her initial perception was that vocabulary instruction was best completed during math and science. Her perception changed after the PD intervention. T6 stated that the best time for vocabulary instruction was when students were motivated. The fire safety lesson was an example where students were motivated. A fireman visited the class in the morning and students were

still engaged with the content during the afternoon. Overall T6 changed her perceptions about vocabulary instruction but remained frustrated about putting new methods into practice.

Question 5

How Did Participating Teachers' Practices Change as a Result of the Professional Development Experience on the Inclusion of Vocabulary Instruction in Science Lessons? The results for this research question are summarized for each participant in a table with a summary. The tables summarize the objective rubric scores from the *SCOW* for the classroom observations in October, November, and December. Teachers were observed after their individualized PD on methods of vocabulary instruction. Each table includes the scores from the September (pre-intervention) observation as well as the three post-intervention observations. The purpose of including the September score is to show a comparison of pre- and post- intervention data.

Teacher T1. The results of the four science classroom observations for T1 are shown in Table 4-5. In October, T1had improved *SCOW* scores in every objective. During September T1 had four low-scoring objectives and one high-scoring objective. During the intervention T1 had no low-scoring objectives and an average of ten high-scoring objectives. T1 demonstrated improvement in each of the objectives during the course of the intervention.

Table 4-5

Comparison of Rating Scores Over Four Months T1

Objective	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	2	6	6	6	14	3.5
2 Understanding of Purpose	0	5	6	5	16	4.0
3 Elicitation of Prior Knowledge	2	5	6	6	19	4.75
4 Intellectual Engagement	1	5	6	6	18	4.5
5 Use of Evidence	0	4	5	6	15	3.75
6 Application of Methodologies	1	5	6	6	18	4.5
7 Formative Assessment	4	6	6	5	21	5.25
8 Making Connections	6	6	5	6	23	5.75
9 Reflection and Metacognition	4	6	4	6	20	5.0
10 Classroom Discourse	4	6	4	6	20	5.0
11 Motivation	4	6	5	6	21	5.25
Total	28	60	59	64	205	51.25
Mean score	2.55	5.45	5.36	5.82	18.64	4.66
**High-scoring (n)	1	10	9	11	30	10
**Low-scoring (n)	4	0	0	0	0	0

*Note. Objective 1: Alignment Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

Table 4-6

Comparison of Rating Scores Over Four Months T2

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	2	0	2	1	5	1.25
2 Understanding of Purpose	2	2	2	2	8	2.0
3 Elicitation of Prior Knowledge	1	5	3	4	13	3.25
4 Intellectual Engagement	2	3	2	2	9	2.25
5 Use of Evidence	1	1	2	2	6	1.50
6 Application of Methodologies	0	5	3	1	9	2.25
7 Formative Assessment	1	4	2	0	7	1.75
8 Making Connections	2	4	3	2	11	2.75
9 Reflection and Metacognition	0	4	3	1	8	2.0
10 Classroom Discourse	2	5	3	3	13	3.25
11 Motivation	1	5	2	1	9	1.50
Total	14	38	27	19	98	24.5
Mean score	1.27	3.45	2.45	1.73	8.91	2.23
**High-scoring (n)	0	3	0	0	3	1
**Low-scoring (n)	6	2	0	5	7	2.33

*Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

Teacher T2. The results of the *SCOW* ratings on the four science classroom observations for T2 are shown in Table 4-6. In October T2 improved her rating scores in

eight objectives with the greatest gain in *Application of Methodologies (Obj. 6*). She had a score of zero in September but earned a score of 5 in October.

Total *SCOW* scores were higher in November and December than scores in September. However, after the highest total score in October scores declined in each successive month. During September T2 had six low-scoring objectives and no high-scoring objectives. During the intervention, T2 had an average of 2.33 low-scoring objectives and an average of one high-scoring objective. T2's S*COW* scores either remained the same or demonstrated improvement at some time during the course of the intervention.

Teacher T3. The results of the four science classroom observations for T3 are shown in Table 4-7. The results of the *SCOW* ratings on the four science classroom observations for T3 are shown in Table 4-7. In October T3 improved her rating scores in five objectives with the greatest gain in *Elicitation of Prior Knowledge (Obj.3).* She had a score of zero in September but earned a score of 4 in October. T3 had the greatest gains in October, earning a total score of 20, up from 16 in September. However, after the highest total score in October, scores declined in each successive month. During September T3 had five low-scoring objectives and no high-scoring objectives. During the intervention T3 had an average of 5.33 low-scoring objectives and an average of zero high-scoring objectives. T3's S*COW* scores were the only scores lower in December than they were in the pre-intervention period. She had six lower scores, one that remained the same, and four that rose. T3 had no high-scoring objectives pre- or post-intervention. Furthermore, her average of low-scoring objectives from the intervention period was higher (5.33) than in the initial September observation (5).

Table 4-7

Comparison of Rating Scores Over Four Months T3

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	0	2	1	1	4	1.0
2 Understanding of Purpose	2	2	2	1	7	1.75
3 Elicitation of Prior Knowledge	0	4	2	4	10	2.50
4 Intellectual Engagement	2	2	1	1	6	1.50
5 Use of Evidence	2	0	1	0	3	0.75
6 Application of Methodologies	3	2	0	0	5	1.25
7 Formative Assessment	1	2	2	1	6	1.50
8 Making Connections	3	2	2	1	8	2.0
9 Reflection and Metacognition	0	2	2	3	7	1.75
10 Classroom Discourse	3	1	1	1	6	1.50
11 Motivation	0	1	2	2	5	1.25
Total	16	20	16	15	67	16.75
Mean score	1.45	1.82	1.45	1.36	6.09	1.52
**High-scoring (n)	0	0	0	0	0	0
**Low-scoring (n)	5	3	5	8	16	5.33

Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

Teacher T4. The results of the four science classroom observations for T4 are shown in Table 4-8. In October T4 improved her rating scores, or had scores that

remained the same in all eleven objectives. Her rating scores did not drop in any objective in October. The greatest improvement (two points) was in *Application of Methodologies (Obj.6).* Once again, in November, T4 improved her rating scores, or had scores that remained the same in all eleven objectives. The greatest gains (2 points) were in *Use of Evidence (Obj.5), Making Connections (Obj.8)* and *Classroom Discourse (Obj.10).* In December T4 had a score of 6 in ten of the eleven objectives. During the months of the intervention, T4 had no rating scores below a 4. In September T4 had 3 high-scoring objectives. The average number of high-scoring objectives rose to an average of 8.67 for the during-intervention months. T4 was open to learning a variety of methods and expressed satisfaction with the multiple ways she could teach her students new science terms.

Table 4-8

Comparison of Rating Scores Over Four Months T4

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	4	5	5	6	20	5.0
2 Understanding of Purpose	4	4	4	6	18	4.50
3 Elicitation of Prior Knowledge	5	6	6	6	23	5.75
4 Intellectual Engagement	4	5	6	5	20	5.0
5 Use of Evidence	4	4	6	6	20	5.0

Table 4-8 Continued

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
6 Application of Methodologies	2	4	5	6	17	4.25
7 Formative Assessment	5	5	5	6	21	5.25
8 Making Connections	2	4	4	6	16	4.0
9 Reflection and Metacognition	4	4	5	6	19	4.75
10 Classroom Discourse	4	6	6	6	22	5.50
11 Motivation	5	5	6	6	22	5.50
Total	43	52	58	65	218	54.5
Mean score	3.91	4.72	5.27	5.91	19.82	4.95
**High-scoring (n)	3	6	9	11	26	8.67
**Low-scoring (n)	0	0	0	0	0	0

Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

Teacher T5. The results of the four science classroom observations for T5 are shown in Table 4-9. In October T5's rating scores rose or remained the same in all eleven objectives.

Table 4-9

Comparison of Rating Scores Over Four Months T5

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	4	4	2	6	16	4.0
2 Understanding of Purpose	2	2	3	5	12	3.0
3 Elicitation of Prior Knowledge	0	4	5	6	15	3.75
4 Intellectual Engagement	2	5	3	5	15	3.75
5 Use of Evidence	0	6	5	5	16	4.0
6 Application of Methodologies	2	6	2	6	16	4.0
7 Formative Assessment	0	5	2	5	12	3.0
8 Making Connections	2	4	4	6	16	4.0
9 Reflection and Metacognition	0	2	3	5	10	2.50
10 Classroom Discourse	2	6	5	5	18	4.50
11 Motivation	0	4	4	5	13	3.25
Total	14	48	38	59	159.0	39.75
Mean score	1.27	4.36	3.45	5.36	14.45	3.61
**High-scoring (n)	0	5	3	11	19	6.33
**Low-scoring (n)	5	0	0	0	0	0

Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

She had gains of four or more points in six of eleven objectives. T5 had no decrease in scores from September to October. T5's greatest improvement in practice, as shown by

improved rating scores, was during the month of October. In November T5's rating scores remained the same or rose for five objectives. T5's scores declined in six objectives. From November to December T5's scores improved by at least four points in two objectives. T5's average across all objectives was the highest in December. She had seven objectives that improved by four or more points from the pre-intervention period. In September T5 had five low-scoring objectives. During the intervention, period she had no low-scoring objectives. In September T5 had no high-scoring objectives. During the intervention T5 had an average of 6.33 high-scoring objectives.

Teacher T6. The results of the four science classroom observations for T6 are shown in Table 4-10. In October T6 had scores that rose, or remained the same, in nine objectives. However, in five objectives (2, 5, 6, 9, and 10) her scores were still a zero. Her rating scores dropped in two objectives. Despite the decline in several scores, T6 improved her average across all objectives from 0 .73 in September to 1.36 in October. In November T6's scores improved or remained the same in eight objectives. She had no scores of zero in November. In December T6 improved her rating scores in eight objectives. T6's rating score dropped for *Making Connections (Obj.* 8) because the objective specified applications to science. T6 conducted a reading lesson so the rubric score was not applicable. The score of zero was not included in her average because I did not want to penalize the teacher.

Table 4-10

Comparison of Rating Scores Over Four Months T6

Objectives	Sept.	Oct.	Nov.	Dec.	T	A
1 Alignment of Lesson Activities	0	2	2	4	8	2.0
2 Understanding of Purpose	0	0	2	1	3	0.75
3 Elicitation of Prior Knowledge	4	4	3	5	16	4.0
4 Intellectual Engagement	0	4	1	4	9	2.25
5 Use of Evidence	1	0	1	5	7	1.75
6 Application of Methodologies	1	0	2	2	5	1.25
7 Formative Assessment	0	2	2	4	8	2.0
8 Making Connections	2	2	1	0	5	1.25
9 Reflection and Metacognition	0	0	2	5	7	1.75
10 Classroom Discourse	0	0	2	5	7	1.75
11 Motivation	0	1	2	5	8	2.0
Total	8	15	20	40	83	20.75
Mean score	0.73	1.36	1.82	4.00	7.55	1.89
**High-scoring (n)	0	0	0	5	5	1.67
**Low-scoring (n)	9	6	3	2	11	3.67

*Note. Objective 1: Alignment of Lesson Activities; Objective 2: Understanding of Purpose; Objective 3: Elicitation of Prior Understanding; Objective 4: Intellectual Engagement; Objective 5: Use of Evidence; Objective 6: Application of Methodologies; Objective 7: Formative Assessment; Objective 8: Making Connections; Objective 9: Reflection and Metacognition; Objective 10: Classroom Discourse and; Objective 11: Motivation

**Note. Scores of 5 or 6 were distinguished as "high-scoring" performances for individual objectives; the number (n) of high scores indicates the tally of all high scores for an individual objective; Similarly, scores of 0 or 1 were distinguished as "low-scoring" performances for individual objectives; the number (n) of low scores indicates the tally of all low scores for an individual objective.

She taught holiday vocabulary during the reading lesson. Her average across all objectives was the highest in December. From the pre-intervention period to December T6's scores improved by four or more points in seven objectives. In September T6 had no high-scoring objectives and nine low-scoring objectives. During the intervention, her low-scoring objectives reduced each month. The average across the three intervention months was 3.67. T6's high-scoring objectives remained at zero for October and November, but rose to five in December. The rise resulted in an average of 1.67 high-scoring objectives during the intervention period.

Summary

In *Elicitation of Prior Knowledge* (*Obj.3*), all teachers' scores rose or remained steady. The scores of four out of six teachers (T1, T2, T3, and T5) rose by more than two points from September to October. In *Application of Methodologies* (*Obj.6*) the scores of four out of six teachers (T1, T2, T4, and T5) rose by two points. This change demonstrated that four of the six teachers used (applied) the new teaching methods. In *Formative Assessment* (*Obj. 7*) the scores of four out of six teachers (T1, T2, T5, and T6) rose by two points. The scores of the other two teachers rose slightly or remained the same. Teachers demonstrated assessing for student understanding more regularly during their science vocabulary lessons. From October to November all six teachers either remained steady or increased their scores in *Understanding of Purpose* (*Obj.2*). In *Use of Evidence* (*Obj. 5*), scores rose or remained steady for five out of six teachers during both November and December observations.

