Introduction of Vocabulary Strategies into Science Curriculum to Increase Student Comprehension

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A Special Project

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Introduction of Vocabulary Strategies into Science

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ABSTRACT

This purpose of this study was to determine if the integration of vocabulary strategies into the science content classroom would increase student comprehension of the language of science, as well as the concepts in science. The supplementation of the vocabulary strategies into the curriculum of a sixth grade science content classroom provided the opportunity for the researcher to analyzed data to determine if student learning and understanding improved. Data from Northwest Evaluation Association tests were gathered in the fall of 2009 and spring of 2010 to assess if students understood the vocabulary being taught. This study concluded that the integration of the specific research-based vocabulary strategies increased students' Northwest Evaluation Association test scores therefore, increased student content comprehension of the language of science.

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CHAPTER 1

Introduction

Background for the Project

Science vocabulary has often been found to be foreign to students and thereby difficult to learn and comprehend. As Wetzel (2009) stated, "Students are faced with the challenge of making sense of these new words and connecting them to concepts in a relatively short period of time" (para. 1). Background knowledge has also been found to be a key ingredient for comprehending new vocabulary. Students must have understood the new words and then connected the words to prior knowledge and experiences. Since long-term knowledge gain in vocabulary was the goal, students must have been exposed to all new science words at least six times in different contexts (Jenkins, Stein, & Wysocki, 1984). The Full Option Science System, the provided curriculum given to teachers, often did not include the integration of vocabulary words into the lessons.

Cognitive research has revealed that mere rote instruction did not provide students with the necessary instruction to store new knowledge into long-term memory. Therefore, the teacher was responsible for finding strategies that aided in the teaching and understanding of the chosen words, and then the teacher must have exposed students to these new words consistently throughout the lesson in order for students to have stored the vocabulary as long-term knowledge. Nelson (1999) stated that students were able to identify what was taught during rote

instruction, yet after probing, findings suggested that the material was not understood. In fact, understanding was limited, or was completely wrong.

Statement of the Problem

Science was a difficult subject for many students for a variety of reasons. Background knowledge was limited, concepts were difficult and abstract, and vocabulary was foreign. If vocabulary was taught in a rote manner, students would only appear to have understood rather than truly comprehended the meaning of the words. Differentiated strategies needed to be introduced into instruction in order to increase student comprehension of difficult and foreign vocabulary words. Vocabulary instruction was not a part of the curriculum at the middle school in which strategies were integrated and data retrieved. The curriculum was largely inquiry-based yet left students with a lack of true understanding of the difficult vocabulary words.

Purpose of the Project

As a result of the study, students would not only better comprehend the science vocabulary, but would also store the information into long-term memory. The students would have used a variety of strategies that allowed for the comprehension of difficult science vocabulary through the use of differentiated, implicit, and explicit teaching strategies integrated by the educator. The vocabulary strategies used were: drawing a diagram or illustration to relate the meaning to previous knowledge, writing the definition in a student's own terms,

writing a sentence using the word, and repetition. Repetition involved the vocabulary words being repeated in context throughout the weekly lesson.

Delimitations

The study consisted of 78 sixth grade middle school science students. The students were using the district assigned curriculum, which consisted of Full Options Science System kits. The textbook highlighted specific vocabulary but the science classes were focused on constructivist and inquiry-based learning that involved lab-based learning. Prior to the research, students had notebooks where vocabulary words and definitions were written down and discussed at the beginning of a lesson.

All students were given a Northwest Evaluation Association science assessment in the fall. For class A, the regular method of vocabulary instruction was kept the same. Class A only wrote down the vocabulary terms and given definitions. For class B, students were taught vocabulary words using the different vocabulary strategies that were integrated throughout the lessons. The continued repetition was to ensure that students were exposed to the vocabulary words in context, at least six times, in order to store the knowledge into long-term memory. Class A and class B were then given a Northwest Evaluation Association science assessment in the spring.

The researcher individually compared the fall and spring tests of class A and the fall and spring tests of class B using a t-test. The researcher then compared

class A's fall test to class B's fall test using a t-test. Finally, the researcher compared class A's spring test to class B's spring test using a t-test. Overall, four comparisons took place in order to find significance.

Assumptions

The assumption was made that student understanding of science vocabulary improved dramatically between class A and class B. The spring tests were assumed to show a significant difference. Students from class B would show significant gains on test scores from the fall to spring Northwest Evaluation Association assessment based on the integration of specific and repetitive vocabulary instruction.

Hypothesis or Research Question

Through the use of integration of specific vocabulary strategies, student test scores, in regards to the Northwest Evaluation Association assessment, will improve, and therefore show statistical significance in the comparison of class A and class B.

Null Hypothesis

Student post test scores will show no statistical significance as measured by the non-independent t test, between the fall and spring Northwest Evaluation Association assessment.

