PERSONAL NARRATIVE: FROM STORY TO SCIENCE

Dena Thorson

ABSTRACT

This study explores how writing personal narratives helps ESL students demonstrate their understanding of science vocabulary and concepts. Key influences include: the funds of knowledge students bring to the classroom (Moll, Amanti, Neff, & Gonzalez, 1992), academic English (Zwiers, 2008) vocabulary instruction (McKeown & Beck, 2004), and scientific literacy (Lee, 2005 and Lemke, 1990). The research method consisted of five cycles of action research with 11 eighth-grade ESL students in an ESL classroom which supported what was concurrently being taught in the mainstream science class. Collected data included observations and written personal narratives. The main findings were: 1) students can demonstrate understanding of both science vocabulary and concepts as wells as academic language functions common to science through personal narrative writing, 2) students can apply science vocabulary when writing about their life experiences, and 3) intentional and thoughtful planning and preteaching of vocabulary helps students access and engage in science content.

INTRODUCTION

Content and ESL (English as a Second Language) teachers need to work together to engage ESL students more in science content. When we examine ESL student participation in the science classroom as well as their grades in science class and their scores on tests and national exams, there seems to be a disconnect; ESL students are not performing as well as they could be. How can we help them realize the connections between their own lives and science concepts both in and out of the classroom? Reasons for this disconnect are numerous. Some students are simply timid or may come from a more traditional educational background where teacher-led learning conflicts with the expectation in U.S. schools that students take a leadership role in their own education by inquiring, questioning, exploring (Fradd & Lee, 1999). Students might also disengage because their definition of science might not overlap with Western science (Aikenhead & Jegede, 1999; Lee, 2001; Solano-Flores & Nelson-Barber, 2001). Students may not be interested in the science lessons or may not see how the learning connects to their own lives (Lemke, 1990). Students may lack prior knowledge necessary to understand the concepts being taught (American Association for the Advancement of Science [AAAS], 1989, p.150) or may not have the language or vocabulary to express their ideas or ask the questions they need answered.

The disconnect between ESL students and science is also apparent in assessments. The achievement gap for ESL students in science is evident and expanding. Most recently, the 2009 National Assessment of Educational Progress (NAEP), reports that nationwide, the average eighth-grade ESL student scored 50 points below the average non-ESL student, whereas, on the 2005 NAEP assessment that same gap was only 44 points (National Center for Education Statistics [NCES], 2009). In Minnesota, scores for ESL students were 10 points higher than the national average but still 48 points behind the average score for non-ESL students (NCES, 2009). ESL students need support to better access science content and close this gap in science achievement (AAAS, 1989).

In addition to teaching English as a Second Language to sixth, seventh, and eighth graders in my own classroom, the past two years I went into an eighth-grade science class every other day for 2 hours to support ESL students in their mainstream content work. Initially, the science teacher and I were both discouraged by our ESL students' low test scores, unenthusiastic participation, and lack of science vocabulary usage in speaking or writing activities. During science class many ESL students are generally hesitant to ask questions or be assertive when it comes to participating in both large or small-group activities, and I certainly do not hear them discussing science concepts or using the vocabulary of the unit being taught; they are not talking science. The science teacher and I did not have a lot of time to plan together, but we were determined to help ESL students be more engaged with the science content. One way to do that is to utilize a familiar format to learn unfamiliar content. This action research project explored the use of personal narrative writing to engage students in science content and provide them with an alternative method of demonstrating comprehension of science concepts and vocabulary.

LITERATURE REVIEW

Science Response to Disconnect

Science for All Americans: Project 2061, the landmark for science education reform sponsored by the American Association for the Advancement of Science, was a monumental response to several problem areas in teaching and learning in the field of science (Lee, 2005). In its effort to enhance scientific literacy, AAAS published a common core of learning in math, science, and technology as well as an extensive set of recommendations that especially targets students who traditionally have been left on the periphery when it comes to learning science, namely, girls and ethnic and language minority students (1989, p. 20).

One way to bring students in from the periphery is by tapping into their *funds of knowledge,* the unseen knowledge and skills gleaned from home, community, and cultural experience, passed from generation to generation, that ESL students bring to the classroom (Moll, Amanti, Neff, & Gonzalez, 1992). The *teacher* in these settings outside of school might be a parent, a relative, or a neighbor who may have a much broader sense of the student than is available to a classroom teacher. In these situations, much of the learning is motivated by the children's interests and questions which may not be the case in the classroom (Moll & Greenberg, 1990). The more teachers know about their students, the more they can tailor content and instruction to motivate and engage students in learning. The study of funds of knowledge grew out of the field of anthropology and ethnography. Time and logistics do not usually allow teachers to do in-depth ethnographic investigations of students' cultural and life experiences. One way to uncover this deeper knowledge of students is through writing personal narratives that give teachers an idea of students' background knowledge of and previous experience with a certain topic.

