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The Implementation Of Interactive Science Notebooks And The Effect It Has On Students Writing

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THE IMPLEMENTATION OF INTERACTIVE SCIENCE NOTEBOOKS AND THE EFFECT IT HAS ON STUDENTS WRITING

by

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ABSTRACT

The purpose of this study was to determine whether or not my practice of implementing Interactive Science Notebooks (ISN) impacts 4th grade students writing in science. Through this action research, students' writing was analyzed to determine whether the use of ISN affected students' use of details, support claims and justifications in their written responses. Also through the use of the Interactive Science Notebook, students' use of science vocabulary in their writing was also analyzed. Finally, students' reflective writing practices were examined in order to determine how students understood and explored physical science. A triangulation of data gathered consisted of the use of rubrics, focus groups and one-on-one conferencing. The data collected from this action research implied that the Interactive Science Notebooks did indeed have an impact on students' scientific writing. Students writing reflections demonstrated an increase in the use of claims and evidence, and meaningful questions related to the science topic investigated.

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CHAPTER 1: INTRODUCTION

Writing in the elementary science classroom is an important skill that 4th graders need to develop. In fact, in 2006 Graham and Perin wrote a 77 page report to the Carnegie Corporation of New York about writing. In this report Graham and Perin referred to writing well as a necessity, as well as being a predictor of academic success. This success of being a good writer can provide students with tools to assist them in writing in other content areas such as science (Keys, 2000). In 4th grade, students were expected write expository and narrative essays based on a given prompt in order to pass the Florida Writes state assessment in the spring (FDOE, 2009). With so much emphasis on writing to prompts for the Florida Writes Assessment, educators sometimes forgot or pushed aside writing in the content areas such as Science. Therefore affecting students' writing in science became the focus of this action research.

Purpose

The purpose of this study was to determine whether or not my practice of implementing Interactive Science Notebooks IISN) impacts students writing in Science through the writing of claims and evidence in student reflections after they explored several physical science activities. .

Questions

In initiating this action research my overall question was how would my practice of implementing Interactive Science Notebooks (ISN) affect students' writing in Science? This was a broad question so I narrowed it down to three basic writing components that I analyzed throughout this study.

1. How would the use of ISN affect students' use of details, support claims and justifications in their written responses?

2. How would the use of the ISN affect students' use of science vocabulary in their writing?

3. How would the implementation of ISN affect student's reflective writing about explored physical science activities?

Rationale

As a 4th grade teacher I am required to teach writing to my students along with the content areas mathematics, science, social studies and language arts. I am confident about most subjects, but science has been one subject area that I have been least familiar. Unfortunately in some elementary schools, teachers do not have enough content knowledge or lack the self confidence to teach Science well. They also often do not have enough time to teach the entire required curriculum. In some cases, teachers do not have enough materials or enough labs to adequately teach science (Schwartz and Gess-Newsome, 2008). I believed that I was lacking in content knowledge and confidence needed to successfully teach my students science. I wasn't sure how to teach my 4th grade students to write in science through the use of claims and evidence, detailed observations, use of science vocabulary and creating meaningful questions. I decided to focus my action research on writing in physical science and examined my growth in delivering science instruction using Interactive Science Notebooks. In conjunction with this focus on my growth, I implemented the use of Interactive Science Notebooks as a tool to monitor and assess students writing through labs, and writing reflections in selected physical science activities.

Fulton and Campbell (2004) discuss how science journals/notebooks can be used as tools in order to help students understand scientific concepts and try to make sense out of what they learned through writing and organizational tools that were personally meaningful to them. The science notebook/journal, which I refer to as the Interactive Science Notebook (ISN) is one way that I planned to help my students improve in their scientific writing. Through my practice of implementing the ISN, I taught my students how to organize their science journal, take notes, write detailed observations and write reflective entries about what they learned along with using claims and evidence in their reflective writing. Fulton and Campbell went onto explain that it is important to give students enough think time, and discussion time prior to their writing in their journals. Students need to have examples of how to organize their ideas. Therefore modeling how to make technical diagrams, labels, and write efficient notes, create charts and graphs along with detailed written observations are essential to the success of the science notebooks according to Fulton and Campbell. Writing in the science content needs to be shown or modeled to students so they know what are the expectations of a complete written response are. Students written responses are also a way to determine whether or not they understand the science concept completely. Fulton and Campbell state that science notebooks can be used to assess the science content. I believe in the constructivist philosophy that if a child can construct their own meaning about what they are learning, then they can better understand the concept being taught as well as be able to explain and justify their reasoning through writing. This action research demonstrated that students can learn how to write in the content area of science through Interactive Science Notebooks.