Some trends became apparent after the December observation. The scores of four

teachers (T1, T4, T5, and T6) rose consistently during the intervention period. Teachers T2 and T3 only had two objectives that rose consistently. The scores of four of the six teachers (T1, T4, T5, and T6) remained steady or rose from November to December: T1- nine of eleven objective scores remained steady or rose, T4- ten of eleven objective scores remained steady or rose, T5- eleven of eleven objective scores remained steady or raised, T6- nine of eleven objective scores remained steady or rose. Teachers T2 (five of eleven objective scores remained steady or rose) and T3 (seven of eleven objective scores remained steady or rose) had limited progress. Both had scores that rose from September to October, but then declined during the next two months. The objectives most resistant to change by a majority of the teachers included *Formative Assessment* (*Obj. 7*) and *Making Connections* (*Obj.8*). In each of these two objectives, four of the six teachers had scores that either decreased by one point or increased by only one point. The increase or decrease is somewhat deceiving for two teachers (T1 and T4) because their starting scores in September were already a five or six. T3 had six objectives scored lower in December than during the September pre-intervention period. Overall, two teachers were more resistant to change than the others. T2 consistently reverted to using dictionary skills for teaching new words. T3 only taught through video viewing. Teachers T1, T4, T5, and T6 expressed interest in learning new methods and consistently applied the methods during lessons. Although T6 taught a *reading* lesson during one of the *science* observations, she still employed the methods of teaching vocabulary she had learned during the intervention period.

Question 6

In What Ways do Quantitative and Qualitative Analyses Agree? (Post-Intervention – MIXED). The quantitative and qualitative analyses did not always agree when looking at what teachers said and what teachers did.

Teacher T1. When analyzing the pre- and post- *SVQ* for T1 there was agreement between what was written on the questionnaire and what was demonstrated in the classroom. All three "level of agreement" statements were answered with "strongly agree" each time. In the open-ended answers T1 showed an increased awareness of more instructional strategies for teaching vocabulary. Additionally, TI expressed the importance of teaching vocabulary and for allocating more time for vocabulary instruction. In the interview, T1 explained she had training in the English Language Proficiency Standards (ELPS). Her experience with vocabulary instruction in school was limited to writing the word and memorizing it. She found this to be ineffective and, therefore, did not do this with her students. T1 said using visuals would be a more effective method for all learners, but particularly with primary grade students. Her previous 'go to' methods for teaching vocabulary were using the Frayer model and using flashcards. As she reflected on what she had learned in the professional development session she decided any method that got students involved with vocabulary would help student comprehend more. This aligned with what I saw during the observations in T1's classroom.

Teacher T2. T2 answered "strongly agree" on each of the three "level of agreement" statements. Her response about effective strategies included "definition

activities" and "writing in question/answer activities." These responses agreed with what was observed in the classroom. T2 showed limited gain in the use of different methods for teaching vocabulary. One of the challenges to teaching vocabulary T2 mentioned both on the questionnaire and during her professional development sessions was gathering resources with pictures for visual representation of the terms. In her interview, T2 said her experience with learning vocabulary was looking up the word in the dictionary and writing a definition. It was the least effective method of learning, but during her years of education, she had never experienced a more effective way to develop vocabulary. It was interesting to note that although T2 said "looking up a word in the dictionary" was one of the least effective methods, this was the primary way she had her students "learn" a word. During one observation she did supplement this with drawing illustrations.

Teacher T3. T3 had "strongly agree" on the first two "level of agreement" statements, but moved from "strongly agree" to "disagree" on the third (most vocabulary is learned indirectly through everyday experience with oral and written language, but some words that represent complex concepts that are not part of everyday experience must be taught directly). The disagreement on this statement aligns with the limited time spent directly teaching vocabulary by T3. On the open-ended questions T3 stated that "without academic vocabulary it is difficult to master content" and that she was teaching, on average, two hours of vocabulary development each week. Again, these responses did not agree with what was observed in the classroom. In her interview, T3 stated that she only remembered looking up words in a dictionary and then copying

words and definitions. She recalled that this method was ineffective and that picture matching would have been more effective. In my observations, I never heard the students discussing and elaborating on word meanings. In her classroom, T3 relied heavily on dictionary definitions and the definitions provided by the video clips. This observation aligned with T3's answer in the interview about how she typically teaches vocabulary. She said her "go to" method was using computer programs.

Teacher T4. T4 answered "strongly agree" on each of the three "level of agreement" statements. In the post-questionnaire T4 listed many more methods of vocabulary development than she did on the pre-questionnaire. She also wrote a more rigorous definition to explain the term "academic vocabulary." T4's comment for the question 'what part of the instructional day would the teaching of academic vocabulary be most effective' was especially evident during the classroom observations. She stated "we discuss, give examples, and make sure everyone understands what's going on." During each observation, nearly every student was provided the opportunity to respond during discussions on the science terms. The responses on the questionnaire aligned with my observations in the classroom. In her interview, T4 remembered learning vocabulary through memorization but would like to make the experience for her students more meaningful. She continued by saying it takes multiple methods to reach all her students; therefore, she uses visuals, anchor charts (using her students' language) and lots of discussion after hands-on experiences. This aligned with what was observed in her classroom.

Teacher T5. T5 rated two questions as "agree" and one as "strongly agree" on the

pre-questionnaire. In the post-questionnaire, all three "level of agreement" statements were rated as "strongly agree." This corresponds with the increased level of vocabulary instruction that was observed during the four months. Her initial response about effective methods was simply to reteach words. After the intervention, she stated that hands-on activities and visuals were strategies used by effective teachers. This aligned with my observations in the classroom. T5 utilized word walls that included both terms and visuals. She had her students draw many responses in conjunction with discussions. Although I could not verify if T5 had increased the time teaching vocabulary development, the evidence in her classroom would indicate that she had been increasing science vocabulary time from September to December. In her interview, T5 said her only experience with vocabulary was writing the definitions from textbooks and it was the least effective method for her. She would have learned more from hands-on experience to understand content, and then to learn the words associated with the experience. T5's answer to how she typically taught vocabulary in her classroom included methods such as "showing pictures or real life objects, making charts to compare and contrast things and to show describing words." Additionally, after introducing words she would make a game to reinforce the words. She also strived to do hands-on experiences, and then link the vocabulary to the hands-on experiences. This aligned to her answers on the "level of agreement statements", but not what I had initially observed in her classroom. The change in T5's methods of teaching that most aligned with her interview comments came during the month of November.

Teacher T6. T6 answered "strongly agree" on each of the three "level of agreement" statements on the pre-questionnaire, but changed two of her responses to "agree" on the post-questionnaire. This doesn't completely align with her open-ended responses. Specifically, one of the responses T6 indicated about the importance of teaching vocabulary was because it would "expose students to words they do not hear at home or other places." Although she indicated that increased time was spent teaching vocabulary each week it was not evident during the observations that increased time was allotted. T6 stated that a challenge with teaching academic vocabulary was that "if they are not learning it in school they might have trouble with testing." I found it regrettable that testing was a considered a reason to teach science vocabulary to kindergarten students. In her interview, T6 remembered learning vocabulary with flashcards. She recalled that it was "repetitive and not fun." She said that she wanted to try new methods of teaching with her students, but there wasn't much time during the day to prepare. Her 'go to' method was reading non-fiction books that aligned with the content. Oral discussion followed. This aligned with what I saw in my observations when new science content was introduced. T6 used reading as her venue to teach most terms.

The group discussion in December, at the conclusion of all observations, provided additional information about the teachers' perceptions about methods of vocabulary instruction. T2 felt that the open sort would be informative when used as an "engage" activity. Teachers could assess where students were in their knowledge of concepts. T5 felt *Draw It!* could be used as an "engage" or an "evaluate" activity. T4 would use the *Important Word* as an evaluation of her students' knowledge of a term or

concept while T1 liked *What's the Connection* as a way for students to demonstrate understanding of several terms. T1 felt the method of vocabulary instruction *What's the Connection* allowed students to make connections between science content (learned in class) and vocabulary (learned through collaboration with peers). Since I was in the classrooms for only a limited amount of time, I asked the teachers what other methods of vocabulary instructions were used. T2 said she had her students using dictionaries; T4 used pre-reading and previewing nonfiction books; T6 and T5 continued to use anchor charts and word walls. T1 said she liked to "mix it up" with the methods she was using. She enjoyed the variety of the methods she had learned and remarked that changing methods kept her students "on their toes." T3 did not participate in the conversation the entire time we discussed vocabulary. I made the attempt several times to draw a response from her, but she remained silent during the entire discussion. She appeared to be uninspired and unresponsive. Another question I asked teachers was, "Other than learning about a variety of methods to teach vocabulary, what would be useful, or supportive, for vocabulary instruction in your classroom?" Five of the six teachers said modeling methods in context, with their students, would be useful. In addition, they expressed time as a factor for not teaching vocabulary in a variety of ways. Three teachers mentioned when I had provided the visual cards for them it assisted in the preparation of the vocabulary lesson. They would appreciate vocabulary cards for all the critical science terms for their grade level. The final question I asked was, "Do you think knowing a variety of methods to teach vocabulary helps you or your students?" T1 said "Absolutely- it keeps it from being boring." T4, T5 and T6 all said using visuals had

been the greatest benefit- whether it was for open sorts, closed sorts or matching with the verbal/visual cards.

Summary for the Agreement between Quantitative and Qualitative Data

Clearly, teachers varied in their effectiveness. Each teacher was observed once in September prior to the vocabulary professional development intervention. Participating teachers were observed three more times after receiving professional development in a specified method of vocabulary development. The during-intervention observations were in October, November, and December.

Table 4-11

Percent change in rating scores between September and December

Participant	September Average	December Average	% Change
T1	2.45	5.82	138.8%
T2	1.27	1.73	39.4%
T3	1.45	1.36	[6.9%]
T4	3.91	5.91	51.2%
T5	1.27	5.36	322.8%
T6	.73	4.0	452.1%

Significant differences between teachers' effectiveness in teaching vocabulary were evident after analyzing the data from the classroom observations. Table 4-11

displays the percent change in rating scores between September and December. Three of the teachers had substantially larger gains as demonstrated through the rating scale on the SCOW. T1 had a 138.8% increase between September and December, T5 had a 322.8% increase between September and December, and T6 had a 452.1% increase between September and December. T4 had a 51.2% increase between September and December. However, her initial average rating score was over one full point higher than any of the other teachers. T2 had a 39.4% increase between September and December, and T3 had the lowest percent gains: a 6.9 % *decrease* between September and December.

Summary

Overall the professional development model I developed appeared to be beneficial. Participating teachers said it provided time to collaborate and experiment with a variety of methods for vocabulary instruction. Teachers had the time to learn and practice effective pedagogical practices. My data suggested after the intervention, teachers *and* students were more cognizant of science vocabulary, and how understanding the terms and their relationship to other terms improved their understanding of science concepts. Additionally, understanding the science terms potentially improved scientific discourse and writing.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Overview of the Research

Methods

Using a mixed-methods design, I assessed the effectiveness of a professional development process, including support through coaching and informal conversations, in changing primary teachers' practices of teaching academic science vocabulary. I used a convergent parallel mixed-methods design (Creswell, 2012) to gain insight into the ways six teachers learned about vocabulary instruction and implemented it into their classrooms. The overarching research question was: What does research suggest about the benefit of this particular professional development training and coaching on kindergarten and second-grade teachers' abilities to implement vocabulary instruction in their classrooms? Quantitative data was collected by administering the *Science Vocabulary Questionnaire* (*SVQ)* prior to and after the intervention and from the *Science Classroom Observation Worksheet (SCOW)* Likert-type scaled score. Qualitative data was collected with the open-ended questions on the pre- and post-*SVQ*, the rationale for rating section on the *SCOW*, interviews, and a group discussion.

Procedure

The purpose of this study was to assess the effectiveness of a self-designed professional development intervention on methods of instruction for three kindergarten and three second grade teachers in the area of academic science vocabulary. I collected

data from classroom observations, teachers' written responses to questionnaires and verbal comments during interviews and conversations to assess the intervention. I used a convergent parallel design to collect both qualitative and quantitative data simultaneously, merge the qualitative and quantitative data, and use the results to understand the problem (Creswell, 2012). I gave equal value to both quantitative and qualitative methods to form new understandings for the study's research questions.

Major Findings

When I looked at what teachers said and did, I found quantitative and qualitative analyses did not always agree. All six teachers indicated an understanding of how important vocabulary was to success in school, and had an awareness of instructional strategies for teaching vocabulary. However, teachers varied in their effectiveness when implementing new methods of vocabulary instruction. I observed each teacher once in September prior to the intervention. I then observed participating teachers three more times after they received professional development on a specified method of vocabulary development. The during-intervention observations were in October, November, and December. Noteworthy differences between teachers' levels of effectiveness in teaching vocabulary were evident after data analysis of classroom observations. Table 5-1 displays a summary of the major findings for each research question.