Funds of knowledge could be a goldmine for teachers looking to align lessons with ESL students' prior knowledge or who are struggling with how to motivate students. Education and science literature calls this *cultural* or *instructional congruence*; teaching in ways that incorporate students' language and cultural experience, their background knowledge and ways of participating in classroom activities, and the cultural and intellectual resources they bring into the classroom (Gay, 2000; Lee & Fradd, 1998; Luykx, et al., 2007) in order to make science content meaningful and relevant to students and thus more accessible. Students from nonmainstream backgrounds acquire in their homes and communities cultural norms and practices that are sometimes incongruent with those of school. Ultimately, it is the classroom teacher who serves as the bridge between the students', and their families', funds of knowledge, and their experience in school, but for various reasons, teachers and schools rarely tap into the funds of knowledge of their students (Lee, 2005; Moll, Amanti, Neff & Gonzalez, 1992; Velez-Ibanez & Greenberg, 1992).

Language Response to the Disconnect

Research on science education with ESL students is a developing field, most articles having been published since the mid-1990s (Lee, 2005, p. 510), and has rarely considered the role of language and culture in students' learning although many researchers realize it is a critical piece in that learning (Janzen, 2008; Lee, Deaktor, Hart, Cuevas & Enders, 2005; Luykx, et al., 2007). Gaps in reading performance between ESL students and native English-speaking students are associated with gaps in vocabulary knowledge (Carlo, et al., 2004; Francis, Rivera, Lesaux, Kieffer & Rivera, 2006) but programs in schools or research studies to improve ESL students' vocabulary are scarce (Beck, McKeown, & Kucan, 2002; Garcia, 2000; Wellington & Osborne, 2001). ESL students need explicit vocabulary instruction targeting both general academic words as well as words specific to science because they are less likely than their native English-speaking peers to be able to discern meaning from context (Beck, et al., 2002; Carlo, et al., 2004; Janzen, 2008).

Vocabulary

There is agreement that word knowledge represents knowledge in general (Townsend & Collins, 2009; Vygotsky, 1986). When teachers ask students to think about new ideas verbally or in writing, students are deepening their engagement with and understanding of new information (Janzen, 2008). Unfortunately for ESL students, a lack of language proficiency and word knowledge may be interpreted as limited content knowledge (Lee, et al., 2005; Luykx, et al., 2007). ESL students are at particular risk for struggling with academic vocabulary because they may not have the same amount of background knowledge or exposure to different layers of meanings for words as native English-speaking students (Janzen, 2008; Townsend & Collins, 2009, p. 995). Academic vocabulary is not only content-specific words like *monarchy* and *ion*, but also the general academic words, such as *therefore* and *results*, used to access science concepts.

McKeown and Beck (2004) classify vocabulary words into three tiers. Tier 1 words are the most basic, high-frequency words – *sister, stop, chair*, and so on, that rarely require explicit vocabulary instruction. Tier 3 words such as *archipelago*, *trapezoid*, and *barometer* are low-frequency and usually specific to a certain content area. A rich understanding of Tier 3 words is not as critical as Tier 1 or Tier 2 seeing as students will probably only encounter these words in specific settings, however, explicit teaching of Tier 3 words can be useful when the need arises which is often the case in science class. Deliberate vocabulary instruction can have a powerful impact on Tier 2 words like *result*, *product*, or *conclusion* - high-frequency, high-utility general terms that cross content areas and are encountered by students in a variety of settings (McKeown & Beck, 2004). Science textbooks tend to focus on Tier 3, science-specific vocabulary, so it is critical that content science teachers are aware of and teach Tier 2 words which can greatly impede or enhance ESL students' access to science content.

Although academic language encompasses a wide-range of vocabulary, grammar, functions, strategies, and features used to describe complex ideas, higher-order thinking, and abstract concepts (Zwiers, 2008, p. 20), this study focuses on the academic vocabulary and concepts used in the content area of science. The academic language of science tends to describe phenomena, establish relationships, make comparisons, support claims with evidence, determine cause and effect, generate hypothesis, interpret data, generalize, and describe procedures (Zwiers, 2008, p. 85-86).

Personal Narrative

Some researchers advocate using narrative writing for precisely the same reason that others might shy away from it; it is not scientific discourse, in the traditional sense, however, this familiar genre can be an effective way to engage students in unfamiliar content and begin the process of helping students to express their thoughts in written language (Wellington & Osborne, 2001, p.75-76). In order to engage students more in science content there has been a movement in the field of science in recent years to shift away from more lecture-based instruction to more creative means of teaching science including the use of storytelling and narrative (Isabelle, 2007; Lemke, 1990; Warren, Ballenger, Ogonowski, Rosebery & Hardicourt-Barnes, 2001). Multiple-choice and true/false tests require students to memorize meanings, but they do not assess students' ability to get to the deeper meanings of the words. Only assessments that require students to flexibly assemble words into sentences for themselves can give us an idea of students' level of comprehension of science vocabulary and concepts (Lemke, 1990, p.172). Since they are drawing from their own experiences and knowledge, narratives provide students the opportunity to demonstrate understanding in a personal and relevant manner without the interference of other unfamiliar words.

METHODOLOGY

Guiding Questions

In order to explore if writing personal narratives can help ESL students be more engaged in science content and demonstrate their understanding in an alternative way, two specific questions guide this study:

1. Does writing personal narratives help students demonstrate their comprehension of science vocabulary and concepts?
2. Are students able to apply science vocabulary and concepts when writing about their own life experiences?