Significance of the Project

The study was performed to show the significance of using

vocabulary strategies in order to increase student understanding of science concepts and terms. The author believed that students would retain meaning, and have a better comprehension, of the terminology learned though the use of more in depth and repeated instruction of specific vocabulary strategies. Students would also be able to relate the vocabulary to previous knowledge in order to make sense of the vocabulary. The prerequisite knowledge would then create a quality of understanding for students rather than a quantity of information gathered and forgotten. If the results of the spring Northwest Evaluation Association test showed significance, then the study will have provided important data stating that specific vocabulary instruction increased student comprehension. If the study showed no significance, then the data will have stated that specific vocabulary instruction did not increase student comprehension.

Procedure

Class A and B took the fall Northwest Educational Association assessment at the beginning of the school year. For class A, the vocabulary was taught as usual. The usual strategy consisted of writing down the words in a science journal. The teacher then briefly discussed the meaning of the words. Students then wrote down the given definition of the words next to the words in the journal.

Class B began vocabulary instruction with the vocabulary being taught with the usual method discussed previously. Along with the usual instruction, four other strategies were introduced. The first three vocabulary strategies used were

the following: (a) drawing an illustration or diagram to relate the meaning of the word to previous knowledge, (b) writing the definition in student's own terms, and (c) writing a sentence using the word. The vocabulary words were then (d) repeated in context at least six times throughout the weekly lesson. Students focused on implementing one strategy per day. Each consecutive day, the instructor introduced a new strategy.

The first day, students in class B drew a four-square chart for each vocabulary word in their journals. In each top left square, students wrote the word and the given definition. The students continued this for each word. The instructor then discussed the definitions of the words with students. The next day, the instructor had students draw, in the top right corner of the squares, a diagram or illustration of how students thought of the words. This helped students relate the work to prerequisite knowledge. The following day, students wrote a personal definition of the words in the bottom left corner of the squares. On the final day, students created sentences using the words, in the bottom right corner of the squares. The instructor continued to use the vocabulary words, in context, repeatedly throughout the weekly lesson.

Class A and B were then given a Northwest Evaluation Association spring test. The test results were analyzed for statistical significance. The fall tests from class A and B were analyzed to show no significance. The spring tests were analyzed to show significance. Class A's fall and spring tests were analyzed and

compared to Class B's fall and spring tests.

Definition of Terms

definition. Definition was the act of making something distinct or clear.

diagram. Diagram was a figure, usually consisting of a line drawing, made to explain the parts.

differentiation. Differentiation was the act of modifying or marking differently from other such things. In education, differentiation was used to teach a concept in a different manner in order to reach all students.

enrichment. Enrichment was the act of supplying the mind with knowledge. In education, enrichment supplies students with additional knowledge.

illustration. Illustration was the act of drawing pictures or other artwork intended for explanation and to make clear or intelligible.

National Science Education Standards. The National Science Education Standards was a report put out by the National Academy of Sciences that established the goals that enable all students to achieve scientific literacy.

No Child Left Behind. No Child Left Behind was a piece of legislation that continued the Elementary and Secondary Education Act of 1965. The No Child Left Behind act was signed into law by President Bush in 2001.

repetition. Repetition was the act of saying something again.

schemata. Schemata were outline or organizational structures that created a conceptual framework. The schema built in the mind was how students stored

information that was founded on existing information.

statistical significance. A statistic was significant if it was unlikely to have occurred by chance.

strategies. Strategies were the plan of action to achieve a particular goal.

synthesis. Synthesis is to arrange, compose construct, create, design, or develop material, and is the fifth level of Bloom's Taxonomy.

terminology. Terminology was the study of words and compound words and how they were used in a specific context.

vocabulary. Vocabulary was knowledge of words and word meanings.

Acronyms

FOSS. Full Option Science System.

OSPI. Office of Superintendent of Public Instruction.

NCLB. No Child Left Behind.

NWEA. Northwest Evaluation Association.

NCAC. National Center on Accessing the General Curriculum

CHAPTER 2

Review of Selected Literature

Introduction

Science was a difficult subject for students and could be frustrating if not taught in a way that made connections. The National Research Council (1996) stated in the National Science Education Standards that everyone needed to be scientifically literate in order to be engaged, intelligent, and understanding of the world. The Office of Superintendent of Public Instruction (OSPI) created standards, developed by Washington educators, scientists, and citizens, that specifically stated what students needed to know by the end of the school year. Although the specific Full Option Science System (FOSS) curriculum was to be used by the teacher, the curriculum lacked adequate teaching of vocabulary terms which were essential to understanding the scientific concepts that the students were to have learned by the end of the school year. Therefore, it was the teacher's responsibility to implement specific vocabulary strategies that would facilitate student learning and instill student comprehension of the science concepts and how the concepts relate to each other. As Marzano, Pickering, and Pollock (2001) stated, teachers had a powerful effect on students and that effective pedagogy involved both instructional strategies used by the teacher and curriculum designed by the teacher.