Table 5.1

Summary Table of Overall Findings

Question	Findings
1. What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons?	1. The results from the Likert-type scaled responses of the six participants on the *SVQ* revealed they all strongly agreed or agreed that understanding vocabulary was critical for comprehension. 2. All strongly agreed or agreed that understanding vocabulary was critical for comprehension. 3. All agreed or strongly agreed vocabulary is acquired both through direct and indirect experiences. 4. Initial perceptions about effective vocabulary instruction methods limited to a few strategies. 5. Teachers currently do not focus on academic vocabulary instruction on a weekly basis.
2. What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons?	1. As a whole, kindergarten and second-grade teachers' *initial* classroom practices in teaching science vocabulary was limited to *discussing* the words**.** 2. None provided any direct instruction of science vocabulary.
3. How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention?	1. Four of the six teachers (T1, T4, T5, and T6) consistently implemented new methods of vocabulary instruction. 2. The most dramatic change in methods for teaching vocabulary was by T1. 3. In *Application of Methodologies* (*Obj.6*) the scores of four out of six teachers (T1, T2, T4, and T5) rose by two points. This change demonstrated that four of the six teachers demonstrated the use (application) of the new teaching methods.
4. How did participating teachers' incoming perceptions change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons?	1. T1 increased the time spent teaching vocabulary by thirty minutes per week. Using new strategies across content areas and focused instruction of new terms at the start of new units. 2. T2's statements on understanding vocabulary and the importance of instruction did not align with her classroom practice. 3. Overall there was no indication that T3's perceptions or practice changed as a result of the individualized PD. 4. T4's responses about effective methods of teaching vocabulary did not vary much between the pre- and post-*SVQ*; a wide range of strategies appropriate for kindergarten were already in use. T4 described a deeper understanding of the *importance* of vocabulary instruction. 5. Prior to intervention, T5 perceived Tier 1words as the ones she should teach. After intervention, she discussed the importance of direct teaching of terms associated with the *science concept* being studied. 6. T6 expanded her perception about effective teaching methods after intervention. She had previously only listed "hands-on and lots of examples" as effective methods. After intervention she listed "using picture cards, asking questions, reading stories, having discussions, and using anchor charts" as effective methods. T6's initial perception was that vocabulary instruction was best completed during math and science. Her perception changed after the PD intervention. T6 stated that the best time for vocabulary instruction was when students "were motivated."

Table 5.1 Continued

Question	Findings
5. How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons?	1. During September T1 had four low-scoring objectives and one high-scoring objective. During the intervention T1 had no low-scoring objectives and an average of ten high-scoring objectives. T1 demonstrated improvement in each of the objectives during the course of the intervention. T1 had a 58% increase between September and December. 2. During September T2 had six low-scoring objectives and no high-scoring objectives. During the intervention T2 had an average of 2.33 low-scoring objectives and an average of one high-scoring objective. T2's S*COW* scores either remained the same or demonstrated improvement at some time during the course of the intervention. T2 had a 26.5% increase between September and December 3. T3's S*COW* scores were the only scores lower in December than they were in the pre-intervention period. T3 had no high-scoring objectives pre- or post-intervention. Furthermore, her average of low-scoring objectives from the intervention period was higher (5.33) than in the initial September observation (5). T3 had the lowest percent change: a 6.6% *decrease* between September and December. 4. During the intervention T4 had no rating scores below a 4. In September T4 had 3 high-scoring objectives. In December T4 had a score of 6 in ten of the eleven objectives. The average number of high-scoring objectives rose to an average of 8.67 for the during-intervention months. T4 had a 33.8% increase between September and December. However, her initial average rating score was over one full point higher than any of the other teachers. 5. From November to December T5's scores improved by at least four points in two objectives. T5's average across all objectives was the highest in December. She had seven objectives that improved by four or more points from the pre-intervention period. In September T5 had five low-scoring objectives. During the intervention period she had no low-scoring objectives. In September T5 had no high-scoring objectives. During the intervention T5 had an average of 6.33 high-scoring objectives. T5 had a 76% increase between September and December. 6. From the pre-intervention period to December T6's scores improved by four or more points in seven objectives. In September T6 had no high-scoring objectives and nine low-scoring objectives. During the intervention her low-scoring objectives reduced each month. The average across the three intervention months was 3.67. T6's high. T6 had an 81.8% increase between September and December.
Question	**Findings**
6. In what ways do quantitative and qualitative analyses agree?	1. The quantitative and qualitative analyses did not always agree when looking at what teachers said and what teachers did. 2. My data suggested teachers *and* students were now more cognizant of science vocabulary, and how understanding the terms and their relationship to other terms improved their understanding of science concept.

Extent to Which Participants Improved Their Pedagogical Skills

The analysis of the *SCOW* scores suggest three kindergarten teachers and one

second-grade teacher increased their knowledge and practice of integrating a variety of methods for teaching vocabulary into science lessons. Table 5-2 shows a summary of participants' rating scores from the *SCOW* during the intervention months in terms of increases (+), decreases (-), or no change (=). The number of scores (97) indicating an increase on the *SCOW* shows the model of four-and-a-half hours of group and individualized professional development does, in fact, increase elementary teachers' effectiveness in teaching academic science vocabulary. However, the data in Table 5-2 does not paint a complete picture. Some of the increased scores demonstrated a rise from a score of 0 to a score of 1. These scores are still in the low-scoring range. Furthermore, some of the decreased scores demonstrated a drop from a score of 6 to a score of 5. These scores are still in the high-scoring range. Two second-grade teachers demonstrated limited to no increase in their knowledge and practice of integrating a variety of methods for teaching vocabulary into science lessons.

Some trends became apparent after the December observation. The scores of four teachers (T1, T4, T5, and T6) rose consistently during the intervention period. Teachers T2 and T3 showed a consistent rise in only two objectives. The scores of four of the six teachers (T1, T4, T5, and T6) remained steady or rose from November to December: T1 - nine of eleven objective scores remained steady or rose, T4 - ten of eleven objective scores remained steady or rose, T5 - eleven of eleven objective scores remained steady or rose, T6 - nine of eleven objective scores remained steady or rose. Teachers T2 - five of eleven objective scores remained steady or rose and T3 - seven of eleven objective scores remained steady or rose. T2 and T3 had limited progress. Both had scores that

rose from September to October, but then declined during the next two months. Three of the teachers showed substantially larger gains as demonstrated through the rating scale on the *SCOW*. Between September and December, T1 had a 58% increase, T2 had a 26.5% increase, T5 had a 76% increase, and T6 had an 81.8% increase. Between September and December T4 had a 33.8% increase; however, T4's initial average rating score was over one full point higher than any of the other teachers. Between September and December T3 had the lowest percent change: a 6.6% *decrease*. Throughout the record of study, all teachers' scores rose or remained steady for *Elicitation of Prior Knowledge* (*Obj.3*).

The two objectives most resistant to change by a majority of the teachers included *Formative Assessment* (*Obj. 7*) and *Making Connections* (*Obj.8*). In each of these two objectives four of the six teachers had scores that either decreased by one point or increased by only one point. The increase or decrease is somewhat deceiving for two teachers (T1 and T4) because their starting scores in September were already high with scores of five or six. Scores for T3 on six objectives indicated lower scores in December than during the September pre-intervention period. Overall, teachers T2 and T3 were more resistant to change than the other four participating teachers.

Regarding other teachers' vocabulary instruction, I observed T2 consistently reverting to the use of dictionary skills for teaching new words; T3 consistently teaching through video viewing; and teachers T1, T4, T5, and T6 expressing interest in learning new methods of vocabulary instruction and consistently applying the new methods during science lessons. Finally, although T6 taught a *reading* lesson during one of the

science observations, she still employed the methods of teaching vocabulary she had learned during the intervention period.

Table 5-2

Rating Scores: Increased (+),No Change (=), Decreased (-)

Ob.	**Rating Scores: Increased (+), No Change (=), Decreased (-)**																		**Totals**		
	T1			**T2**			**T3**			**T4**			**T5**			**T6**					
	O	**N**	**D**	**O**	**N**	**D**	**O**	**N**	**D**	**O**	**N**	**D**	**O**	**N**	**D**	**O**	**N**	**D**	**+**	**=**	**-**
1	+	=	=	-	+	-	+	-	=	+	=	+	=	-	+	+	=	+	**8+**	**6=**	**4-**
2	+	+	-	=	=	=	=	=	-	=	=	+	=	+	+	=	+	-	**6+**	**9=**	**3-**
3	+	+	=	+	-	+	+	-	+	+	=	+	+	+	+	=	-	+	**12+**	**3=**	**3-**
4	+	+	=	+	-	=	=	-	=	+	+	-	+	-	+	+	-	+	**9+**	**4=**	**5-**
5	+	+	+	=	+	=	-	+	-	=	+	=	+	-	=	-	+	+	**9+**	**5=**	**4-**
6	+	+	=	+	-	-	-	-	=	+	+	+	+	-	+	-	+	=	**9+**	**3=**	**6-**
7	+	=	-	+	-	-	+	=	-	=	=	+	+	-	+	+	=	+	**8+**	**5=**	**5-**
8	=	-	+	+	-	-	-	=	-	+	=	+	+	=	+	=	-	-	**6+**	**5=**	**7-**
9	+	-	+	+	-	-	+	=	+	=	+	+	+	+	+	=	+	+	**12+**	**3=**	**3-**
10	+	-	+	+	-	=	-	=	=	+	=	=	+	-	=	=	+	+	**7+**	**7=**	**4-**
11	+	-	+	+	-	-	+	+	=	=	+	=	+	=	+	+	+	+	**11+**	**4=**	**3-**
+	10	5	5	8	2	1	5	2	2	6	5	7	9	3	9	4	6	8	**97+**		
=	1	2	4	2	1	4	2	5	5	5	6	3	2	2	2	5	2	1		**54=**	
-	0	4	2	1	8	6	4	4	4	0	0	1	0	6	0	2	3	2			**47-**

Note. O = October; N = November; D = December; Ob. = objective

Conclusions

The purpose of the record of study was to evaluate the effectiveness of a professional development model designed to increase elementary teachers' effectiveness in teaching academic science vocabulary. The model included two whole-group professional development sessions (for a total of three hours) with the participating teachers, three half-hour individualized learning sessions with each participating teacher, coaching in the context of the classroom setting, formal interviews, and informal conversations occurring after classroom observations. Consistent with prior research, findings from this record of study corroborated the recommendation that students should have multiple exposures to words through a variety of modalities, such as games, repeated readings and discussions (Beck, McKeown, & Kucan, 2002; National Reading Panel, 2000; Stahl & Fairbanks, 1986).

The professional development sessions were perceived to be beneficial by four of the six participants (Group discussion, 2013). However, the professional development minimally altered two primary grade teachers' ability to incorporate vocabulary instruction during science lessons. The group discussion brought to light some probable reasons for the minimal changes in T2 and T3's vocabulary instruction. T2 reported she had recently experienced a life-event and her primary focus was no longer classroom teaching practices. T3 said she was no longer satisfied with the profession of teaching saying, "Pay is too low and expectations are too great." In both cases these teachers indicated they had lost interest in growing their pedagogy or content knowledge.

The data collected during the observations provided insight into the value of the professional development. The qualitative data from the *SCOW* captured the teacher's classroom practices, descriptions of the teacher's engagement with students, and the teacher's use of science terms within the lesson. Using the *SCOW* rubric, the narrative was translated to a scaled score. The data revealed that four teachers (T1, T4, T5, and T6) consistently applied what they learned during the professional development to their classroom practice. One teacher, T2, occasionally applied what she learned during the professional development to her classroom practice. This supports the notion that with targeted professional development, participants gained an understanding and methods for teaching vocabulary. During classroom observations in which vocabulary methods were implemented, students demonstrated a greater understanding and use of academic science vocabulary. Students used the new terms during class discussions and within small group interactions. The interview data revealed teachers felt more capable of using new methods for teaching when they had been provided individualized instruction and the time to practice the method with me in the classroom. Three participants (T1, T5, and T6) felt it would have been valuable for me to model the new method in their classroom so they could observe the flow of the science lesson with vocabulary incorporated (as opposed to teaching vocabulary in isolation). Three participants (T1, T2, and T5) expressed the need for resources, such as ready-made verbal-visual cards, in order to implement the vocabulary lessons more easily.