Data Collection

Participants/Setting

Participants were 11 eighth-grade ESL students. Home languages represented in this group included: Somali, Khmer, Tigrinya, Spanish, and Mandarin Chinese. Levels of proficiency in English ranged from Beginner (some social English proficiency but very limited academic English proficiency) to Advanced (proficient in both social and academic English and getting ready to transition out of the ESL program). Each student in the study was assigned a number, 1 through 11, for identification purposes while analyzing the data. The number of students participating in each action research cycle varied due to students moving in or out of the school district or being absent for vacation. All student names have been changed.

The school in this study schedules classes based on a block schedule model; daily schedules alternate between *green days* and *blue days*. On green days the eighth-grade ESL students had science during their seventh and eighth periods. I went into their science class with them to take notes, assist with labs, support students during quizzes and tests, and to make sure that I understood the content. On blue days during seventh and eighth periods, students had ESL where I supported the science content and carried out my action research.

Data Collection Technique – Personal Narratives

Narrative is a genre of writing with several defining characteristics that differ from the expository writing often used to convey science content. There are many types of narratives, but this study used what Derewianka (1991) would call a *personal recount* where a writer reconstructs a past experience and the purpose is to tell what happened. It begins with an orientation (i.e. the who, where, and when of the event) followed by a series of events usually in chronological order. It may contain some personal comments about the event but it does not necessarily make use of a problem/resolution organizing structure. Although what students were expected to write is called a personal recount by Derewianka, it is referred to as a personal narrative throughout this study which speaks more to the genre of writing and is more widely recognized by students and teachers.

Students received several directions to guide them in writing their narratives. Narratives had to be based on something real from students' own lives. Students were directed to use all the target words within the narrative but could utilize parenthetical references if the words did not fit tidily into a sentence. In a narrative about energy, regarding a day spent at the Mall of America to celebrate Eid, one student wrote, "I was riding the roller coaster. It stopped at the top (potential) and then it dropped (kinetic)." By using parenthesis in her writing she was able to demonstrate an understanding of the target vocabulary words *potential*, stored energy represented by the roller coaster stopped at the top ready to drop, and *kinetic*, moving energy represented by the roller coaster dropping.

Action Research Cycles: General Procedures

The structure of action research can vary from project to project. Sometimes a unique, planned component is added to each cycle and subsequently analyzed. My study, however, used a similar procedure for each cycle and at the end of five cycles, the effectiveness of personal narratives was analyzed by looking at how students incorporated science vocabulary and concepts into their written narratives across all cycles. The timeframe between steps one and six was approximately 3 weeks. Language instruction began in the ESL classroom approximately 1 week before the unit began in the science classroom so that ESL students could go into the science unit with some background knowledge.

1. Prior to each science unit, which corresponded to an action research cycle, the science teacher and I identified ten target vocabulary words using McKeown and Beck's (2004) classification of vocabulary words into three tiers. The vocabulary words we chose were a combination of Tier 3 and relevant Tier 2 words from the science textbook or the science teacher's materials. I selected some additional Tier 2 words based on McKeown and Beck's (2004) criteria: interesting and useful, found in a variety of contexts, and can be explained with words that students already know.
2. In order to write student-friendly definitions for each word, I consulted The American Heritage Student Dictionary, the Collins Cobuild Dictionary, designed especially for creating student-friendly definitions (Beck, et al., 2002), ACCESS Science (Duran, Gusman, & Shefelbine, 2005), a textbook designed to build literacy through science, and the classroom science teacher. These definitions were then used to scaffold the definitions given in the science classroom or the mainstream science textbook.
3. After a brief engaging introductory activity with the words, students copied the teacher-created, student-friendly definitions and then as a large group, generated an example sentence for each word that demonstrated the word's meaning within the science context of the current unit.
4. Students then worked with target vocabulary in a variety of activities. I was able to tailor the activities to meet the specific science objectives for each unit as well as give students ample opportunities to play with the words.
5. Content instruction began in science classroom.
6. Students wrote personal narratives incorporating the target vocabulary words. Peer and teacher conferences at times helped redirect students to more appropriate meanings for the words.

Action Research Cycles: Cycle-Specific Procedures

Before the action research began, students had practiced the general procedures with a unit on energy. Students were given an example narrative created from my own life that used the vocabulary words within a personal context. Each of the five cycles followed the same general procedures detailed above, but the excerpt below gives specific information on the vocabulary, vocabulary teaching activity, and language instruction used in one of the five action research cycles. During and after each action research cycle I noted observations, reflections/evaluations, and any modifications for future cycles.

Cycle 2: Genetics

The following table lists the target vocabulary words, the teacher-created, student-friendly definitions, and the group-generated example sentences for each word in this cycle. Student names have been changed.