Wetzel (2009) stated that the strategies used in teaching science need to

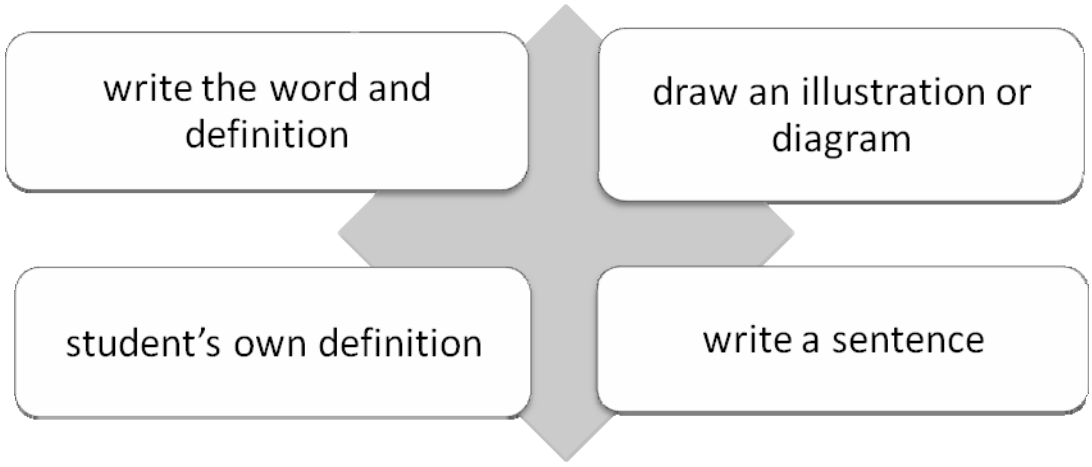
involve an approach that supported student learning and included vocabulary building that was multidimensional. Because much of the science vocabulary was unfamiliar to many students, Wetzel (2009) believed that teaching science vocabulary required more than rote memorization when students were ". . . . faced with making sense of the new science words and connecting them to concepts in a relatively short period of time" (para. 1). Wetzel (2009) affirmed the importance of differentiation and enrichment within the teaching of vocabulary in order for all students to learn and comprehend. The researcher incorporated the ideas of differentiation and enrichment by using the four researched based vocabulary teaching strategies in the study to enhance learning for all students.

Young (2005) found that specific instructional vocabulary strategies were essential in education in order for students to comprehend content area concepts. Science vocabulary instruction was used to increase conceptual development, which was the major goal of science education. Furthermore, Young's research (2005) established that providing students with specific vocabulary strategies could drastically support student understanding which would in turn ". . . . bridge the gap between the language of the science content and the language and background knowledge that students bring to the class" (p. 12).

Students were exposed to science vocabulary through a number of vocabulary strategies. As Young (2005) found, the vocabulary strategies engaged students when taught in several different researched-based approaches. The specific

researched-based strategies used in the study provided a multi-faceted approach to integrating the different contexts for student learning. The four strategies that were used in the study, and discussed in the review of literature were (a) personal association through illustrations and diagrams (b) writing the definition in student's own terms (c) writing a sentence using the word, and (d) repetition of the vocabulary words, used in context, throughout the lessons. These strategies were incorporated into the classroom on a concept card as seen on Figure 1.

Figure 1
Concept Card



On the concept card, which was divided into four sections, students wrote the word and definition, drew an illustration or diagram to describe the word, created their own definition, and wrote a sentence that included the vocabulary word.

Personal Association through Illustration

For students to comprehend what was, the individuals ". . . . must draw meaning from their own experiences and knowledge . . . ." (Macceca, 2007, p. 4). Through the use of the first vocabulary strategy, drawing illustrations and diagrams that described the vocabulary words, which was incorporated into the science lesson, students had to submerge into their own background knowledge in order to come up with ideas that helped the learners understand the new vocabulary words. Macceca (2007) found that when students used personal association and prior knowledge to build on the students' schemata, increased motivation and comprehension would result. Young (2005) affirmed that creating imagery through illustration helped students internalize the vocabulary words. Therefore when teachers incorporated the use of creating imagery through illustration, a form of non-linguistic instruction, the results would ". . . .guide and enhance students' understanding of content . . . ." (p. 13).

Offering personal association through illustration also offered students differentiated instruction. Differentiated instruction gave students a different ". . . . approach to teaching and learning so that students have multiple options for taking in information and making sense of ideas" (Hall, 2009, para. 1). Hall (2009), senior researcher for the National Center on Accessing the General Curriculum (NCAC), went on to state that through differentiated instruction, students' varying background knowledge was recognized.

Brummitt-Yale (2009) affirmed that learning through association, through the use of drawing a picture or symbol, was one of the four main strategies for acquiring new vocabulary. A reader was able to connect a new word to prior knowledge. These ". . . . nonverbal representations could be a powerful tool for student learning" (Fries-Gaither, 2009, para. 9). Students acquired understanding of the vocabulary terms by associating the concepts with ideas that are already understood by each individual student. The learning was personalized and was based on previous knowledge; therefore better connections were made within the students' minds.