Recommendations for Improving the Intervention

I would recommend the following modifications to the professional development schedule I used in this record of study: 1. Encourage all campus teachers to participate; 2. Encourage collaboration with colleagues; 3. Create a media presentation for each of the methods of vocabulary instruction; 4. Develop an on-line bank of templates and vocabulary resources for each method taught; 5. Invite the science content coordinator to participate in the professional development sessions in order develop a sustainability plan; and 6. Create media presentations of science *content* lessons where methods for teaching vocabulary are used in context. Based on a review of the literature and the findings of this record of study, I identified several implications for instructional leaders who wish to implement vocabulary instruction during content lessons: 1. Provide teachers with time to plan, practice, and collaborate; 2. Provide professional development sustained over time; 3. Encourage the read-aloud of non-fiction science texts in the primary grades; and 4. Encourage a variety of instructional methods so that all students will have the opportunity to learn vocabulary.

The teachers in this study demonstrated obvious gaps in their content knowledge. The gaps may have contributed to their hesitation to teach vocabulary found in the science content. Providing teachers with time to plan, practice, and collaborate, along with professional development sustained over time, and using non-fiction science texts may help to increase teachers' confidence when teaching science content along with vocabulary. Teachers should be encouraged to continue experimenting with the various methods of vocabulary instruction and extend it further by collaborating with colleagues.

The results of the present record of study support the majority of the previously-cited research related to vocabulary development. However, since conducting this record of study I have encountered additional research on effective vocabulary instruction methods. For example, Husty and Jackson (2008) demonstrated increased vocabulary understanding by using interactive science word walls that incorporate realia. I hope that teachers will continue to seek out additional research-based strategies focused on vocabulary instruction, and incorporate these methods into their classrooms along with the methods learned during the record of study.

Recommendations for Future Research

Based on findings from this evaluation, I see several implications for future research. I would recommend more research to be conducted in the primary grades in the field of vocabulary acquisition as a way to understand science concepts. Currently, the majority of the research has been conducted to demonstrate how an increase of vocabulary knowledge improves *reading comprehension*. I observed that when students understood the scientific language they were more engaged in the science content and wrote with more detail about observed science phenomena. In addition, disruptive behavior decreased when students were engaged in the lessons. The use of interactive word walls using real items (realia), and developed collaboratively by the teacher and students, is one method worthy of additional research. I would recommend more research to be conducted incorporating larger sample sizes in order to increase the generalizability of findings. Additionally, a treatment group and a control group should be incorporated in order to better demonstrate the effectiveness of a professional

development model designed to increase elementary teachers' effectiveness in teaching academic science vocabulary.

Summary

The gains by teachers who used a variety of methods of vocabulary instruction indicated when teachers are provided tools for teaching vocabulary and support through coaching they are more likely to continue improving their teaching practices. Furthermore, as teachers engaged students with vocabulary understanding and word play, students' knowledge of terms and connections to content increased (Teachers' comments, Group discussion, 2013). Teachers benefited from the modeling of the various methods of vocabulary instruction in the classroom. There were no differences between the needs of the veteran teacher and the novice teacher in terms of support for a new teaching practice. Both the veteran and novice teacher benefitted from coaching, model teaching, and support with resources. The most common reason given by teachers for why vocabulary was not previously taught with any fidelity was "lack of time." The time for collecting or making resources to support instruction was rarely available. In the primary grades the amount of time devoted to teaching reading and writing took precedence over time for teaching science. Once teachers realized how literacy skills, such as vocabulary acquisition, could seamlessly be integrated into science lessons, the amount of time spent on teaching vocabulary increased.

As referenced in the literature review and throughout the record of study, history indicates trends in the area of vocabulary instruction and pedagogy. This research continues to stress the importance of vocabulary instruction both in and out of the

classroom. This record of study aligns with the findings of Carlo, August, McLaughlin, Snow, Dressler, Lippman, Lively and White (2004); vocabulary instruction was effective when taught in context. Furthermore, vocabulary was understood and applied in new situations when students were exposed to the new science terms in a variety of ways and had the opportunity for repeated practice. Despite any limitations, this record of study has offered additional methods for increasing teachers' ability to incorporate vocabulary into science lessons, extending the existing literature base.

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APPENDIX A

Participant Consent Form

Project Title: *Developing Teacher's Pedagogical Content Knowledge of Academic Science Vocabulary Instruction*

You are invited to take part in a research study being conducted by Annette M. Venegas, a researcher from Texas A&M University. The information in this form is provided to help you decide whether or not to take part. If you decide to take part in the study, you will be asked to sign this consent form. If you decide you do not want to participate, there will be no penalty to you, and you will not lose any benefits you normally would have.

Why Is This Study Being Done?

The purpose of this study is to determine whether professional development and support through coaching are effective solutions for increasing teachers' pedagogical content knowledge of how to instruct students in the acquisition of academic science vocabulary.

Why Am I Being Asked To Be In This Study?

You are being asked to be in this study because you are currently a kindergarten, first, or second, grade classroom teacher in La Vernia ISD.

How Many People Will Be Asked To Be In This Study?

Approximately 30 teachers in La Vernia ISD, kindergarten through grade two, are being invited to participate in this study.

What Are the Alternatives to being in this study?

Not participating is the alternative to being in the study.

What Will I Be Asked To Do In This Study?

You will be asked to participate in two professional development sessions, complete a pre- and post- study survey regarding methods of vocabulary development for students and participate in informal small group coaching/discussion sessions. Your participation in this study will last up to four months.

Will Photos, Video or Audio Recordings Be Made Of Me during the Study?

The researchers will make an audio recording of the teacher during the study so that data can be gathered about participants' pedagogical content knowledge of how to instruct students in the acquisition of academic science vocabulary only if you give your permission to do so. Indicate your decision below by initialing in the space provided.

_____ *I give my permission for audio recordings to be made of me during my participation in this research study.*

_____ *I do not give my permission for audio recordings to be made of me during my participation in this research study.*

Are There Any Risks To Me?

The things that you will be doing are no more risks than you would come across in everyday life.

Will There Be Any Costs To Me?

Aside from your time, there are no costs for taking part in the study.

Will Information From This Study Be Kept Private?

The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Research records will be stored securely and only Annette Venegas will have access to the records. Information about you will be stored in a locked file cabinet and in computer files protected with a password. This consent form will be filed securely in an official area. People who have access to your information include the Principal Investigator and research study personnel. Representatives of regulatory agencies such as the Office of Human Research Protections (OHRP) and entities such as the Texas A&M University Human Subjects Protection Program may access your records to make sure the study is being run correctly and that information is collected properly.

We may be legally obligated to disclose information under the Texas Public Information Act. *Information about you and related to this study will be kept confidential to the extent permitted or required by law. The Texas Public Information Act provides a mechanism for the public to request public information in Texas A&M University's possession, which may include information about you and/or information related to this study. If Texas A&M University receives a request for public information relating to this study, the university will seek to withhold information about you and/or this study to the extent such information may be considered confidential by law and to the extent legally permitted and authorized by the Texas Attorney General's Office to do so.*

Who may I Contact for More Information?

You may contact the Principal Investigator, Dr. Carol Stuessy, to tell her about a concern or complaint about this research at (979) 845-8384 or cstuessy@tamu.edu. You may also contact the Protocol Director, Annette Venegas at (830)708-8131 or amv0528@gmail.com.

For questions about your rights as a research participant; or if you have questions, complaints, or concerns about the research, you may call the Texas A&M University Human Subjects Protection Program office at (979) 458-4067 or irb@tamu.edu.

What if I Change My Mind About Participating?

This research is voluntary and you have the choice whether or not to be in this research study. You may decide to not begin or to stop participating at any time. If you choose not to be in this study or stop being in the study, there will be no effect on your employment or teacher evaluation. Any new information discovered about the research will be provided to you. This information could affect your willingness to continue your participation.

STATEMENT OF CONSENT

I agree to be in this study and know that I am not giving up any legal rights by signing this form. The procedures, risks, and benefits have been explained to me, and my questions have been answered. I know that new information about this research study will be provided to me as it becomes available and that the researcher will tell me if I must be removed from the study. I can ask more questions if I want. A copy of this entire consent form will be given to me.

_____ _____

Participant's Signature Date

_____

Printed Name Date

INVESTIGATOR'S AFFIDAVIT:

Either I have or my agent has carefully explained to the participant the nature of the above project. I hereby certify that to the best of my knowledge the person who signed this consent form was informed of the nature, demands, benefits, and risks involved in his/her participation.

_____

Signature of Presenter Date

_____

Printed Name Date

APPENDIX B

Science Vocabulary Questionnaire (SVQ)

Science Vocabulary Questionnaire				
Please state your level of Agreement with the following three statements:				
Vocabulary is critically important to readers who use the words they speak and hear to make sense of the words they see in print. Decoding without understanding what words mean is not reading meaningfully.	Strongly Agree	Agree	Disagree	Strongly Disagree
Additional comments:				
Vocabulary is critical to reading comprehension throughout the grades. A reader cannot comprehend what is read if he or she does not know the meanings of most of the words. As children advance in reading, they encounter words that are not part of their oral vocabularies, which they need to learn in order to understand what they are reading.	Strongly Agree	Agree	Disagree	Strongly Disagree
Additional comments:				

Most vocabulary is learned indirectly through everyday experience with oral and written language, but some words that represent complex concepts that are not part of everyday experience must be taught directly.	Strongly Agree	Agree	Disagree	Strongly Disagree
Additional comments:				
Please answer the following open-ended questions:				
1. What instructional strategies do effective teachers use to teach vocabulary development?				
2. Which instructional strategies are most often used by effective teachers?				
3. What does the term "academic vocabulary" mean to you?				
4. In what ways is teaching academic vocabulary important?				
5. Please estimate how much time you spend each week, on average, teaching vocabulary development.				
6. Are there any challenges when faced with teaching academic vocabulary? Please include any examples.				
7. During what part of the instructional day would the teaching of academic vocabulary be most effective?				

APPENDIX C

Timeline of Intervention and Data Collection

Date	Research Activity	Description, data collection, and/or research question to be answered
8/20/12	Initial whole-group meeting with the 33 primary grade classroom teachers The two-hour session offered an overview of vocabulary instruction as well as an introduction of my Record of Study.	Present the 2 hour professional development session on vocabulary instruction. A PowerPoint was used to guide the session (APPENDIX D). All primary grade teachers were instructed to attend by the campus principal. Explain record of study to the primary grade classroom teachers. Distribute the Consent Forms, allow time for the primary grade teachers to complete the forms, and then collect the forms.
8/20/12	All 33 primary grade teachers are asked to complete the *SVQ*.	The *SVQ* is completed by all 33 primary grade classroom teachers. They are asked to put their first and last initial and the grade taught (K, 1, 2) in the upper right corner of the questionnaire. Collect data: 1.What were participant primary teachers' incoming perceptions related to the inclusion of vocabulary instruction in science lessons? (Before Intervention - QUAN)
8/21/12	Sort the Consent Forms according to teachers who did or did not want to participate in the study. Collate the consent forms of teachers willing to participate in the study with their coded *SVQ*. Meet with the campus principal to receive input on the 8 kindergarten teachers who were willing to participate in the study. The principal chose the three teachers she felt were best suited to participating. Reasons for excluding particular teachers included recent deaths in the family, recent births in the family, and teachers who were new to the school during 2012-2013.	
9/20/12	Initial Classroom Observations (pre-intervention) Each teacher who consented to participating in the study signed up for an initial classroom observation. The observation was for a 30 minute time period during the teacher's normal daily science lesson. Three teachers were observed on this date.	The *SCOW* (APPENDIX E) is completed during each initial (pre-intervention) observation in order to collect initial data to answer the question: What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons? (Before Intervention – QUAN/QUAL)

9/21/12	Initial Classroom Observations (pre-intervention) Each teacher who consented to participating in the study signed up for an initial classroom observation. The observation was for a 30 minute time period during the teacher's normal daily science lesson. Three teachers were observed on this date.	The *SCOW* is completed during each initial (pre-intervention) observation in order to collect initial data to answer the question: What were participant primary teachers' incoming classroom practices related to the inclusion of vocabulary instruction in science lessons? (Before Intervention – QUAN/QUAL)
9/22/12 9/23/12	Review the data from the *SCOW* (from the observations conducted on 9/20 and 9/21) as well as the initial responses on the *SVQ*. Reread the Review of the Literature in order to assess the forms of vocabulary instruction to prepare for the initial professional development intervention.	Questions to Consider while designing the professional development: How will the results from the quantitative and qualitative analyses be used in designing a PD intervention to meet the needs of kindergarten and second-grade teachers in teaching science vocabulary? What particular strategies related to teaching science vocabulary has been identified in the literature that should be included in the PD intervention? What needs related to teaching science vocabulary were identified by an examination of kindergarten and second-grade teachers' initial perceptions and practices related to teaching science vocabulary? How will these results inform the development of the professional development experiences to improve teachers' effectiveness in teaching science?
9/28/12	(Intervention) Professional Development (1 hour) The six teachers who agreed to participate in the study met for a whole group professional development session targeting methods of vocabulary instruction for primary grade students. Teachers are provided the opportunity to practice both the verbal/visual method and the word sort method. These methods were chosen because the teachers were most familiar with these methods. Request participating teachers to choose a date for their first classroom observation (post professional development intervention).	The PowerPoint "Multisensory Vocabulary in Science" (APPENDIX I) is used to guide the session. Handouts are shown in Appendix K
10/5/12	Classroom Observation for three teachers. *SCOW*: the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal. Follow-up discussion is conducted, and individualized professional development is provided for another method of vocabulary instruction.	Collect data for research question: How did participating teachers' practices change as a result of the professional development experience on the inclusion of vocabulary instruction in science lessons? (After the Intervention - QUAL)