Science explanations and content writing can be challenging for a 4th grader. At my school, the 3rd, 4th and 5th grade teams have met and discussed students writing during vertical alignment meetings. Through their collective experience and observations they have noted that students seem to have more experiences writing fictional stories, personal narratives, or "how-to" writing pieces due to the design of the order of instruction in Language Arts stated in each grade levels standards. Asking students to explain *why* something happened and use evidence to support their claim can be very daunting to them since they have not yet been taught how. Most 4th graders should be able to explain *what* has happened, *when* it happened and *who* was involved based on grade level benchmarks (FDOE, 2009). These simple components of writing are considered to be within the lower levels of cognitive development through Blooms taxonomy. The *why* and the *how* are higher level critical thinking skills like analyze, synthesize and evaluate. Aviles (2000) explained that according to Bloom's taxonomy the first cognitive level of knowledge represents the lowest or simplest taxonomy level. He also went on to explain that knowledge means define, identify, state, list, or recognize. This includes the basic who, what and when questions in student written responses in 4th grade.

In 1965 Bloom and fellow psychologists developed the various classifications of intellectual behavior in regards to learning. Bloom also found that over 95 % of test questions students encountered mainly required them to think at the lowest possible level and that is basically a recall of information. The why and the how explanations begin at the fourth level of Bloom's Taxonomy called analysis. In Blooms taxonomy, analysis is the first higher level of critical thinking that begins to mention using evidence to support a claim according to Aviles' (2000) article. The cognitive levels continue through synthesis and evaluation. In Bloom's taxonomy evaluation is considered the highest cognitive level and states that at this level one can "make judgments based on external criteria or internal evidence" (Aviles, 2000, p. 17). In a content area such as science, when I ask a student to write about why something has occurred, they rely on what they already know about the concept, what they observed about the concept and finally what they can conclude about the concept. Students should be able to sift through the facts, activities, prior knowledge in order to mesh their ideas together and form a valid conclusion about the science concept they are learning. Even if students were not comfortable with using science vocabulary in their explanations the idea of what they attempted to say should be seen through examples or support in their writing. With the Interactive Science Notebooks, I planned to help develop students' basic *knowledge level* writing into writing that demonstrated higher level critical thinking skills that Blooms taxonomy referred to as *evaluation* which includes justifications.

Understanding the science concept is the main goal of any science activity or investigation. Writing explanations with support and reflections on what student's have learned can demonstrate what they know about the concept. Chin and Brown (2002) wrote that writing explanations in science is "potentially" important because explanations can show students understanding of the how and why something is happening in science. Students need to be able to develop their writing explanations and reflections of scientific concepts in order to demonstrate their understanding of the science concept being learned.

At the 56th Annual Science Conference (ASC) in Detroit one of the main topics discussed was writing explanations in science. Within scientific writing students should be able to include claims, evidence and reasoning (2008). Students need to learn how to implement these components into their scientific writing through teacher modeling, analyzing other written responses and direct teaching lessons. Of course, they need a lot of practice to become scientific writers. In this action research I facilitated my students' learning using ISN to develop their scientific writing skills. I realized that I needed to learn how to ask higher level questions that would help my students think deeper about the science concepts. "Good questioning lies at the heart of meaningful learning" (Chin, 2002). Along with asking higher level questions, I anticipated that my students would learn how to ask better questions about what they were investigating as a direct result of my modeling. Students needed to learn what type of questions to ask each other in order to provoke one another's thinking. Sometimes a teacher can "suppress or avoid questions due to their own lack of knowledge" (Chin, 2002, p. 522). Students don't know how to scaffold each other thinking students through questioning techniques on their own. Through questioning I expected my students to be able to think more about the science concept and in turn show their thinking in their explanations using science vocabulary, and justifications with claim and evidence. With this focus of scientific writing in the ISN, students constructed their own meaning and made sense of the science they were investigating. Students bring to the table a variety of background knowledge and schema that helps them construct this understanding. Vygotsky referred to this as *constructivism*. He firmly believed in constructivism and that students learn by doing instead of just observing. Vygotsky and Piaget believed that "students bring prior knowledge into a learning situation in which they must critique and re-evaluate their understanding of it. This process of interpretation, articulation, and re-evaluation is repeated until they can demonstrate their comprehension of the subject" (Carvin, 2009, p. 1). Using the constructivist approach students gain a better understanding of the science concepts, which in turn may help them to be able to write more proficiently in their Interactive Science Notebooks.