Table 3.2 Cycle 2 Genetics Vocabulary Words, Definitions, and Example Sentences

Vocabulary	Student-friendly definitions	Group-generated example sentences
genetics (n.)	the study of how traits (characteristics or qualities) are passed on from parents to children	*Scientists are using genetics to study why tigers are sometimes white.*
trait (n.)	a feature that can be controlled by genes (for example, eye or hair color)	*Amran may have inherited the trait influencing her moods from her mom.*
inherit (v.)	to receive a quality from someone in your family	*Dalia inherited her height from her dad.*
DNA (n.)	a chemical in the cell that stores genes (deoxyribonucleic acid)	*Teshome inherited his DNA from his parents.*
divide (v.)	to cut or split into parts	*Visal divided my paper into two pieces for the math quiz and gave one to Mikayla.*
offspring (n.)	one or more organisms born of or from a parent (baby plant or animal)	*Tigers usually have three offspring (cubs) each time they give birth.*
gene (n.)	the part of a cell that controls a person's, animal's, or plant's characteristics, growth, and development; a section of DNA from a chromosome that passes on traits from parents to offspring	*Asad got the gene for his ears from his dad.*
characteristic (n.)	the nonscientific word for "trait", a quality that defines or describes something, could be shy or talkative, for example (character)	*Animal and bacteria cells have different characteristics.*
chromosome (n.)	structures in the cell nucleus that have information or plans for the organism	*The function of the chromosome is to give directions to the cell.*
produce (v.)	to make, give us	*The tree produced food, oxygen, shelter, and paper.*

The vocabulary teaching activity we focused on in this unit incorporated classifying. Students were given a list of traits or behaviors and they had to classify these into two groups: determined by genetics or not determined by genetics. In science class students sorted the vocabulary words into a chart using the following categories: *I don't know this word*, *I know this word but I don't know what it means*, *I know this word and can use it in a sentence*. They also made their own personal Word Walls.

As part of the language instruction for this cycle, I reminded students of how to begin a narrative by introducing and describing the specific characters and the setting as well as making sure to use a consistent past tense. I redirected them to the initial example I had written demonstrating what was expected.

DATA ANALYSIS

Students underlined the target vocabulary words in their narratives making it easier to mark an "S" (correct scientific meaning), "P" (polysemous meaning), or "I" (incorrect) above each word directly on the narratives. Tallied responses are seen in the table below. Numbers in the table represent quantity of students in each category. First, the number of students who actually used each target vocabulary word in their narratives was tallied. If used, I then tallied and classified vocabulary results according to how the words were used in the narratives: 1. vocabulary word used correctly, with the intended scientific meaning, 2. vocabulary word used in a polysemous way, and 3. vocabulary word used incorrectly. I marked words incorrect if a student failed to provide enough information in the sentence to discern meaning, if it was obvious the student did not understand the word enough to use it correctly, or if the exact definition from class was used in a sentence, also making it difficult to discern if the student truly understood the meaning. If I was unsure if the word was being used correctly in the intended scientific domain, the science teacher verified meaning. This scoring guide allowed me to focus both on the vocabulary words themselves, i.e., were there any patterns where certain words gave all students trouble or not, as well as on the individual students, i.e., how well each student used each word. In the final analysis, only words used with the intended scientific meaning were counted as correct. The polysemous meanings were both correct, used in a meaningful way, and incorrect, the meaning was outside of the scientific context. Noting the polysemous meanings helped me see where I needed to clarify content, but I left them out of the final analysis.

Action Research Cycles – Vocabulary

Cycle 2: Genetics

Vocabulary. trait (n.), inherit (v.), divide (v.), characteristic (n.), produce (v.), genetics (n.), DNA (n.), offspring (n.), gene (n.), chromosome (n.)

Table 4.2 How Cycle 2 Genetics Vocabulary Words Were Used in Narratives (n = 9)

Vocabulary words	Number of students who used the word in narrative	Number of students who did not use the word	Number of students who used the intended scientific meaning	Number of students who used the word in a polysemous way	Number of students who used the word incorrectly
trait	9		8		1
inherit	9		8		1
divide	9		7	2	
characteristic	9		7	1	1
produce	9		9		
genetics	9		2		7
DNA	9		8		1
offspring	9		7		2
gene	9		8		1
chromosome	9		1		8

All nine students used all ten vocabulary words in their narratives. Only one word, *produce*, was used with the scientific meaning by all students. Four words, *trait*, *inherit*, *DNA*, and *gene* were used correctly by eight out of nine students. Two students used *divide* in a polysemous way while one student used *characteristic* in a polysemous way. Two words that at least half of the students used incorrectly were *genetics* and *chromosome*. In fact, only two students used *genetics* correctly and only one student used *chromosome* correctly.

Eight out of the nine students did not use the word *chromosome* correctly. They seemed to understand that chromosomes carry information that determines what we look like, but most students said those traits were due to a varying number of chromosomes instead of a variety of information on each chromosome. When discussing two tiger cubs seen on TV, one student wrote:

> One cub inherit his dad skin color. Then they has another baby cub (offspring). this baby have the same trait as his mom. The two baby look alike too because have the same DNA as there parents. The second baby [got] gene for print on his body from his dad. The two tigers has a lot of different characteristics even though they were produce from the same parents. They both still look alike because they have the same number of chromosomes.

Nine students completed this cycle of ten vocabulary words. There were no instances where words were not included in the narratives and three instances where words were used in polysemous ways leaving 87 instances of using words in narratives either correctly or incorrectly. Overall, 75% of the words were used correctly while 25% were used incorrectly.