10/9/12	Interviews conducted with three teachers. The interview form (APPENDIX J) is used to collect the data.	Collect data for research questions: What needs related to teaching science vocabulary were identified by an examination of kindergarten and second-grade teachers' initial perceptions and practices related to teaching science vocabulary?
10/19/12	Classroom Observation for three teachers. *SCOW*: the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal. Follow-up discussion is conducted, and individualized professional development is provided for another method of vocabulary instruction.	Collect data for research question: How did participant primary teachers implement vocabulary instruction during the period in which I provided the individualized professional development/coaching intervention? (During Intervention –QUAN/ QUAL)
11/2/12	Interviews conducted with three teachers. The interview form is used to collect the data. After the individual, semi-formal interview, each teacher is provided an individualized, 30- minute professional development on a method of vocabulary instruction of their choice.	Collect data for research questions: What needs related to teaching science vocabulary were identified by an examination of kindergarten and second grade teachers' initial perceptions and practices related to teaching science vocabulary?
11/13/12	Classroom Observation for three teachers. *SCOW*: the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal. Follow-up discussion is conducted, and individualized 30-minute professional development is provided for another method of vocabulary instruction.	How will the results from the quantitative and qualitative analyses be used in designing a PD intervention to meet the needs of kindergarten and second grade teachers in teaching science vocabulary?
11/16/12	Classroom Observation for three teachers. *SCOW* and *SCOW Rubric* (APPENDICES E and F): the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal.	Collect data for research questions: To *what extent* is vocabulary being covered in an observed science lesson? Is there *more attention* to vocabulary instruction in the science lesson? What *new strategies* did the teacher employ?
12/7/12	Individualized, 30-minute professional development is provided for another method of vocabulary instruction. Classroom Observation for three teachers. *SCOW*: the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal.	Collect data for research questions: To *what extent* is vocabulary being covered in an observed science lesson? Is there *more attention* to vocabulary instruction in the science lesson? What *new strategies* did the teacher employ?
12/11/12	Individualized, 30-minute professional development is provided for another method of vocabulary instruction. Classroom Observation for three teachers. *SCOW*: the scaled score and rationale for scaled score are completed as well as notes in the reflexive journal.	Collect data for research questions: To *what extent* is vocabulary being covered in an observed science lesson? Is there *more attention* to vocabulary instruction in the science lesson? What *new strategies* did the teacher employ?
12/17/12	Group discussion Using questions number two, three, four, six, and seven on the Interview form (Appendix J) as a guide, participants are provided the opportunity to expand their comments on these questions. In addition, participants provide additional comments	Narrative: Taken together, what do these comparisons suggest about *the Value of this particular professional development training* on kindergarten and second grade teachers' abilities to implement vocabulary instruction in their classrooms?

	about the professional development and on vocabulary instruction in general.	
12/17/12	Post *Science Vocabulary Questionnaire* (APPENDIX B)	Collect data on Quantitative Research Question: What are kindergarten and second-grade teachers' perceptions about teaching science vocabulary *after* they have received professional development training in teaching science vocabulary? Qualitative Research Question: How have kindergarten and second-grade teachers' instructional practices changed after they have received professional development training in science vocabulary instruction?
12/2012 to 1/2014	Data Analysis	

APPENDIX D

PowerPoint for the First Whole Group Professional Development Session

Teaching Science Academic Vocabulary

Why is explicit instruction of key words so important?

Vocabulary knowledge is important because it encompasses all the words we must know to access our background knowledge, express our ideas and communicate effectively, and learn about new concepts. (Joan Sedita, 2005)

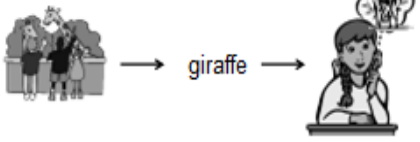
Students' word knowledge is linked strongly to academic success because students who have large vocabularies can understand new ideas and concepts more quickly than students with limited vocabularies. (Chall & Jacobs, 2003).

- As we work with students to build academic vocabulary we create routes to comprehension and enable academic success.
- For ELLs, the expected passing rates for the students who were taught academic vocabulary exceeded the control groups across all measures by an average of 16.5 percent

Vocabulary Instruction:

Caught or Taught?

- A student's background knowledge and prior experiences play a large role in vocabulary development.
- As students build connections between known words and unknown words, they develop a deeper understanding of their reading.



- One way students develop vocabulary is indirectly through reading, listening, and speaking.

- The more experiences children have with reading or being read to before they enter school, the more background knowledge they have to support the understanding of their reading.

What are the critical components of an effective vocabulary program?

1. Create pre-reading and post-reading questions or prompts.

2. Use intentional word selection (words that represent new concepts, are important outside of the specific activity, or cross content areas).

3. Have direct instruction in word meaning and in strategies used to learn new words.

4. Model strategies and processes for learning new words

5. Have multiple exposures to new words and opportunities to use new words, such as non-fiction science text reading, intentional word-focused activities, and ongoing review.

6. Create a system to help students track new vocabulary, such as creating picture dictionary, attaching word cards on a binder-ring, using a personal word wall.

- Marzano lists eight research-based guidelines for teachers implementing direct vocabulary instruction in his books *Building Background Knowledge* and *Building Academic Vocabulary: Teachers Manual*.

1. Effective vocabulary instruction does not rely on definitions alone. Words should be written in a conversational manner rather than in the more formal dictionary format.

2. Students must represent their knowledge of words in linguistic and/or nonlinguistic ways. Students can draw a picture, create a symbol, or dramatize the word.


rocks

3. Effective vocabulary instruction involves the gradual shaping of word meanings through multiple exposures. These include comparing and contrasting, classifying, and creating metaphors and analogies.

4. Different types of words require different types of instruction.

5. Students should discuss the terms they are learning through cooperative learning activities.

6. Students should play with words using challenging and engaging vocabulary games.

7. Effective vocabulary instruction involves the gradual shaping of word meanings through multiple exposures. These include comparing and contrasting, classifying, and creating metaphors and analogies.

8. Instruction should focus on terms that have a high probability of enhancing academic success.

Key Academic Vocabulary vs. Vocabulary of Instruction

- Academic vocabulary is the vocabulary critical to understanding the concepts of the content taught in schools.
- It is vocabulary that supports student comprehension of instructional content.

- Level 1 words are concrete and easy to identify with little or no instruction.
- Level 2 words appear in text so infrequently that the possibility of learning them in context is slim.
- Level 3 words are *specific* to a *particular content area*.
- Marzano recommends teaching words in Level 3 (content-related words) rather than those that are seldom encountered during reading.

Some Dos and Don'ts

- Choose fewer words, but go into more depth with each.
- Teach words that are central or essential to the unit or theme of study.
- Teach words that address key concepts or ideas.
- Teach words that will be used repeatedly throughout the semester or year.
- Teach words that have multiple meanings, especially in other content areas.
- Show an excitement about learning new words.
- Model how words can be analyzed to figure out meanings (root words, affixes)
- Teach words just because they are highlighted or pre-selected in the teacher manual. You be the judge of what your students need.
- Teach words just because they appear in a list at the end of a chapter.
- Teach words that will have little utility once the student has passed a test.
- Assign words that you cannot define.
- Assign a large number of words at one time.
- Assign words that students will rarely encounter again.

Integrating Vocabulary into the Science Lesson

- Verbal Visual Cards (K-1)
- Word-Picture-Definition
- Frayer Model
- Word Sorts
- Ask a Question
- What's the Connection
- Concept map
- Advanced Organizer
- Before and After
- Draw it!
- Layered vocabulary(4-5)
- Direct Teach
- Concentration
- The Important Word

Verbal Visual Cards (K-1)

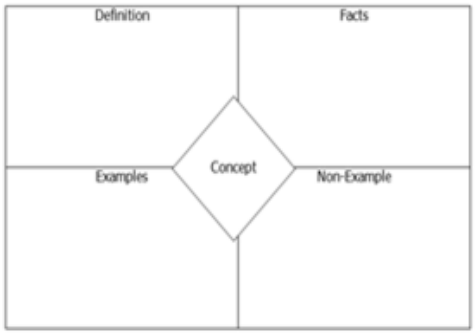
recycle	safety	trash or litter	metal	plastic
				
healthy	environment	problem	paper	wind
				

Word-Picture-Definition

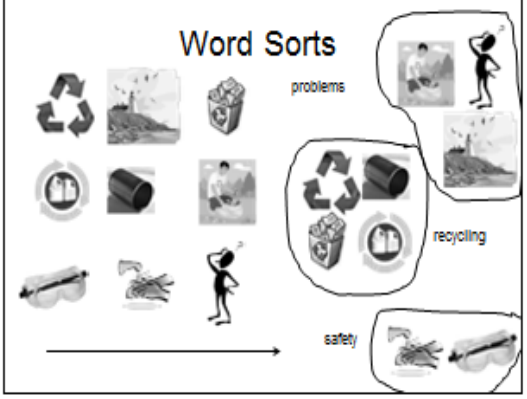
Students can complete this activity directly in their science notebook, or they can be provided with a template to complete. Fro students who may need more language support consider providing word banks for this activity or pair students and allow collaboration.

a combination of two or more substances that have not combined chemically and that can be separated by physical means		mixture

Frayer Model



Word Sorts



Ask a Question

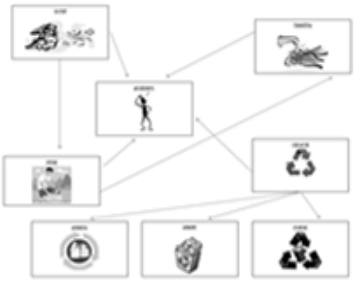
Who's got energy?	it's electric	Get moving!	What state are you in?	it's my property
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

What's the Connection

- Read the ___ words.
- In your notebook, draw and color your representation of the words as they link together.
- Pictures, arrows and linking words and/or descriptions are critical here!
- Take your time finding the connections.
  - What other words could you add?
  - Would the meaning be changed if one or more words were removed? Why or why not?
- Be prepared to share your learning.

What's the Connection

Kindergarten and Grade 1 version



What's the Connection

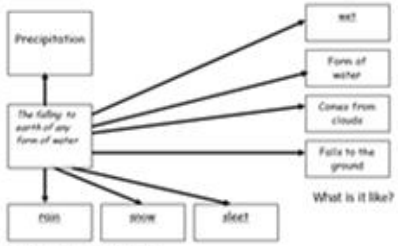
Grade 2 and up

What's the Connection

Grade 2 and up

Concept map

What is it?

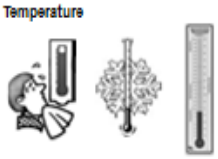


What are some examples?

Draw it!

- This is exactly what it says. Provide students with a word or term and allow time for students to draw their understanding of the word.

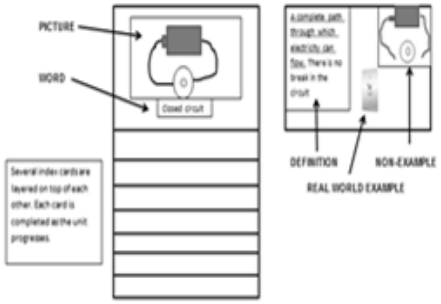
Example: **Temperature**



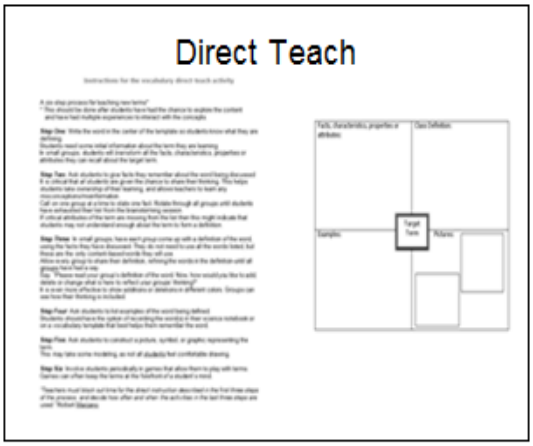
How hot or how cold something is.
The temperature can be measured on a thermometer.