Personal association through the use of illustrations and diagrams was considered explicit instruction. Hall (2009) described explicit instruction as:

> A systematic instructional approach that includes [a] set of delivery and design procedures derived from effective school research. There are two essential components to well designed explicit instruction: (a) visible delivery features . . . with a high level of teacher and student interactions, and (b) instructional design principles . . . that make up the content and strategies to be taught" (para. 2).

Explicit instruction was considered ". . . . one of the most effective methods of helping children learn new vocabulary words" (Brummitt-Yale, 2009, para. 2). Macceca (2007) stated that students worked to create images that represented various words and concepts. Therefore, teachers should have students make these

connections through imagery, which would then help synthesize the information into the students' existing schema. The National Reading Panel (2002) confirmed that explicit vocabulary instruction, which included the use of association through illustration, helped students connect background knowledge to the new vocabulary words.

Marzano et al. (2001) described the use of student-created illustrations as nonlinguistic representations and stated that the more teachers guided students in nonlinguistic representations, the better the students would recall knowledge and increase achievement. The use of nonlinguistic representation elaborated on what students previously knew. This nonlinguistic representation allowed students to understand the knowledge in greater depth and recall the knowledge without difficulty.

Student-Created Definition

After two or three days of learning the new vocabulary, the students created a self-definition of the vocabulary words. The student-created definition was a form of self-regulation and retell that supported the students' background knowledge. Macceca (2007) found that this form of self-regulation and retell helped students ". . . . make connections between what they already know and what they are learning" (p. 11). The concept of the student-created definition allowed for students to check for understanding of the terms and to self-regulate personal knowledge.

Robb (2003) found that content literacy was formed through active student engagement and that retell of knowledge enabled students to refine knowledge. Consequently, enabling students to make sense of vocabulary words through student-created definitions was an effective vocabulary strategy. When students redefined terms in the students' own words, based off of the original given vocabulary definitions, the background knowledge from the student-made illustrations, and the daily discussion of the terms used in context, the students used retell to help refine knowledge and become more literate in the content area.

The results of O'Hara and Pritchard (2008) were similar to Robb (2003). O'Hara and Pritchard (2008) studied the student-created definition vocabulary strategy on English language learners and found that vocabulary strategy was worthwhile and permitted students to personalize learning. The student-created definitions allowed for the students to think of what the words meant to the students personally and to redefine in the students' own terms.

By having students create a self-definition; another form of exposure to new vocabulary had taken place. Wetzel (2009) found that having students explain new vocabulary words in the students' own terms was an effective strategy used in order to increase exposure. The students had to use background knowledge to form a definition. Once vocabulary words had been discussed in a variety of ways, and students had been exposed to the words numerous times, the students had a larger background knowledge and depth of meaning of the vocabulary

words. Students then had to use higher level thinking skills to synthesize a definition.

Using a Word in a Sentence

The creation of a sentence using a specific vocabulary word appropriately showed that students understood the meaning of the word and were able to use it in context. The sentence strategy released the responsibility from the teacher to the student. The students had to implement the application of vocabulary words in the appropriate context, to create a sentence (Macceca, 2007). The strategy of using the new vocabulary words in a student-made sentence was a form of synthesis as based on Bloom's taxonomy, created by Benjamin Bloom in 1956. The students had to gather the newly formed knowledge of the specific vocabulary words in order to accurately construct and compose a logical sentence.

Using the vocabulary words ". . . . in a sentence encouraged ownership of the word based on experiences and deeper understanding" (Foote, Harper, & Kester-Philips, 2008, p. 65). When students were submerged in a word rich environment, the students developed word awareness (Foote, et al. 2008). Yet, Foote, Harper, and Kester-Philips (2008) cautioned teachers against having students write sentences for new words before the words were studied in depth. The premature composition could have caused students to use the new words inappropriately, hence causing the students to misunderstand the correct meaning of the words.

To appropriately incorporate the vocabulary strategy, Foote et al. (2008)

suggested that teachers increase student time in using the words through writing sentences to connect the words to known concepts. The incorporation of vocabulary words in to student-created sentences made the students "word collectors" (Foote et al. 2008).

Hall (2009) suggested that the previous vocabulary strategies were mediated scaffolding, signifying that temporary guidance was provided by the instructor. The student-formed sentence using the vocabulary terms was more strategic integration and instruction where the learners had the ". . . . opportunity to successfully integrate . . . ." (para. 8) the ideas once mastered. Hall (2009) went on to state that "the strategic integration of content in the curriculum can help students learn when to use specific knowledge beyond classroom application (para. 8). The formation of sentences using the science vocabulary words enabled students to strategically, accurately, and logically integrate knowledge into context.

Repetition

"It may seem common sense that the more times we are exposed to a word, the stronger our understanding becomes" (Brummitt-Yale, 2009, para. 3). The previous statement was the prominent initiative for using the repetition strategy as a part of the vocabulary strategies introduced to students. Research by Jenkins et al. (1984) found that multiple exposures (at least six) to a vocabulary word caused synapses to be built between neurons, which allowed students to store the

vocabulary words, and the meanings of the words, into long-term memory.