Preteaching the vocabulary helped students access and be more engaged with the science content. After working with most of these students for three years, it was evident that their confidence had increased. During a quiz in the science classroom, a few students turned to me with big smiles on their faces when a question about cells appeared on the screen. They knew the answer. Others readily volunteered in the science classroom for a skit I had written. While working on the narratives, one student, on her own, got an ACCESS science book off the shelf to help her understand the concepts better and get her words to fit into her narrative. I do not often see this kind of initiative. Two students asked me if *trait* and *characteristic* were the same thing. I told them, "Yes, but *trait* is used more just for science." When trying to figure out which letters go in which boxes in Punnett squares, one student's eyes lit up, "Like a multiplication table?" Students were making connections to prior learning all on their own.

Several students exhibited scientific thinking, an aspect of academic language, in their personal narratives. When writing about knowing a set of twins, one student demonstrated several aspects of scientific thinking:

> They both had the same <u>characteristics</u> like they alike like their nose was wide open their eyes was brown, … but what really surprised me was their height. One was taller than another. Oh, before I get you too exciting and surprising about my story, I have to tell you their names.

He went on to explain that one parent was tall and one parent was short so the twins probably inherited their heights each from a different parent. This example shows how he demonstrated scientific thinking by making claims, for instance, the twins had the same facial characteristics but were different heights due to what they inherited from their parents, and then supporting those claims with evidence or details by describing nose shape and eye color and the different heights of the parents and the twins. Later he used conditional statements, to pose questions and hypothesize, another form of scientific thinking, "If the two brothers were the same except height, what about the DNA? Was it the same? Was the <u>chromosome</u> equal? I thought so but I knew for sure Mikal's gene was from his mom." Using conditional statements demonstrates that students are thinking beyond their personal experience and making connections between ideas (Zweirs, 2008, p. 31).

A common function of the academic language of science is to establish and describe relationships. Many narratives from this unit provided examples of this. One student demonstrated a general understanding of the science concepts related to genetics and genetic relationships when she wrote about taking family pictures:

> Picture Perfect - My family is made of 6 people: my dad, mom, sister, and two brothers. So when its picture it's a lot of work. Like we all have to dress up and all. It is fun to take picture with my family, especially when we mostly look a like. My other brother looks different than the rest of the family. It's like he didn't <u>inherit</u> anything from my dad and mom. Trust me with this if you see him two, you would say did you

> adopt this child. When I was younger that's what I used to think. I would say my family is divided in to 3 section, you can see this in pictures. So my brother doesn't look alike anyone, my sister look like my dad and then me and Ayman look alike my mom. Even thow we all have different characteristic we have that one thing that connect us. me and my brother have a lot of trait from our mom. Like the shape of our faces and our teeth. Even thow we all where the offspring of our parints we are still different in many ways. "Everyone ready" snap snap the photo guy took our pictures. As we were wating for our next fram I remembered something. That me and my sister have the same face structure, even thow she is not my mom. I think that's because we both have the same number of chromosome from each parent. I am gussing that we may even have some DNA the same. My sister got the gene for her lips from our dad. Even thow he both produced us. Many people don't know the genetics of my tallness but it all gose back to my grate grandfather. He was 7, 2. That's very tall. Snap, snap, we took all of our picture and we were done for the day. P.S. I can bring you those picture if I find them.

This student demonstrated another example of scientific thinking by hypothesizing, "I am gussing…" a common function of the academic language of science, when she questioned why she and her sister have the same facial structure.

Action Research Cycles – Funds of Knowledge

The contexts used by students in their narratives provide information as to the background knowledge and lived experience around a certain topic, the funds of knowledge, that students bring into the science classroom. Examples of contexts used by students in the Cycle 2 – Genetics narratives included: a student donating her long hair inherited from her grandma, visiting a museum with parents in home country and studying mosquito DNA, talking with a friend who is good at soccer and where he got those skills, one student knew twin boys and discussed why they were similar and different in appearance, another student discussed family resemblances while writing about getting a family portrait taken, food preferences within a family, why brothers look the same and different, discussing tiger cubs seen on television, family pictures, and discussing family personality characteristics such as impatience.

When contexts from all five cycles are examined, we see that many students used examples from their home countries. Home country contexts included visiting museums on school field trips or with parents, playing with friends and family, and celebrating holidays. By far, the most common contexts were family-centered. These ranged from trips taken with family in and out of state or country as well as numerous examples of being sick and being cared for by family. Extended family including cousins, grandparents, aunts and uncles, were mentioned as often as parents. An aunt advised what to do when gum was swallowed. An uncle helped clean and paint a new house. A cousin suffered from and survived cancer.

Learning seemed to be another common theme that emerged. One student wrote about learning how to fix cars from a cousin and earning money from helping out. This student had been failing and disengaged in most classes for two years but surprisingly he wrote two narratives about fixing cars with his cousin and even asked me for help. Another student detailed the steps of making cheesecake with her mom. Another student wrote about his new house and learning how to help his dad and uncle reattach cabinets with a new electric screwdriver. Even though a few narratives talked about learning in a science classroom, either in the United States or in a student's home country, not once was a classroom teacher included as a character in a narrative. In all of these situations the *teacher* was a family member which is exactly what the literature on funds of knowledge highlights; learning is motivated by students' interests and questions and teaching is done by a family or community member.

FINDINGS

Writing personal narratives provides an alternative way for ESL students to demonstrate understanding of science vocabulary and concepts as well as academic language functions common to science.