Layered Vocabulary

(more advanced)

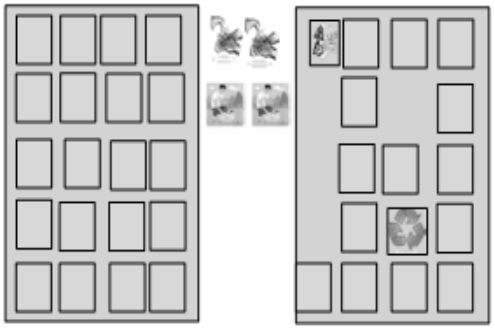


Direct Teach



Concentration

Also known as "Memory" or "Pairs"



The Important Word

The important thing about _____is_____.

It
_____.

It
_____.

It
_____.

BUT,

The important thing about _____is_____.

The Important Word

The important thing about vocabulary is that it is critical to understanding concepts.

It can be represented visually.

It can be represented verbally.

It provides a label for objects and ideas.

BUT,

The important thing about vocabulary is that it is critical to understanding concepts.

APPENDIX E

Science Classroom Observation Worksheet (SCOW)

Science Classroom Observation Worksheet

School and District: La Vernia Primary/LVISD Date: _____

Teacher Code: _____ Grade and Subject: _____

Observer: Annette Venegas

Pre-Observation Questions:

What topics has this class covered recently?

What method of teaching vocabulary do you anticipate doing with the class today?

What do you expect students to learn during this lesson?

Learning Objectives

1. **Alignment of lesson activities:** The vocabulary lesson leads to a deeper understanding of the science content or concept.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

2. **Understanding of Purpose:** The students relate the activity with the learning of the new science term.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

Developing Understanding

3. **Elicitation of Prior Knowledge:** Students have the opportunity to state what they currently understand about the new term.

   Rating: 0 1 2 3 4 5 6

Rationale for Rating

4. **Intellectual Engagement:** Students are engaged with the vocabulary activity and are challenged to think at a higher cognitive level.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

5. **Use of Evidence:** Students are provided the opportunity to state their claim and back the claim with evidence. (Example, I think the term _____means _____ because _____.)

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

6. **Application of Methodologies:** Students apply what they learned in the lesson to a new context.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

7. **Formative Assessment:** The teacher continually assessed the depth of student understanding of the learning objectives, and when appropriate, adjusted instruction accordingly.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

Sense-Making

8. **Making Connections:** Students make connections between new science term and science concepts.

   Rating: 0 1 2 3 4 5 6
   Rationale for Rating

9. **Reflection and Metacognition:** Students are provided multiple opportunities to make sense of the new vocabulary.

Rating: 0 1 2 3 4 5 6
Rationale for Rating

Classroom Culture

10. **Classroom Discourse:** Students are provided the opportunity to discuss science concepts with their peers; making use of speaking, listening, reading and writing the new Terms.

    Rating: 0 1 2 3 4 5 6
    Rationale for Rating

11. **Motivation:** Students are encouraged to work with the new Terms.

    Rating: 0 1 2 3 4 5 6
    Rationale for Rating

APPENDIX F

Science Classroom Observation Worksheet Rubric					
#	**Objectives**	**0**	**2**	**4**	**6**
Learning Objectives—The teacher stated learning objectives were clear, aligned with lesson activities, and communicated to students.					
1	**Alignment of Lesson Activities**	The vocabulary lesson did not lead to an understanding of the new Terms. There was a clear mismatch between the methodologies and the lesson activities.	The vocabulary lesson addressed the new term. It was difficult to understand how the methodologies and the lesson activities lead to an understanding of the Terms.	The vocabulary lesson addressed the new term but there was some question about how the lesson activities would lead to a deeper student understanding of the new term.	The vocabulary lesson leads to a deeper understanding of the new science term. It was very clear how the lesson activities and methodologies would lead to deeper student understanding of the new term.
2	**Under-standing of Purpose**	Throughout the lesson, students did not relate the activity with the learning of the new science term and, instead, most students were mechanically following a prescribed sequence of instructions.	Throughout the lesson, some students relate the activity with the learning of the new science term, but the purpose of activities was not sufficiently clear.	Throughout the lesson, many of the students relate the activity with the learning of the new science term, but the purpose of activities could have been more explicit.	Throughout the lesson, most of the students relate the activity with the learning of the new science term.
Developing Understanding—Students constructed their own understanding based concrete experiences and evidence.					
3	**Elicitation of Prior Under-standing**	Students did not have the opportunity to state what they currently understand about the new term.	A few students had the opportunity to state what they currently understand about the new term.	Some students had the opportunity to state what they currently understand about the new term.	Most students had the opportunity to state what they currently understand about the new term.

4	**Intellectual Engagement**	Students were generally intellectually unengaged with the vocabulary activity related to the lesson activities.	A few of the students were intellectually engaged with the vocabulary activity related to the lesson activities. The lesson challenged a few students to think at high cognitive levels.	Some of the students were intellectually engaged with the vocabulary activity related to the lesson activities. The lesson challenged some students to think at high cognitive levels.	Most of the students were intellectually engaged with the vocabulary activity related to the lesson activities. The learning tasks challenged most students to think at high cognitive levels.
5	**Use of Evidence**	Students were not provided the opportunity to state their claim and back the claim with evidence.	A few students are provided the opportunity to state their claim and back the claim with evidence.	Some students are provided the opportunity to state their claim and back the claim with evidence.	Most students are provided the opportunity to state their claim and back the claim with evidence.
6	**Application of Methodologies**	There was no opportunity for students to apply something they learned in the lesson to a new context.	A few students applied something they learned in the lesson to a new context.	Some students applied something they learned in the lesson to a new context.	Most of the students applied what they learned in the lesson to a new context.
7	**Formative Assessment**	There was little or no evidence that the teacher assessed the depth of student understanding of the learning objectives.	The teacher rarely assessed the depth of student understanding of the learning objectives, and when appropriate, adjusted instruction accordingly.	The teacher occasionally assessed the depth of student understanding of the learning objectives, and when appropriate, adjusted instruction accordingly.	The teacher continually assessed the depth of student understanding of the learning objectives, and when appropriate, adjusted instruction accordingly.
Sense-Making—Students make sense of the intended science concepts.					
8	**Making Connections**	Students had no opportunity to make connections between new science term and science concepts.	Few students make connections between new science term and science concepts.	Some students make connections between new science term and science concepts.	Most students make connections between new science term and science concepts.
9	**Reflection and Metacognition**	Students did not have an opportunity to reflect on their thinking at all.	Students are provided limited opportunities to reflect on their learning and to make sense of the new vocabulary.	Students are provided a few opportunities to reflect on their learning and to make sense of the new vocabulary.	Students are provided multiple opportunities to reflect on their learning and to make sense of the new vocabulary.
Classroom Culture—Classroom was a positive, motivating, safe, and challenging learning environment.					

10	**Classroom Discourse**	Classroom culture did not support and encourage student discourse. Students are not provided the opportunity to discuss science concepts with their peers; making use of speaking, listening, reading and writing the new terms.	Generally students and teachers support and encourage respectful and constructive discourse but few students are provided the opportunity to discuss science concepts with their peers; making use of speaking, listening, reading and writing the new terms.	For the most part, students and teachers support and encourage respectful and constructive discourse, however only some students are provided the opportunity to discuss science concepts with their peers; making use of speaking, listening, reading and writing the new terms.	Students and teachers support and encourage respectful and constructive discourse. Students are provided the opportunity to discuss science concepts with their peers; making use of speaking, listening, reading and writing the new terms.
11	**Motivation**	The lesson did little or nothing to motivate students to work with the new terms.	Students are rarely encouraged or motivated to work with the new terms.	Students are sometimes encouraged and motivated to work with the new terms.	Students are encouraged and motivated to work with the new terms.

APPENDIX G

Reflexive Journal Sample

Observations	Reflections and Questions
T: Describes one example for each picture card on light energy: light, sources of light, bright, dim, increase, and decrease. T: Only allowed time for one student to respond. T: Distributed handout with terms to the students; walked around the room to monitor. S: "Bright is when you go outside and the sun makes your eyes (she squints) like this."	It will be interesting to see if students draw the teacher's examples or if they use their own. This work could be a formative understanding of the content, or merely an example of following procedures. The teacher ignores the comment; the explanation was much different from the teacher's, but reflects the student's understanding.

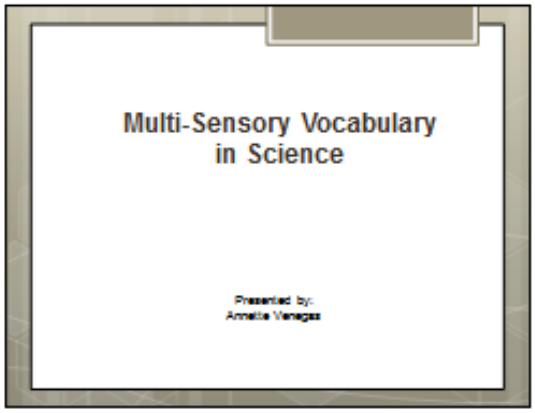
APPENDIX H

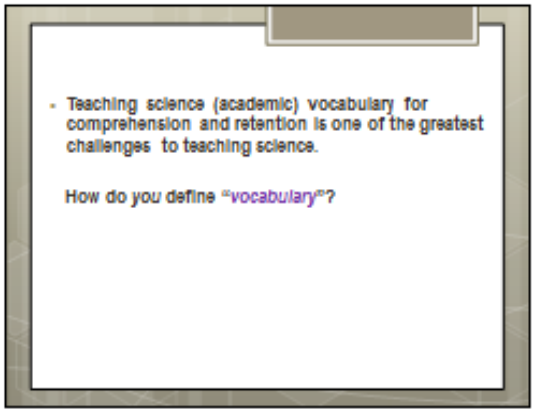
Sequence of Activities for the Second Whole Group Professional Development Session

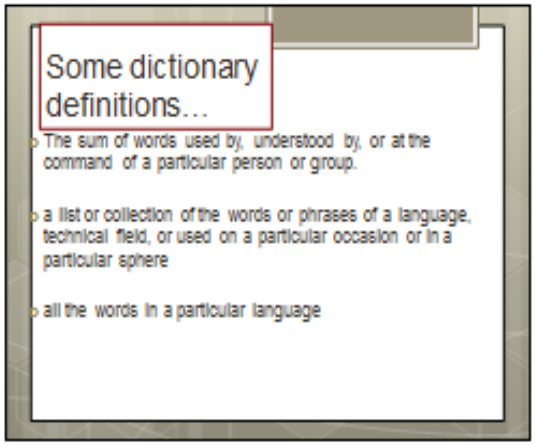
Activity	Method	Purpose	Goal	Materials
Reviewing curriculum documents with a focus on vocabulary	1. Distribute the Year at a Glance (YAG) 2. Distribute the Instructional Focus Document (IFD)	Review the units still to come in the first 9 weeks.	Determine essential vocabulary to be taught during the first nine weeks of instruction	Curriculum documents: YAG IFD
Methods of instruction (Ensure teachers understand words used in their classroom will be words *they* choose, not necessarily the ones we use for practice.)	Use the PPT Multisensory Vocabulary strategies as a guide.	PD provider demonstrates the method Participants practice Participants ask questions about the method Participants demonstrate the use of the method	Demonstrate competency in delivering the method of vocabulary instruction	Word sort cards and Verbal/Visual cards for the Student Expectation (SE) 2.5B, 2.5C; K.5A, K.7C
Activity	**Method**	**Purpose**	**Goal**	**Materials**
What does the research say about choosing words?	Distribute and Discuss "How to Select Vocabulary Words for Explicit Instruction"	Get feedback from teachers about the method they are comfortable with, and will use, to select the vocabulary words.	Select a limited number of words per unit	Article by Anita Archer
Answer any teacher questions about the PD	Discussion	Clarification	Teachers leave the PD with the ability to use the new methods in their classroom	none

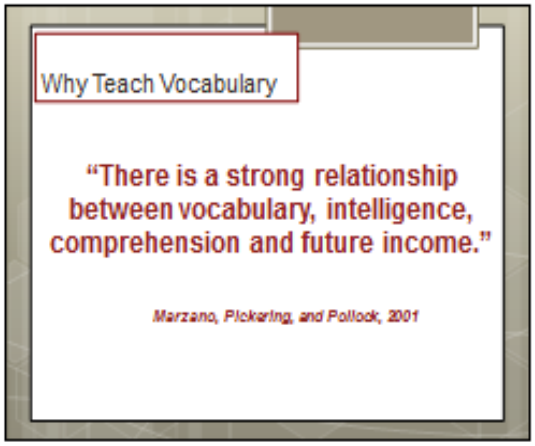
APPENDIX I

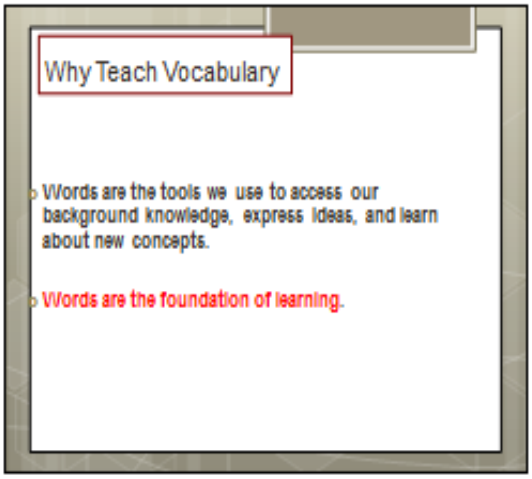
PowerPoint for the Second Whole Group Professional Development Session