Every time a student encountered a word, a little bit more was learned about that word. In science, the concepts and ideas were ideal for repeated encounters (Fries-Gaither, 2009). The vocabulary words introduced in science were usually somewhat to completely foreign to students. Learning gains were increased when the words were repeated and students were exposed repeatedly (National Reading Panel Report, 2002). The National Reading Panel Report (2002) also stated that repetition of vocabulary words in different contexts increased comprehension.

Students were repeatedly exposed to the new vocabulary words through the variety of vocabulary strategies used in the study, as well as throughout the weekly science lessons and laboratories. Webb (2007) confirmed that ". . . . incidental learning studies have found that the number of times an unknown word is met in context affects whether its meaning will be acquired" (p. 46). The strategy of repetition within the study was used throughout the lessons in order to ensure that the vocabulary words were used in context both written and verbally. The correlation between the number of times a word was repeated and learning gains was found by Webb (2007) to be 0.34, and therefore showed that repetition impacted learning.

Hall (2009) stated "that effective review promotes transfer of learning by requiring application of content at different times and in different context. Planned review is essential, to ensure that students maintain a conceptual and

procedural grasp of important knowledge" (para. 9). Repetition, through both the use of a variety of effective vocabulary strategies, and verbally, in context within the weekly lessons, enabled students to increase comprehension of the new vocabulary words and store that understanding into long-term memory.

Summary

Based on the 47 studies, the National Reading Panel (2002) found that all four strategies used in the researcher's study were valid vocabulary teaching strategies used for vocabulary instruction. Knowing the meanings of words was an integral part of reading comprehension and specific vocabulary instruction led to gains in comprehension. The National Reading Panel (2002) further stated that "pre-teaching of vocabulary words and repeated exposure in different contexts were found to improve vocabulary and comprehension" (p. 12). As students started reading more content material, more vocabulary instruction was needed. The National Reading panel (2002) also found that vocabulary instruction was most effective when a variety of methods were used and therefore led to an increase in vocabulary learning.

Understanding the science vocabulary was essential to student comprehension. By studying the various vocabulary words and integrating the words into students' schema through the use of various vocabulary strategies, students' knowledge base increased. As Brummitt-Yale (2009) found, ". . . . you cannot comprehend . . . if you do not understand the words being used . . . ."

(para. 4). The National Science Digital Library (2009) stated that research has found that students must develop vocabulary in order to succeed in understanding the content and processes of science. The development of vocabulary, especially unfamiliar terms, must have been done explicitly, systematically, and independently, by the instructor. The instruction should have promoted authentic knowledge that was multidimensional and then related that knowledge into a network of ideas. The National Science Education Standards (1996) stated that teachers must have selected teaching and assessment strategies which supported development of student understanding. Student understanding created a community of science learners.

The four vocabulary strategies used by the researcher for the study: personal association through illustration, student-created definition, using the word in a sentence, and repetition, were valid, researched-based vocabulary instruction strategies as found by the National Reading Panel (2002). The panel researched 47 studies and found that "When readers are given cognitive-strategies instruction, they make significant gains . . . and teaching the strategies in content areas leads to increased memory and understanding . . . and improvements in comprehension" (p. 13).

Lehr, Osborn, and Hiebert (2010) found that acquired ownership of vocabulary words is a long term process that involved repetition, both spoken and written, in varying contexts. Through illustration, the students were able to

connect the words to prior knowledge. The student-created definition challenged the students to engage in retell, to check for understanding of the terms and to self-regulate personal knowledge. The use of a word in a sentence allowed students to synthesize knowledge through accurate construction and composition of a sentence containing the vocabulary word. Finally, repetition tied all of the strategies together through increased exposure to the vocabulary words, in the context of science, and more importantly facilitated an overall improvement in the students' comprehension of the scientific concepts.

CHAPTER 3

Methodology and Treatment of Data

Introduction

The purpose of this quantitative research study was to examine the effectiveness of specific vocabulary strategies integrated into the science curriculum in order to aid in increased student comprehension of scientific concepts. Class A, which consisted of 35 students and was considered the control group, received the teacher's usual instruction. The instruction consisted of writing down the vocabulary terms and given definitions. Class B, which consisted of 43 students and was considered the experimental group, received specific research-based vocabulary strategies. The four strategies were the following: (a) personal association through illustrations and diagrams, (b) writing the definition in student's own terms, (c) writing a sentence using the word, and (d) repetition of the vocabulary words, used in context, throughout the lessons.

The researcher compared the fall Northwest Evaluation Association (NWEA) test scores of class A and class B, and then compared the spring NWEA test scores of class A and class B strategies. The researcher also analyzed the individual class scores of the fall and spring NWEA assessments of each class for significance. In the fall previous to the NWEA assessment, both classes had received the same instruction. After the fall NWEA assessment, the instructor implemented the four vocabulary strategies with class B. The instructor

maintained the previous vocabulary instruction with class A.

The quantitative research method was implemented to analyze the data from the non-independent and independent t-tests. The researcher assessed the scores in order to check for significance. Conclusions and recommendations were based upon the results of the t-tests and the reviews of the selected literature.