I heard about the Interactive Science Notebooks (ISN) from a highly qualified science teacher and Science specialist in my district. The science specialist suggested that I go and observe another science teacher who was using the ISN in her diverse middle school classes from a lower socio- economic area. The classes ranged from 6^{th} – 8^{th} grade, with one having only ESOL students. After observing the students and their notebooks, I was aware that even with the ESOL students and students with more academic challenges, the entries in students ISN were full of science vocabulary, explanations and justifications. After talking with this colleague, I decided that I would try to implement the ISN in order to engage my students in science through writing about science and ultimately to maybe better understand more about science. The only thing hindering me was the question of *how* could I assess their writing in Science in conjunction with using the ISN. Again, through my graduate coursework I was becoming more familiar with qualitative and quantitative data, but not quite enough to know what to assess and how.

The challenge was to present opportunities for writing in science every chance I could. I had to create authentic, real-world science learning activities which promote learning but also guided students into questioning, thinking, discussing and ultimately writing critically about science concepts. I anticipated that students would be able to construct their own meaning about science through writing and participation in the activities. Throughout this process I realized that I would also need to determine how I would examine and assess my students' writing.

As an educator, assessing students' writing in the content areas has always been a challenge. As a 4^{th} grade teacher of writing, I assess students writing of narrative and expository essays on a weekly basis through our state rubrics or teacher created rubrics that focus on the specific skills taught. This can be very time consuming, especially when you are trying to give ongoing constructive feedback that could help students become better writers and help prepare them for the upcoming state assessment on writing in February. Through my graduate program, I became more aware of the importance of student's writing in mathematics and science. I also came to realize that I needed to change my ideas about assessment in the content area such as science if I wanted students to become more successful learners of science. I decided to use the Interactive Science Notebooks as a tool to assess student's writing. The ISN became a tool that assisted me in understanding students' thinking about the physical science experiments they experienced, as well as identify probably misconceptions they had.

My first "aha" moment about assessment was when I started reading *Active Assessment for Active Science* by Hein and Price. Here I found that the forms of assessment are almost as diverse as the students themselves. Hein and Price (1994), state that our teaching needs to be effective by providing student with opportunities to "construct, apply and restate concepts". In addition these assessments should allow "students to express how they have understood the world around them through different ways" (p. 14). It was my belief that the ISN provide an opportunity for my students to demonstrate their understanding of what they understood about science.

As I continued to research background information about my topic, I realize that as a teacher, I must first decide *what* I expect the children to learn. From there, I need to observe them discussing the concepts with each other, look at their writing, interview them one on one and ultimately have them show me through written expression, what they have understood. This can't be done in a ten question quiz. Qualitative assessment encompasses a wide range of options and can give you a bigger picture of what the student is learning through multiple pathways of assessing. "The backbone of qualitative research is extensive collection of data, typically from multiple sources of information" (Creswell, 1998). With the ISN, I realized that I would need to determine what source(s) I needed to assess student's scientific writing. Through rubrics, focus group questions, anecdotal notes from one-on-one interviews I analyzed students writing and thoughts about scientific writing.

Through this action research on my use of ISN, I wanted to answer my research questions and share the findings with the other educators. Also, I wanted to share the successes and challenges I faced using Interactive Science Notebooks with my fourth grade students. I decided to continue using the ISN beyond the scope of my action research project and used it for the remainder of the school year in order to analyze its affect on students' scientific writing over an extended span of time.