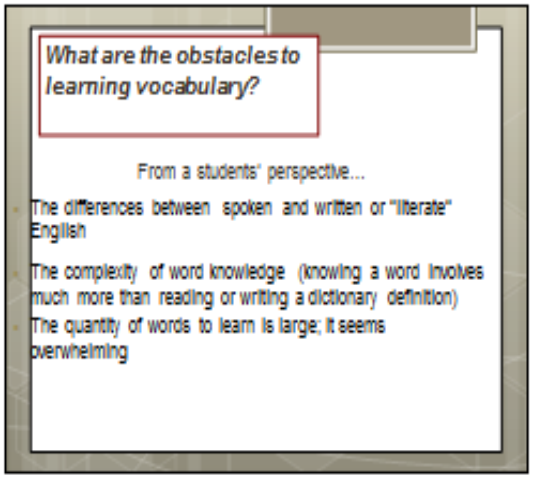


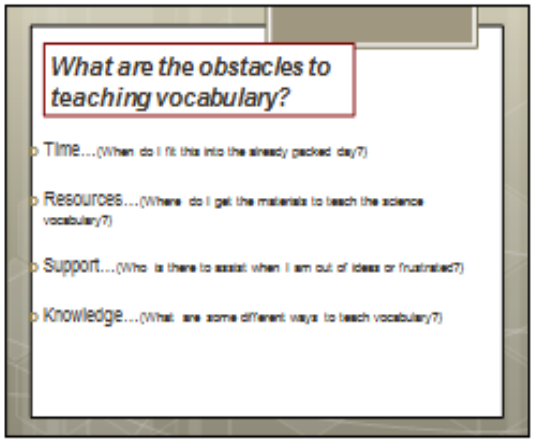


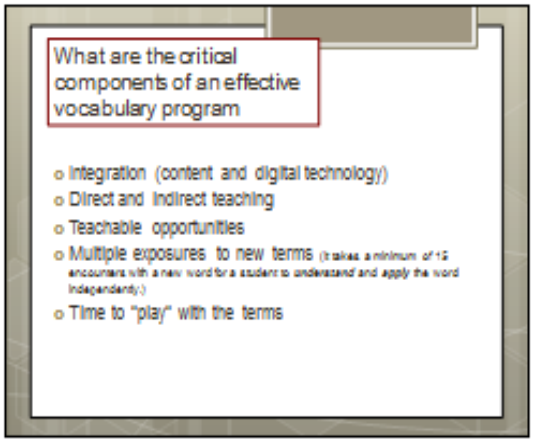


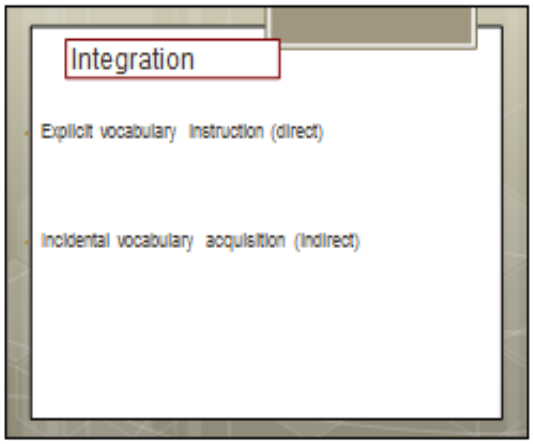


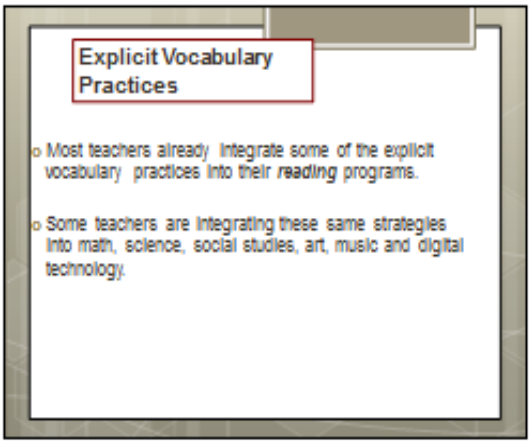


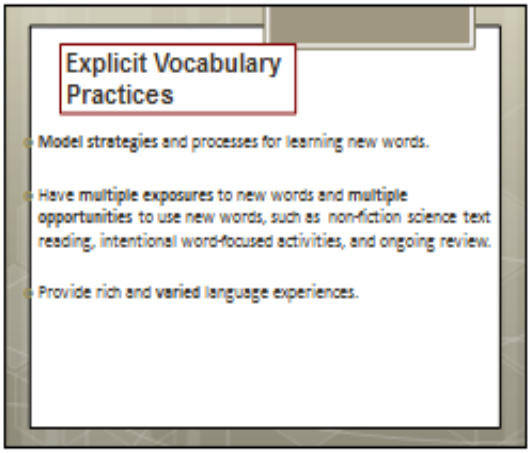


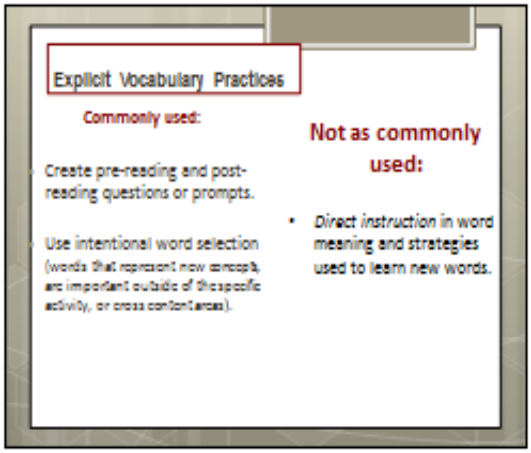

What are the obstacles to teaching vocabulary?
Time...(When do I fit this into the already packed day?)
Resources...(Where do I get the materials to teach the science vocabulary?)
Support...(Who is there to assist when I am out of ideas or frustrated?)
Knowledge...(What are some different ways to teach vocabulary?)

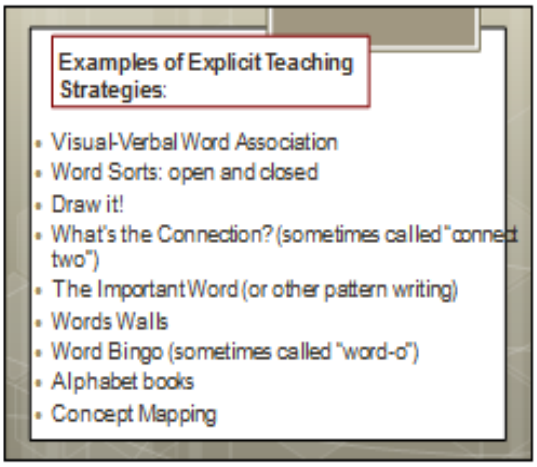

What are the critical components of an effective vocabulary program
Integration (content and digital technology)
Direct and indirect teaching
Teachable opportunities
Multiple exposures to new terms (It takes a minimum of 12 encounters with a new word for a student to understand and apply the word independently.)
Time to "play" with the terms

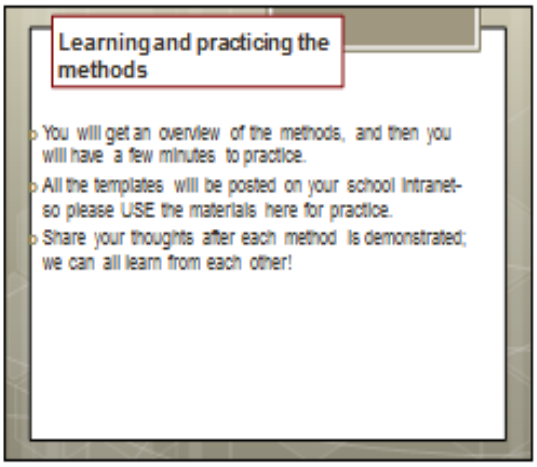

Integration
Explicit vocabulary instruction (direct)
Incidental vocabulary acquisition (indirect)

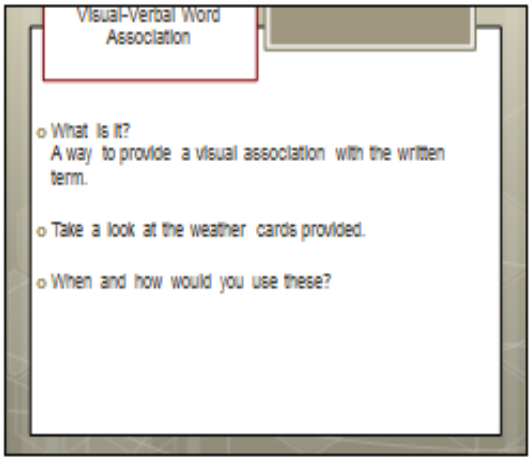

Explicit Vocabulary Practices
Most teachers already integrate some of the explicit vocabulary practices into their reading programs.
Some teachers are integrating these same strategies into math, science, social studies, art, music and digital technology.

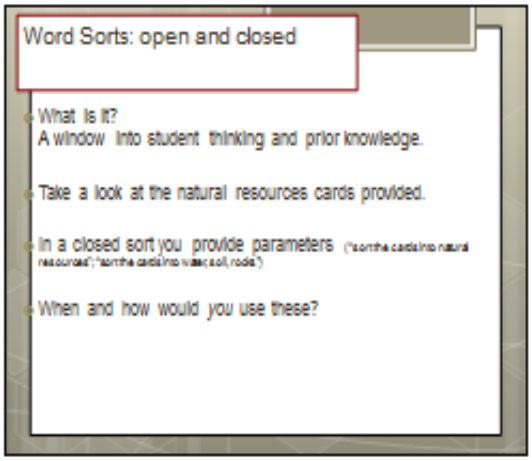

Explicit Vocabulary Practices
Model strategies and processes for learning new words.
Have multiple exposures to new words and multiple opportunities to use new words, such as non-fiction science text reading, intentional word-focused activities, and ongoing review.
Provide rich and varied language experiences.

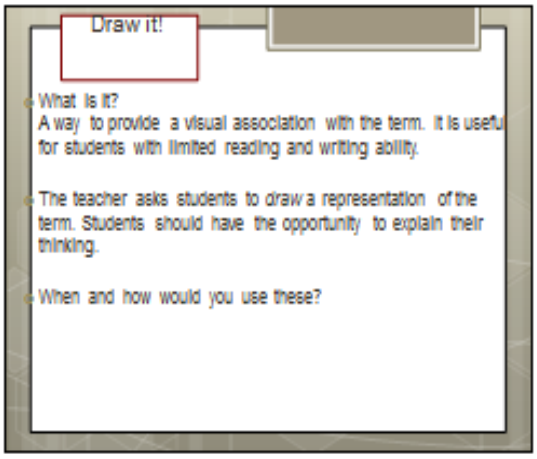

Explicit Vocabulary Practices
Commonly used:
Create pre-reading and post-reading questions or prompts.
Use intentional word selection (words that represent new concepts, are important outside of the specific activity, or cross content areas).
Not as commonly used:
Direct instruction in word meaning and strategies used to learn new words.