Methodology

The author conducted a quantitative research study that was experimental in nature. Class A was considered the control group of the experimental study. Class B, the experimental group, received the vocabulary strategies. Both the non-independent and independent t-tests were used to analyze the data from class A and class B.

The following tests were used:

1. Non-independent t-tests
    a. Class A-fall NWEA test scores compared to spring NWEA test scores
    b. Class B-fall NWEA test scores compared to spring NWEA test scores
2. Independent t-tests
    a. Class A- fall NWEA test scores compared to class B- fall NWEA test scores
    b. Class A-spring NWEA test scores compared to class B-spring NWEA test scores

The researcher worked in conjunction with a teacher from a local middle

school. The researcher discussed the vocabulary strategies in depth with the teacher as well as created the supplementary curriculum for the implementation of the vocabulary strategies. Throughout the study, the researcher met on a weekly basis with the teacher to discuss the progress of the implementation in order to monitor and ascertain if the vocabulary strategies were being employed correctly. The researcher chose two classes that had similar fall NWEA test scores as compared by the independent t-test.

Participants

The participants in the study consisted of 78 sixth graders. The district was at the heart of a diverse community. The school where the study was taking place had an enrollment at 702 students. The ethnic breakdown was 56.4% Caucasian, 36.4% Hispanic, and each of the following ethnicities were at 1.4%: American Indian, Asian, Pacific Islander, and African American. Special Programs consisted of 63.2% Free or Reduced-Price meals, 9.8% Special Education, Transitional 4.4% Bilingual, and 3.4% Migrant.

There were 41 teachers at the middle school and, on average, 78% of those held at least a Masters Degree and had 10 years of teaching experience. All of the teachers were considered highly qualified as described by the No Child Left Behind Highly Qualified definition.

Instruments

NWEA was an acronym for the Northwest Evaluation Association (NWEA).

The primary mission of NWEA (2010) was to ". . . . make kid-centric education a reality for every child, every day" (para. 1). The belief that accurate and comprehensive data was essential aligned with the core mission of NWEA. The data was then used to inform educators of each student's optimal learning path. The NWEA assessment was used to track the initial measure of student knowledge with their progress throughout the school year.

Design

The design of the study is quantitative, experimental, and uses a pre and post test. The study used the fall and spring NWEA test scores of two groups of students. The groups consisted of four science classes divided into two groups. These groups were then labeled class A and class B. The data retrieved from the scores was used to calculate significance, if any, of the integration of vocabulary strategies within the context of science. The quantitative study used a STATPAK to analyze the data and show the relationship between the scores. The NWEA test scores were provided by the school district and given to the teacher in order to allow the teacher to use the data to assess student learning.

Procedure

The researcher analyzed various vocabulary strategies to determine which strategies were research-based. After the researcher determined the strategies that would be used and created a curriculum design, the researcher introduced the strategies to the teacher assigned to deliver the instruction. The teacher proceeded

to deliver vocabulary strategy instruction to class B, the experimental group, while instruction stayed the same for class A, the control group. The researcher met weekly with the instructor to monitor and discuss the progress.

The researcher gathered the fall and spring NWEA test scores from the teacher. Then, independent and non-independent t-tests were run on the data using the STATPAK. Four tests were run. The researcher ran two non-independent t-tests and two independent t-tests. The non-independent t-tests individually compared each class's fall and spring NWEA tests. The independent t-tests compared the two classes fall and spring NWEA tests to each other. Conclusions were then made about the analyzed data.

Treatment of the Data

The data gathered by the researcher was analyzed using STATPAK software. The STATPAK software came with the "Educational Research: Competencies for Analysis and Applications" (Gay, Mills, & Airasian, 2006). The STATPAK offered the non-independent and independent t-tests as a part of the software. The data, the scores from the NWEA assessments, were plugged into the t-tests and levels of significance were determined via the STATPAK software.

Summary

The researcher collaborated with the sixth grade science teacher on the implementation of the vocabulary strategies in the classroom. The researcher provided the teacher with the information on the specific vocabulary strategies to

be used in the classroom and followed up with weekly progress monitoring of the study. The strategies were implemented by the teacher on one group of students while the other group was left as the control group. The instruction of the the vocabulary teaching methodology continued for a period of seven months.

The teacher who collaborated with the researcher provided the fall and spring NWEA assessment data of the students. The researcher then analyzed the data, using the STATPAK, to determine statistical significance. The overall design allowed the researcher to compare the effects of instruction of specific research-based vocabulary strategies on class B and test for significance when comparing the fall and spring NWEA assessment scores of class A and class B.

CHAPTER 4

Analysis of the Data

Introduction

The study examined the effectiveness of specific vocabulary strategies integrated into the science curriculum in order to aid in increased student comprehension of scientific concepts. The strategies used in the classroom were all research-based vocabulary strategies. The strategies were then supplemented into the present curriculum in manageable format. Class A did not receive the strategies and class B did receive the strategies. The study took approximately eight months and involved 78 sixth grade students.