Assumptions

Through my teaching experience and investigation of the research literature, I began this study with some assumptions. First, that I would be able to modify the Cornell Note taking method of right side (input from teacher) to right side (output from student's understanding and observations) within the Interactive Science Notebooks to fit the needs of my 4^{th} graders. The Cornell Note method is a middle school model. Although I received a modified version of this input/output method from a county science specialist, it presented a big challenge to some of my inclusion students. They were not accustomed to coming up with their own ideas of how to share the science learned and relied on what I modeled. Another assumption I had was that in focusing on the writing aspect within the Interactive Science Notebook, I would be able to analyze students writing samples to determine their understanding of the science concept or recognize any misconceptions in their writing. To include science understanding and misconceptions in my analysis became a huge undertaking; therefore my focus of data collecting was limited to student's actual writing reflections with the use of claims and evidence, science vocabulary and questions. A third assumption was that I would have accessibility to the science lab and be on a consistent schedule with my 4^{th} graders. This proved to be difficult due to the science lab not being ready because we just moved into a new school and in the scheduling of time in the science lab.

Limitations

One of the limitations that I faced was that the Interactive Science Notebooks (journals) were used mainly in a middle and high school setting and not in the elementary school. Some of the writing within the ISN had to be modified to fit the needs of my 4^{th} graders. For clarification, the Cornell Note System is a very detailed and complex organizational tool. It is used in the

AVID (2007) program to promote students study skills in middle school. With so much focus on writing, the internal validity could have been compromised due to students' attitude towards writing since I do have an inclusion classroom with students who have Individual Education Plans (IEP's) that contain learning goals in writing. According to Fraenkel and Wallen (2009) internal validity could include student attitudes. Another possible limitation was that since I am the teacher and researcher there could have been some bias in the data collected. However, the triangulation of data collecting through the use of rubrics, focus questions and anecdotal notes helped to ensure credibility of the results gathered. Since I had not used the Interactive Science Notebooks before, I needed to create my own ISN sample as I went through the unit of physical science with my students. I also modeled entries for students so that they would know what the expectations were for their lab entries, drawings and reflections. This proved to be very time consuming (Reardon, 2002) and therefore extended the amount of time modeling the format of the ISN in this unit of physical science. My 4th graders needed continual practice with this organizational format of taking notes, observations for their labs and writing about science. Another limitation to this action research was the amount of background knowledge about physical science that my students had prior to this unit from the previous year. The data collected from this study could have been more revealing if it continued to the end of the school year in order to see the long range effect on students writing.

Terms

Bloom's Taxonomy – a hierarchy of critical thinking levels (Aviles, 2000).

Claim – a statement or conclusion that answers the original question/problem (McNeill and Krajik, 2007).

Constructivism – a philosophy that states children can learn by constructing their own meaning.

Cornell Notes – an organized format of note taking that enables students categorize information, then analyze and study the information through an "input/output" method (Learning Toolbox, 2009)

Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim (McNeill and Krajik, 2007).

Florida Writes – a state writing assessment given to all 4th graders that is based on prompts (FDOE, 2009).

Input – information that a teacher gives to a student such as specific notes about a subject, definition of words and/or phrases on the right side of the journal page (Learning Toolbox, 2009).

Interactive Science Notebooks – an interactive notebook that contains a variety of detailed graphic organizers, pictures, tables, notes (Cornell format) and labs. The ISN provides strategies to create a personal, organized and documented learning record (Waldman and Crippen, 2009).

Internal Validity - "any relationship observed between two or more variables should be unambiguous as to what it means rather than being due to something else" (Fraenkel and Wallen, p. 166)

Output- an organized format of what students learned from the notes and lab (usually on the left side of the journal page). Students select how they will show what they've learned through a variety of graphic organizers, tables, charts, diagrams, pictures etc. (Learning Toolbox, 2009).

Rubric – describe levels of performance or understanding for a particular topic (Marzano, 2000).

Reflection – a form of personal response to experiences, situations, events or new information. A 'processing' phase where thinking and learning take place Brookfield, 1987).

Sunshine State Standards – a set of standards created in all content areas that direct the instruction and expectations of a specific grade level (FDOE, 2009-2010).

Technical drawing – drawings and/or sketches that represent an observation or explanation of a science lab (Waldman and Crippen, 2009).

Summary

I have explained my journey which led me to conduct my action research on how I used Interactive Science Notebooks to analyze student's writing in selected physical science activities.