Narratives, a format with which students are already familiar, provides a framework for students to sort out and organize complex information in a sequential manner so that it makes sense and is easier to recall (Herman & Childs, 2003; Hudson, 2007; Koda, 2005; Lemke, 1990). One way we can see the effectiveness of narratives is by looking at how target vocabulary words were used within the student narratives.

- *Used/Not Used.* Overall, only 13 instances of not using a word in a narrative were recorded across all five action research cycles.
- *Used a Polysemous Meaning.* Originally, words were designated as either Tier 2 or Tier 3 words but as the narrative data was analyzed it became evident that for some words it was difficult to designate them solely to one tier or the other, too subjective a process to use as a concrete finding. In the end, I discarded the tiers altogether but I still think that the results, based on my original assignments of Tier 2 and Tier 3, are significant. Many Tier 2 words, by their nature, have the potential of being used in a polysemous way. When looking across cycles and adjusting for the instances of when students did not use a Tier 2 word in their narratives, there were only 25 of a potential 300 instances of students using a Tier 2 word in a polysemous way instead of with the intended scientific meaning. That means that 275 times, or 92% of the time, students chose to use the scientific meaning over a polysemous one. Luykx et al. (2007) found that students frequently interpret science terms with reference to their everyday meanings rather than their specialized meanings so the results in my study are significant because students did not default to familiar meanings but made a conscious decision to work with the scientific meanings presented in class.
- *Used the Intended Scientific Meaning/Used Incorrectly.* Forty-six narratives were written over the course of the five cycles meaning that there were 460 potential instances of using vocabulary words in the narratives (46 narratives times 10 vocabulary words per cycle). When the 460 instances are adjusted for instances of words not used in narratives or words used in a polysemous way, we get a total of 422 instances of words being used either correctly or incorrectly in the narratives. Overall, 75% of the words were used correctly (with the intended scientific meaning) while 25% were used incorrectly.

Personal narratives not only provide students an alternative method of demonstrating understanding of science vocabulary, they also allow teachers unique access into students' understanding of scientific concepts. One example clearly demonstrates the benefit of using narrative in the science classroom. A large number of students did not get the meaning of *chromosome* correct, and after examining their narratives more thoroughly, it became evident that they got the word wrong because they thought that genetic differences were a result of a varying number of chromosomes in humans, not varying information carried by chromosomes. As Vygotsky (1986) explains, thoughts are manifested in words, and it was through their words that it became clear that a major misunderstanding needed to be corrected. A teacher might not have been able to access and then redirect that misunderstanding on a multiple choice or definition matching exam.

Although personal narrative is not considered traditional science writing, it was an effective way for students to demonstrate use of academic language functions common to science with cause and effect being demonstrated most often. Especially exciting was when students used their writing to formulate hypothesis, for example, when writing about why parts of a cheesecake were still soft when it came out of the oven. Another example of scientific thinking demonstrated in the narratives was supporting claims with evidence. For instance, one student made a claim about the impending weather and supported it with details. She correctly wove the workings of high and low air pressure systems into her narrative about a trip to a lake with her family.

ESL students are able to draw from their funds of knowledge to apply science vocabulary and concepts when writing about their own life experiences.

Students had a relatively easy time thinking of ideas or situations to use in their narratives. When they did ask for help they eventually arrived at the ideas themselves with little guidance from me. I was not surprised to see that many students' narratives revolved around family events and I even saw examples of family members as teachers in a few narratives. One student who had been failing classes and not doing homework for a couple years seemed engaged in the narrative writing process, possibly because he was writing about something interesting to him and his own experience, even asking me for new vocabulary to use in his narrative. This example supports the research of Moll and Greenburg (1990) who claim that outside of school, in families or communities, student learning is motivated by student questions and interests instead of dictated by a curriculum.

After making notes of anecdotal observations, overheard comments, group interaction, and performance in science class, it was found that intentional and thoughtful planning and preteaching of vocabulary helped students access and engage more with the science content.

Because I was a teacher-researcher, and have known and taught many of these students for three years, I was able to make notes of interactions and behaviors that were somewhat out of the norm for many of the students. Evidence that preteaching vocabulary is effective can be seen by increased confidence and participation in science class, increased questioning and on-task dialogue about the vocabulary words between students and with me, and increased initiative in ESL class while writing the narratives. Students seemed to be motivated to write, even after five cycles of the same process. Part of that motivation may be the result of participating in vocabulary teaching activities that were fun, active, and gave students an opportunity to manipulate the words in a unique way (Carlo, et al., 2004).

Limitations

One limitation that impacted this study was researcher subjectivity. Even though I consulted with the science teacher and asked students directly, meanings were sometimes still unclear in the narratives and another researcher might have deemed some of what I marked *correct* as *incorrect* and vice versa. For example, the word *charge* was used in a polysemous way by six students, but all six definitions were somewhat related to the scientific meaning given in class. Another researcher may have counted correct what I marked incorrect. Subjectivity was also the reason I eventually discarded the use of tiers to designate vocabulary words. Without a formal process to classify words into tiers, that analysis was beyond the scope of this study.