The students involved in the study took a fall Northwest Evaluation Association (NWEA) test and a spring NWEA test. The scores were then compared to assess if the research-based vocabulary strategies were effective in increasing student comprehension of the science content. The research focused on determining if there was statistical significance showing that the chosen vocabulary strategies were effective in enabling students to better understand the scientific terms and concepts being taught in the classroom.

Description of the Environment

The researcher chose the vocabulary strategies to be used in the study based upon literature that supported the validity of the specific strategies as determined by multiple research studies. The strategies were narrowed down to four and then

the researcher designed the curriculum for supplementation in the classroom.

The study took place in one sixth grade classroom. Four sixth grade science classes were chosen and divided into two groups. The groups were labeled class A and class B. The classes chosen for the study had similar fall NWEA test scores. The sixth grade science teacher chosen for the study began supplementation of the vocabulary curriculum, created by the researcher, into class B, immediately after the fall NWEA assessment.

Class A, considered the control group, received the teacher's usual instruction. The instruction consisted of writing down the vocabulary terms and given definitions. Class B, the experimental group, received the research-based vocabulary strategies along with the same instruction class A received. Instruction occurred for a period of eight months. The researcher met weekly with the teacher to assess the instruction of the vocabulary strategies. This was to ensure that the strategies were being taught correctly and continuously for the duration of the study.

The teacher had students use a science notebook for the study. Class A recorded the vocabulary words and definitions as given by the teacher. Class B used the notebooks to build the concept card for each vocabulary word. The concept card, as previously seen in Figure 1, was divided into four sections and each section portrayed a different strategy. The vocabulary words were also consistently repeated (the fourth strategy). This instruction took place every day

for the duration of eight months.

Up until the fall NWEA assessment, class A and class B received the same instruction. This consisted of writing the vocabulary words and their definitions. After the fall NWEA assessment, class B then received the four research-based vocabulary strategies while class A remained the same. Class A and class B took the spring NWEA assessment in May. The researcher then used the fall and spring NWEA test scores of class A and class B to test for significance.

Hypothesis

Through the use of integration of specific vocabulary strategies, student test scores, in regards to the NWEA assessment, will improve, and therefore show statistical significance in the comparison of class A and class B.

Null Hypothesis

Student post test scores will show no statistical significance as measured by the non-independent t test, between the fall and spring NWEA assessments.

Results of the Study

The fall NWEA test scores showed the fall comparisons between class A and class B. The scores were to show similarities or differences between the two classes before the four vocabulary strategies were introduced into class B. The results are shown on Table 1.

Table 1

Fall Comparison Between Class A and B

Group	Statistical Findings		
Class A Fall NWEA Scores	N = 35	Mean = 204.9	SD = 12.05
Class B Fall NWEA Scores	N = 43	Mean = 200.47	SD = 11.42
Independent T-Test	t-value = 1.36	*df* = 76	p < .10

Note. N = Number; SD = Standard Deviation; *df* = degrees of freedom; p = probability

In the fall, both classes had similar means in relation to scores taken for the NWEA assessment. The means were four points from each other and the standard deviations were also close. In other words, the classes' scores on the NWEA assessment were similar to one another. An independent t-test, between class A and B was run to test for statistical significance or non-significance. The t-test showed that there was no statistical significance between the class A's and class B's fall NWEA test scores.

The spring NWEA test scores showed the spring comparisons between class A and B. The scores were to show similarities or differences between the two classes after the four vocabulary strategies were introduced into class B. The comparison of class A and class B after the supplementation of vocabulary strategies in class B and continuation of rote instruction in class A is shown on Table 2.

Table 2

Spring Comparison Between Class A and B

Group	Statistical Findings		
Class A Spring NWEA Scores	N = 35	Mean = 204.83	SD = 14.43
Class B Spring NWEA scores	N = 43	Mean = 206.9	SD = 11.73
Independent T-Test	t-value = -.46	*df* = 72	p < .10

Note. N = Number; SD = Standard Deviation; *df* = degrees of freedom; p = probability

In the spring, both classes again had means that were similar in relation to the scores taken for the NWEA assessment. This time, the means were two points from each other. Yet, class A's mean stayed almost the same from the fall test and class B's had increased by six points. An independent t-test was again run to test for statistical significance or non-significance. The independent t-test showed no statistical significance between class A and class B's spring NWEA test scores.

Non-independent t-tests were run in the spring to analyze the individual class scores of the fall and spring NWEA assessments. The comparisons between class A's fall and spring NWEA scores and class B's fall and spring NWEA test scores were assessed for statistical significance or non-significance. The mean and standard deviation of class A and class B were supplied from Table 1 and Table 2. The results for each individual class are shown on Table 3.