Chapter Two reviewed how I presented the literature review. Chapter Three the methodology and design of this action research were discussed. In Chapter Four, the data were reviewed and analyzed as it related to my implementation of the ISN and its impact on students writing. In Chapter Five I presented conclusions for this action research and stated possible implications of my findings along with future research possibilities.

CHAPTER 2: LITERATURE REVIEW

Introduction

This literature review summarizes relevant research that supported the overall question of how my practice of implementing interactive science notebooks during a Physical Science unit affected students writing couched in the conceptual framework focused on the importance of inquiry and misconceptions in student learning.

This chapter opens with a brief background of where Science is today on a national level. It discusses Dewey's concern about teaching children science. Inquiry is discussed as a form of classroom instruction that includes the use of claims and evidence. Further in the chapter Interactive Science Notebooks are introduced as a tool that supports students' involvement in the learning and writing about science. To reinforce writing in the ISN, this chapter also discusses how writing can reinforce students understanding about science. Within the writing component of notebook/journal writing, misconceptions can be identified and clarified.

Science is quickly becoming a focused area of study due to student's low performance in the science disciplines. In math and science U.S. 15 year-olds are being outperformed by the majority of their peers around the world according to the Program for International Students Assessments (PISA) highlight report in 2006. In this report it stated that out of the 30 countries who are a part of the OECD (Organization for Economic Cooperation and Development) the United States scored lower than the 499 average. In fact, the U.S. ranked 22 out of 30 under scientific evidence, 23 out of 30 under scientific explanations and 21 out of 30 under science literacy. This report indicates that the U.S falls short in science competency compared to a number of other countries around the world.

How students learn science, and how to teach science has been a well discussed topic over the years. Throughout science education you can find varying views on the problems that exist in science education today. As far back as the 1900's there emerged concerns over science education. Professor John Dewey addressed the American Association for the Advancement of Science in Boston, MA in 1909. In his speech, Dewey revealed his concerns with the status and quality of student's scientific thinking as well as the quality of teaching science within the school system. He by his own admission stated that the subject area of science itself was extremely broad in the mass of information needed to be taught. Therefore, due to this amount of information, teachers were teaching many different science topics across the board, but not teaching in depth to where children truly understood the basic science concepts. Dewey also held true to the ideal that science education should begin in the early years. In one of his speeches, Dewey stated that "the attitude toward the study of science is, and should be, fixed during the earlier years of life" (1909, p. 123). And rightly so, today science has become a core content area of education in our elementary schools. However, there still exists a difference of opinions over how children learn science, how teachers teach science and how to get children to understand science.

Today it seems that the concerns are even more widespread about students' achievement in science. One concern is that science is not taught often enough or in-depth enough for our children to fully understand scientific concepts and principles. A research brief was written in California by the Lawrence Hall of Science. They claim that "there is a lack of time, training, money, and relevance when it comes to science teaching" (2006-2007, p. 1). The article goes on to further state that, "80% of multiple-subject k-5teachers who are responsible for teaching science in their classrooms reported spending 60 minutes or less per week on science with 16% of teachers spending no time at all on science"(p. 1). In addition to not being taught science, especially in the elementary grades is often taught by teachers who do not have substantial science subject content and report not feeling qualified to teach it. In fact, some teachers in the middle grades often lack strong science content. In 2000, The National Academies Press of Washington, D.C. wrote their revisions for 2008 report. In this paper they stated that "93% of students in grades 5–8 were taught physical science by a teacher lacking a major or certification in the physical sciences (chemistry, geology, general science, or physics)". Tilgner (1990) also makes reference to the three obstacles elementary teachers faced 20 years ago when teaching science which include: (1) Inadequate teacher background in science, (2) inadequate science equipment, and (3) inadequate time and space (p. 421). Unfortunately this has been an ongoing dilemma in the teaching of science. While the lack of science teacher's content knowledge seems to be an added struggle within the boundaries of Science education, the way student's learn and understand scientific concepts appears to be even more prevalent.

Inquiry

As educators what can we do to help fill the gap in science understanding beginning with our elementary school children? Of course it goes without saying that what we need are competent, educated and enthusiastic teachers to teach science in a way that can create and nurture a learning environment of scientific understanding. Research has been done on the effects of teaching science through inquiry in order to achieve higher level thinking and understanding of scientific concepts. Baxter, Bass and Glasser (2001) stated that "inquiry is viewed as a key strategy for developing students' understanding of science concepts" (p. 123). In their study on three fifth grade classrooms, guided inquiry or open inquiry was used in conjunction with notebook writing for students to demonstrate their understanding of science concepts.