Implications

Science teachers often ask students to draw upon their own life experiences during class discussions. A record of the situations written about in narratives can help science teachers prompt students if they struggle to apply concepts to their own lives. A deeper, broader knowledge of students also helps teachers design lessons, assessments, and activities that connect to students' lives, their prior learning, and their cultural and life experiences. For example, making cheesecake with mom would fit nicely into a lesson on chemical and physical change. This is a small endeavor that could engage students in the content, but if teachers do not know about students' experiences, they can not incorporate them. Personal narratives are one way for teachers to access students' funds of knowledge. Not only are ESL students validated and engaged when their stories and life experiences are used in teaching, other students more familiar with Western science could also benefit by learning that there are alternate ways to understand the world around us (Cobern & Loving, 2001).

Narrative also provides science teachers with an alternative method of formative or summative assessment. The process of using and evaluating narratives requires a significant amount of time, but narratives do not have to be lengthy and could be included in the form of an essay question on any assessment. This would allow teachers with many students an opportunity to assess at least one core concept of each unit in this manner. If the process is described in detail and modeled initially, then subsequent use of narratives will not require as much time and prep. Narrative writing could also be used during remediation if students seem to be struggling with a concept or are not performing well on more traditional assessments. Through narratives, teachers gain a more detailed idea of where the misunderstanding is rooted.

It is critical for ESL and content teachers to collaborate, especially to identify key vocabulary words in content instruction. In order for collaboration to be effective, ESL teachers need the content expertise of a science teacher and science teachers benefit from an ESL teacher's focus on the language and cultural background of students. It takes a great amount of time and effort to ensure definitions of science vocabulary words and concepts are composed of words already understood by students. Vocabulary planning needs to be much more deliberate than simply pulling out words, and certainly more thoughtful than just focusing on the bolded words in a textbook. One must consider potential of usage and utility across content areas, and have insight into what students already know as well as how they might possibly interpret what is being presented. To do that, a teacher must know her students well. Using, sharing, and discussing students' narrative writing allows teachers a window into how students are processing information and a way to know if some concepts need to be revisited. This depth of knowledge of a student's comprehension is not always accessible through traditional methods of assessment and evaluation.

Further Research

An extension of this study would look at how writing personal narratives affects progress in science class and scores on science assessments. Data on pre and post tests for each science unit was collected but not included in the final analysis because the focus of this study is the use of narrative to demonstrate understanding. The process of writing narratives is just as valuable as the product of narrative writing. During the process of narrative writing, students have the opportunity to ask the questions that arise from trying to apply science concepts to their own lives. Students are required to do more than recall or explain a concept, they need to manipulate the information to fit a certain context and that requires higher level thinking and reasoning. Working with science vocabulary and concepts through narrative writing translates into success in the science classroom as demonstrated by more confident participation, but a more in-depth study is needed to determine the actual impact on assessment scores.

Since the study of funds of knowledge grew out of the field of anthropology, it would be greatly beneficial to conduct a deeper ethnography of a few students' lives and cultures by visiting homes, interviewing families, and spending time with students outside of the school environment to observe and document, for example, how students learned while fixing cars and baking cheesecake. Did students ask the adults questions and vice versa? Was there a lot of explaining or was it more of a visual or kinesthetic learning environment? This would lead to a more detailed description of how students from different cultural backgrounds learn and if it is congruent with what is typically seen in mainstream classrooms across the United States.

Conclusion

National studies as well as observations of my own ESL students in science class show that ESL students need to be engaged more in science content. ESL students bring a wealth of life experiences to the classroom and previous research, along with the results of this study, demonstrate that if teachers can tap into that background knowledge more, they might see more participation and academic success for ESL students in science. Using personal narrative writing is an instructionally congruent way to integrate students' funds of knowledge and science content. Narrative writing provides students with a means to use their own voice to demonstrate their understanding of science concepts and vocabulary, exhibiting a level of comprehension and scientific thinking that may not be revealed in a traditional science exam. If we can help ESL students access science content in alternative ways, we can make science more meaningful and relevant to their lives and help them realize the science knowledge and skills they already possess.

AUTHOR

Dena Thorson teaches ESL at Dakota Hills Middle School in ISD 196. She has taught ESL at Job Corps in St. Paul, MN and in the Peace Corps in Estonia. She received an MA in Intercultural Relations from Lesley University and an MA in ESL from Hamline University. If you are interested in reading the entire capstone from which this article is excerpted, please contact her at dena.thorson@district196.org.

REFERENCES

American Association for the Advancement of Science. (1989). *Science for all Americans: A project 2061 report on literacy goals in science, mathematics, and technology*. Washington, D.C.: American Association for the Advancement of Science.

Aikenhead, G., & Jegede, O. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching, 36*(4), 269-287.

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. New York: Guilford Press.

Carlo, M. S., August, D., Mclaughlin, B., Snow, C. E., Dressler, C., Lippman, D. N., Lively, T., & White, C. (2004). Closing the gap: Addressing the vocabulary needs of English-language learners in bilingual and mainstream. *Reading Research Quarterly, 39*(2), 188-215. Retrieved July 2, 2010, from JSTOR database.

Cobern, W., & Loving, C. (2001). Defining "science" in a multicultural world: Implications for science education. *Science Education, 85*(1), 50-67.

Derewianka, B. (1991). *Exploring how texts work* (Rev. ed.). Rozelle, NSW: Primary English Teaching Association.