Table 3

Comparison of Class A and B's Individual NWEA Scores from Fall to Spring

Group	Statistical Findings
Class A Fall to Spring NWEA Scores	
	Fall N = 35 Mean = 204.9 SD = 12.05
	Spring N = 35 Mean = 204.83 SD = 14.43
Non-Independent T-Test	t-value = .53 *df* = 34 p < .20
Class B Fall to Spring NWEA scores	
	Fall N = 43 Mean = 200.47 SD = 11.42
	Spring N = 43 Mean = 206.9 SD = 11.73
Non-Independent T-Test	t-value = 4.69 *df* = 42 p < .001

Note. N = Number; SD = Standard Deviation; *df* = degrees of freedom; p = probability

The non-independent t-test for class A from fall to spring showed no statistical significance. The mean for class A decreased by .07 points. The non-independent t-test for class B showed statistical significance. The mean increased by 6.5 points and the probability was less than .001. Therefore, the null hypothesis is rejected.

Findings

The findings supported the hypothesis. Class B showed significant improvement from fall to spring NWEA test scores whereas class A's fall to spring NWEA test scores stayed approximately the same. Although the independent t-test did not show statistical significance in class A's and B's fall

scores and class A's and B's spring scores, the non-independent t-test showed statistical significance in overall scores of the two classes. The findings suggested that the implementation of research-based vocabulary strategies into the science curriculum improved student comprehension of the language of science as well as the content. Class B received the research-based vocabulary instruction and showed greater improvement in scores over class A, whom did not receive research-based vocabulary instruction.

Discussion

The study was comparable to the research found on the implementation of explicit research-based vocabulary strategies. Research demonstrated that differentiated vocabulary instruction consisted of a variety of strategies and increased student comprehension of vocabulary words and content. Analyzing the data of the individual NWEA test scores of class A and B confirmed that the implementation of the research-based vocabulary instruction increased scores. The standard rote vocabulary instruction appeared to not have improved class A's fall to spring NWEA test scores as the scores remained stagnant. Meanwhile class B received the specialized instruction and scores improved significantly. Wetzel (2009) affirmed the importance of differentiation and enrichment within the teaching of vocabulary in order for all students to learn and comprehend.

Summary

The fall and spring NWEA test scores of class A and class B were collected

and analyzed for significance. Independent t-tests and non-independent t-tests were used to calculate the scores for statistical significance. The mean, standard deviation, and probability were determined. Class A's and class B's fall scores were first compared to check for statistical non-significance. The two classes were similar in scores with class B's scores being four points lower than class A's scores. Then class A and class B's spring scores were compared. The spring scores also tested as non-significant as the scores were similar. Class B's scores were two points higher than class A's. Finally, the class scores were analyzed individually. Class A's scores remained the same while class B's scores increased by six points. The difference in class A and B's individual scores were statistically significant.

CHAPTER 5

Summary, Conclusions and Recommendations

Introduction

The purpose of this project was to conclude whether the supplementation of specific research-based vocabulary strategies into the sixth grade science curriculum would increase both student learning of the science vocabulary words and student understanding of the science content. The strategies were introduced into a sixth grade classroom and fall and spring Northwest Evaluation Association (NWEA) test scores were analyzed for statistical significance.

Summary

The project consisted of two groups of 78 sixth grade students. One group of 35 students received vocabulary taught in rote format. The rote format consisted of writing the vocabulary words and definitions. The other group of 43 students received the research-based vocabulary strategies. The strategies consisted of the following: (a) drawing an illustration or diagram to relate the meaning of the word to previous knowledge, (b) writing the definition in student's own terms, (c) writing a sentence using the word, and (d) repetition.

The students took a fall NWEA assessment before the study began and a spring NWEA assessment eight months later at the end of the study. The results of the NWEA assessments were analyzed, using independent and non-independent t-tests, to assess for significance.

Conclusions

The findings from the review of literature suggested that more than rote instruction is necessary to teach difficult vocabulary words in the science curriculum. Research-based vocabulary strategies that differentiate and enrich student learning help students comprehend the science content and vocabulary.

The analyzed NWEA test scores from the study suggested that student scores increased significantly with the integration of the research-based vocabulary strategies. The vocabulary strategies appeared to have been effective in increasing student comprehension of the science content.

Recommendations

The current FOSS science curriculum does not provide research-based vocabulary strategies. Therefore, teachers in the sixth grade science classrooms need to supplement the curriculum with the strategies to help increase student understanding. Through the use of differentiation, students of all learning types and levels would be accommodated and a classroom where students are engaged and motivated would be created. As research shows, differentiated strategies introduced into instruction will increase student comprehension of difficult and unfamiliar vocabulary words. In order to meet state and federal standards, teachers need to incorporate differentiated instruction that focuses on student needs.

Teachers can incorporate the research-based vocabulary strategies into the

daily lesson. Teachers can preview the important vocabulary words for upcoming lesson. The first five to ten minutes of class can be set aside for vocabulary instruction. The teacher can introduce the words and then have students start building concept cards. Throughout the lesson, the teacher and students can repeat the vocabulary words.

Science is difficult for students to comprehend. If the curriculum is not sufficient in its vocabulary instruction, teachers must supplement with research-based vocabulary strategies. Therefore, the integration of the research-based vocabulary strategies into the science content will help improve student understanding of the unfamiliar vocabulary words and increase student content comprehension.

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