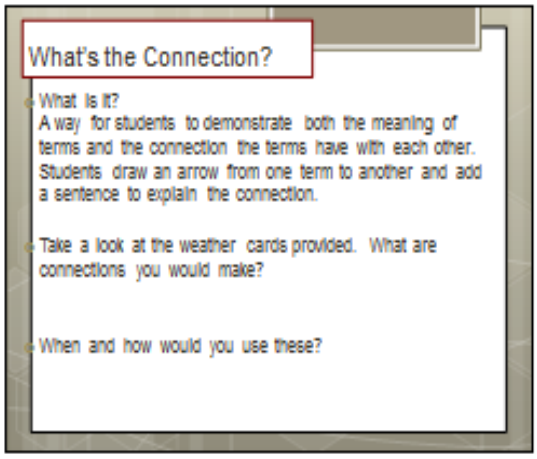

Examples of Explicit Teaching Strategies:
Visual-Verbal Word Association
Word Sorts: open and closed
Draw it!
What's the Connection? (sometimes called "connect two")
The Important Word (or other pattern writing)
Words Walls
Word Bingo (sometimes called "word-o")
Alphabet books
Concept Mapping

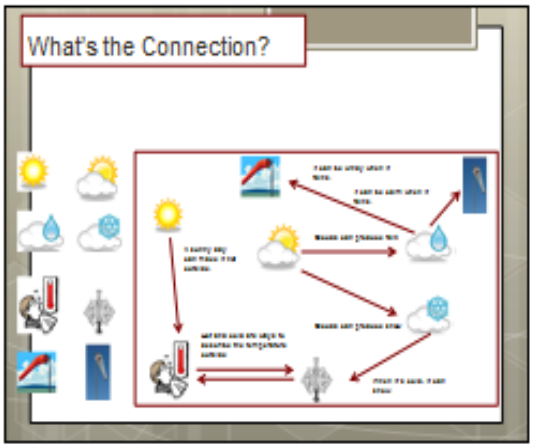

Learning and practicing the methods
You will get an overview of the methods, and then you will have a few minutes to practice.
All the templates will be posted on your school intranet- so please USE the materials here for practice.
Share your thoughts after each method is demonstrated; we can all learn from each other!

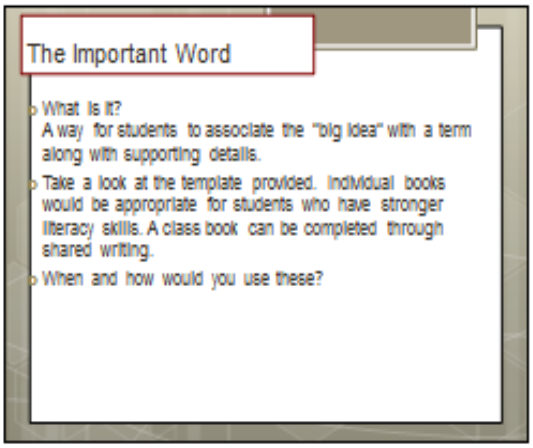

Visual-Verbal Word Association
What is it?
A way to provide a visual association with the written term.
Take a look at the weather cards provided.
When and how would you use these?

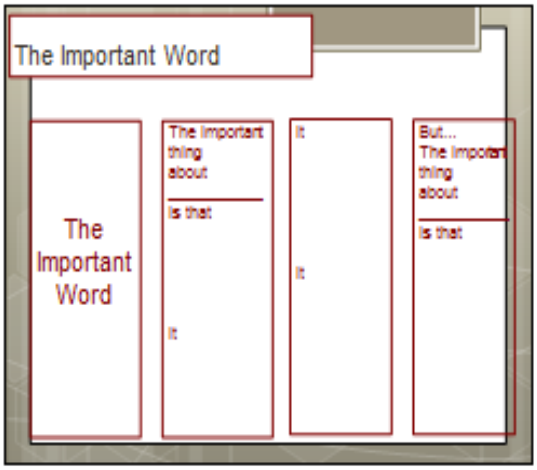

Word Sorts: open and closed
What is it?
A window into student thinking and prior knowledge.
Take a look at the natural resources cards provided.
In a closed sort you provide parameters
When and how would you use these?

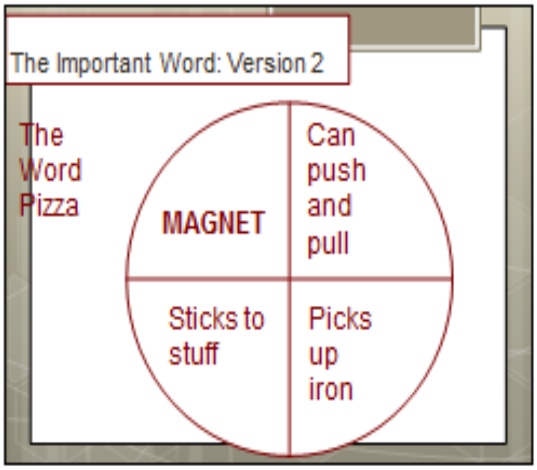

Draw it!
What is it?
A way to provide a visual association with the term. It is useful for students with limited reading and writing ability.
The teacher asks students to draw a representation of the term. Students should have the opportunity to explain their thinking.
When and how would you use these?

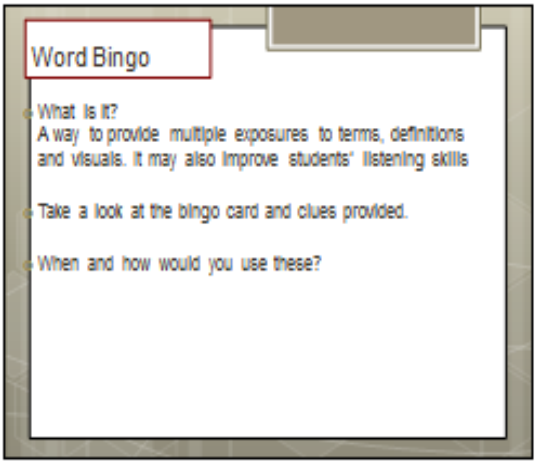

What's the Connection?
What is it?
A way for students to demonstrate both the meaning of terms and the connection the terms have with each other. Students draw an arrow from one term to another and add a sentence to explain the connection.
Take a look at the weather cards provided. What are connections you would make?
When and how would you use these?


What's the Connection?


The Important Word
What is it?
A way for students to associate the "big idea" with a term along with supporting details.
Take a look at the template provided. Individual books would be appropriate for students who have stronger literacy skills. A class book can be completed through shared writing.
When and how would you use these?


The Important Word
The Important Word
The important thing about
is that
It
It
It
But…
The important thing about
is that


The Important Word: Version 2
The Word Pizza
MAGNET
Can push and pull
Sticks to stuff
Picks up iron


Word Bingo
What is it?
A way to provide multiple exposures to terms, definitions and visuals. It may also improve students' listening skills
Take a look at the bingo card and clues provided.
When and how would you use these?


Word Bingo
REDUCE
RECYCLE
REUSE
REPURPOSE

Word Walls

- A word wall is a systematically organized collection of key words from a unit of study.
- Usually a classroom contains a *variety* of word walls based on classroom needs: high frequency words, content words
- Are interactive: The word wall is integrated into *daily* literacy activities, skills, and strategies. It provides *ongoing support* for a range of language learners.
- Ideally, they are student created and contain real items.

Keep Word Walls:

- Accessible
- Highly Visible
- Clutter-Free
- Referred to Often
- Memorable
- Useful
- Practical

Word Walls

- Involve the students in the creation of the word wall.
- If the teacher creates the word wall students are less likely to have buy in.
- Affix real items (where possible or practical) to the word wall.

Word Walls: sample

"Multi-sensory word walls allow students to informally see, hear, touch, manipulate, name, and discuss content vocabulary. Acting as visual scaffolds, they provide semantic links between key science vocabulary and concepts, as well as related pictures and objects."

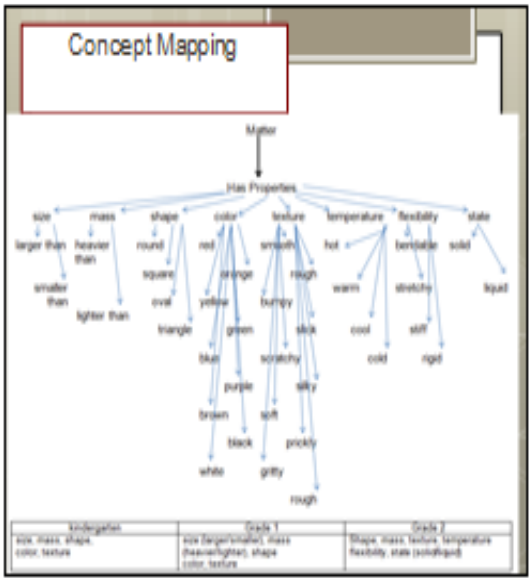
J. Jackson, 2012

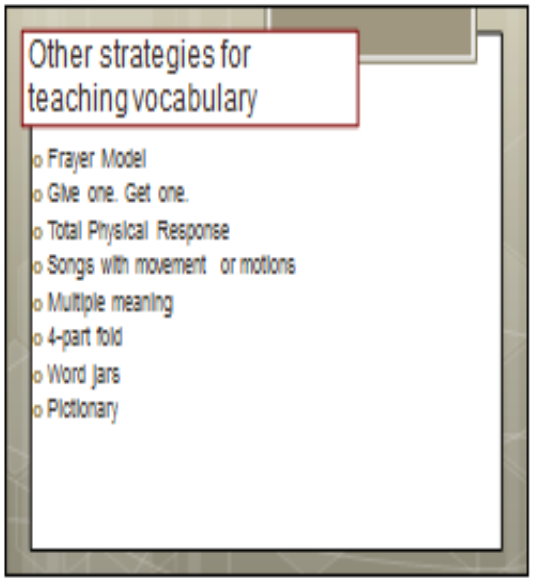
Alphabet Books

- What is it?
  A way to provide multiple exposures to terms, definitions and visuals. These may be completed for an entire unit of study.
- When and how would *you* use these?
- A template for an Alphabet book will be posted.

Concept Mapping

- What is it?
  It is a graphic organizer used to define a concept and show how it is related to other ideas
- When and how would *you* use these?


Concept Mapping
Matter
Has Properties
size
mass
shape
color
texture
temperature
flexibility
state
larger than
heavier than
round
red
smooth
hot
bendable
solid
square
orange
rough
warm
stretchy
liquid
smaller than
oval
yellow
bumpy
lighter than
triangle
green
stick
cool
stiff
blue
scratchy
cold
rigid
purple
silky
brown
soft
black
prickly
white
gritty
rough
Kindergarten
size, mass, shape,
color, texture
Grade 1
size (larger/smaller), mass
(heavier/lighter), shape
color, texture
Grade 2
Shape, mass, texture, temperature
flexibility, state (solid/liquid)


Other strategies for teaching vocabulary
Frayer Model
Give one. Get one.
Total Physical Response
Songs with movement or motions
Multiple meaning
4-part fold
Word jars
Pictionary

APPENDIX J

INTERVIEW FORM

Date of Interview	
Interviewee Code	
Explanation of who I am	Explained to interviewee? Yes ____ I am currently a science content specialist at the Education Service Center, Region 13, in Austin. I work with CSCOPE curriculum program to develop both curriculum and instructional lessons in science. I am currently enrolled at Texas A&M University in their Ed.D in Curriculum and Instruction Program.
Relevant responses from interviewee?	<Fill in here>
Purpose of interview	Explained to interviewee? Yes___ My record of study will help me develop leadership skills associated with solving educational problems using field-based research methods. I am designing a field-based study to examine teachers' pedagogical content knowledge of how to instruct students in the acquisition of academic science vocabulary.
Right to refuse answering any questions	Explained to interviewee? Yes ____ The questions in this interview are designed to assist me in refining my ideas about my proposed study. You need to know that you may refuse to answer any question in the interview for any purpose, without having to reveal to me your reasons for not answering the question. Do you understand that Agreeing to participate in the interview does not mean that you must answer all questions? Indicate the participants' response in this space.
Anonymity explained	Explained to interviewee? Yes ____ Your name will never be used. I have assigned a code to your name and I am the only one who knows this information. Your responses will be used to help me refine the focus and/or purpose of my field-based research study.
Formal Agreement to participate	Do you Agree to participate in an interview about my proposed field-based study? Participants' response _____ Yes _____ No
Explain your basic plan of the study	The purpose of my study is to examine teachers' pedagogical content knowledge of how to instruct students in the acquisition of academic science vocabulary. To determine their level of understanding, I will use quantitative and qualitative measures. Quantitatively, I will use a questionnaire on academic vocabulary as a pre-and post-assessment. Qualitatively, I will use Observations and interviews to provide information about the teachers' understanding of how to instruct students in the acquisition of academic science vocabulary. Based on the teachers' current level of understandings:

	I will create a series of professional developments designed to increase teacher knowledge of methods for teaching academic science vocabulary. I will provide support for learning activities in the classroom through instructional coaching and modeling (as requested).
Are there parts of the plan that you would like me to explain further?	
1. How many years of teaching experience do you have? In which grade levels?	
2. What is your background in science? (college courses, professional development, workshops, summer intensives such as Texas Regional Collaboratives (TRC)	
3. What are your recollections about learning vocabulary?	
4. What were the least and most effective ways you have learned new vocabulary (as a student or as a second language learner)?	
5. In what ways do your students have difficulty (or struggle) with the acquisition of science vocabulary? What do you believe is the sources of these struggles? Please provide as much detail as possible.	
6. How do you typically teach science vocabulary in your classroom?	
7. Explain the importance of learning science vocabulary in the primary grades.	
8. Do you have other comments about the methods of vocabulary instruction?	
Thank you so much for your time. Your answers have given me a lot to think about in the design of my study.	