Duran, E., Gusman, J., & Shefelbine, J. (2005). *Access science.* Wilmington, MA: Great Source Education Group.

Fradd, S., & Lee, O. (1999). Teachers' roles in promoting science inquiry with students from diverse language backgrounds. *Educational Researcher, 28*(4), 14-20, 42. Retrieved June 26, 2011, from JSTOR database.

Francis, D. J., Rivera, M., Lesaux, N., Kieffer, M. & Rivera, H. (2006). *Practical guidelines for the education of English language learners: Research-based recommendations for instruction and academic interventions.* Portsmouth, NH: RMC Research Corporation, Center on Instruction.

Garcia, G.E. (2000). Bilingual children's reading. In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, & R. Barr (Eds.), *Handbook of reading research*, vol. 3, pp. 813-834. Mahwah, NJ: Lawrence Erlbaum Associates.

Gay, G. (2000). *Culturally responsive teaching: Theory, research, and practice*. New York: Teachers College Press.

Herman, D., & Childs, B. (2003, June). Narrative and cognition in Beowulf. *Style, 37*(2), 177-203. Retrieved June 22, 2010, from Expanded Academic ASAP database.

Hudson, T. (2007). *Teaching second language reading*. Oxford: Oxford University Press.

Isabelle, A. D. (2007). Teaching science using stories: The storyline approach. *Science Scope, 31*(2), 16-25. Retrieved June 22, 2010, from http://www.nsta.org/publications/browse_journals.aspx?action=issue&id=10.2505/3/ss07_031_02

Janzen, J. (2008). Teaching English language learners in the content areas. *Review of Educational Research, 78*(4), 1010-1038. Retrieved June 30, 2010, from JSTOR database.

Koda, K. (2005). *Insights into second language reading: A cross- linguistic approach*. New York: Cambridge University Press.

Lee, O. (2001). Culture and language in science education: What do we know and what do we need to know? *Journal of Research in Science Teaching, 38*(5), 499-501.

Lee, O. (2005). Science education with English language learners: Synthesis and research agenda. *Review of Educational Research, 75*(4), 491-530. Retrieved July 1, 2010, from JSTOR database.

Lee, O., Deaktor, R., Hart, J., Cuevas, P., & Enders, C. (2005). An instructional intervention's impact on the science and literacy achievement of culturally and linguistically diverse elementary students. *Journal of Research in Science Teaching, 42*(8), 857-887.

Lee, O., & Fradd, S. (1998). Science for all, including students from non-English-language backgrounds. *Educational Researcher, 27*(4), 12-21.

Lemke, J. (1990). *Talking science: Language, learning, and values*. Norwood, NJ: Ablex Publishing Company.

Luykx, A., Lee, O., Mahotiere, M., Lester, B., Hart, J., & Deaktor, R. (2007). Cultural and home language influences on children's responses to science assessments. *Teachers College Record, 109*(4), 897-926. Retrieved June 23, 2010, from EBSCOhost database.

McKeown, M.G., & Beck, I. (2004) Direct and rich instruction. In J.F. Bauman & E.J. Kame'enui (Eds.), *Vocabulary instruction: Research to practice* (pp. 13-27). New York: The Gifford Press.

Moll, L. C., Amanti, C., Neff, D., & Gonzalez, N. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice, 31*(2), 132-141. Retrieved July 1, 2010, from JSTOR database.

Moll, C., & Greenberg, J. (1990) Creating zones of possibilities: Combining social contexts for instruction. In Moll L. C. (Ed.), *Vygotsky and education: Instructional implications and applications of sociohistorical psychology* (p. 319–348). New York: Cambridge University Press.

National Center for Education Statistics. (2009) *The nation's report card: National assessment of educational progress at grades 4, 8, and 12.* Retrieved July 7, 2011, from http://nces.ed.gov/nationsreportcard/naepdata/

Solano-Flores, G., & Nelson-Barber, S. (2001). On the cultural validity of science assessments. *Journal of Research in Science Teaching, 38*(5), 553-573. Retrieved June 24, 2010, from John Wiley & Sons database.

Townsend, D., & Collins, P. (2009). Academic vocabulary and middle school English learners: An intervention study. *Reading and Writing, 22*(9), 993-1019. Retrieved July 2, 2010, from CSA Linguistics and Language Behavior Abstracts database.

Vélez-Ibáñez, C. G., & Greenberg, J. B. (1992). Formation and transformation of funds of knowledge among U.S.-Mexican households. *Anthropology & Education Quarterly, 23*(4), 313-335. Retrieved July 1, 2010, from JSTOR database.

Vygotsky, L. S. (1986). *Thought and language* (A. Kozulin, Ed.) (Rev. ed.). Cambridge, MA: MIT Press. (Original work published 1934).

Warren, B., Ballenger, C., Ogonowski, M., Rosebery, A., & Hardicourt-Barnes, J. (2001). Rethinking diversity in learning science: The logic of everyday sense-making. *Journal of Research in Science Teaching, 38*(5), 529-552.

Wellington, J. J., & Osborne, J. (2001). *Language and literacy in science education*. Philadelphia, PA: Open University Press.

Zwiers, J. (2008). Building academic language: Essential practices for content classrooms. San Fransisco, CA: Jossey-Bass.