Pearce (1999) wrote that "the job of the educator is to help children recognize, explore, and celebrate logical, rigorous thought and elegant reasoning" which he refers to as inquiry (p. viii). He also went on to explain that children are natural scientists from a young age because they are curious about the world around them. The inquiry approach cycle that Pierce refers to includes: the student, testable questions, experimental design, discoveries and student dissemination (p. 6); in the midst of these categories lays an underlying element of *communication* through *discussing* and *writing*. Pearce explains that this inquiry cycle as student experiences and curiosities where students answer the questions of how, why, what or is it possible. The cycle continues with the experimental design which includes controls, variables and scientific thinking. There is also the discovery portion where students make observations, and collects data. The end of the inquiry cycle includes students' dissemination of the concept through presentations, journal articles and books. He does claim that "children learn best through scientific inquiry" (p. 66) and that National Science Education Standards are written as a "blueprint to improve science curricula" (p. 66). These standards support inquiry based science according to Pearce. With the standards in place and research to support inquiry based science we as educators need to reflect upon our own practice to determine whether or not we are meeting our students' needs in science.

The National Science Teachers Association (NSTA) claims that "scientific inquiry is a powerful way of understanding science content. Students learn how to ask questions and use evidence to answer them. Students collect evidence ….develop an explanation from the data, and communicate and defend their conclusions" (2000, p. 1). In addition, NSTA has included science inquiry as one of their content standards. There are some who feel that inquiry is a natural part of a child's perception of science. Pearce (1999) explains that children "use the processes of science" without being taught. Science inquiry includes children asking questions and figuring out the solutions to those questions (p. 5). Within the constraints of science inquiry lies student's thinking, analyzing, reasoning, explaining, and justifying through the process of inquiry.

This evidence of students thinking and questioning can be demonstrated through *scientific writing*. According to the Department for Children, Schools and Families on Better Writing in Science (2005), "pupils need to develop the skills of writing in science in order to clearly communicate the full extent of their ideas, knowledge and understanding" (p. 1). Writing in science notebooks/journals is just one avenue to analyze students thought processes and show evidence of their scientific understanding through inquiry based activities. The Interactive Science Notebooks (ISN) take notebooks/journaling a step further and adds a variety of note taking strategies, graphic organizers and students output products in conjunction with a focus on writing. Hence, ISN is a tool that can assist students in documenting and reporting their content and process understanding obtained through their science inquiry experiences.

Interactive Science Notebooks

The Interactive Science Notebook is another form science notebooks or science journals. All three use writing as a focus for students to demonstrate their understanding of the science concept being learned. Waldeman and Kent (2009) claim that an Interactive Science Notebook (ISN) can be a powerful instruction tool, allowing students to take control of their learning while processing information and engaging in self-reflection" (p. 51). They also go on to claim that the ISN helps students to become more organized and helps them to document their process of learning and thinking through science activities. Interactive notebooks are diverse in their content and can be very colorful. Students determine how they will synthesize the information that they've learned through a variety of ways such as but not limited to: charts, tables, graphic organizers, sketches and writing.

Chesbro (2006) explains in his article about Interactive Science Notebooks, that they "promotes the most cutting-edge constructivist teachings strategies while simultaneously addressing standards, differentiation of instruction" (p. 31). He used the two column input/output method in his 8th grade classroom. This two column input/output method is modeled after the Cornell notes model organized note taking. The right side (input) contains "lecture notes, lab data, reading notes, etc. and then students process that input in a meaningful and personalized manner on the left side pages in the form of output" (p. 31). Chesbro claims that this form of organization "requires students to show that they get the content of the lab in a way that works for them", (p. 33). The Orange County Public School System has adopted the Cornell Note taking system and it is located on some middle and high school web sites as a form of study program (2009, p. 1). Swanson (2002) describes the Cornell Notetaking System as a "method for understanding information, not just recording facts". She also claims that Cornell notes are used to "organize ideas into categories and to help students better understand" the concepts being taught (p. 5). Swanson adapted the Cornell Notetaking model from AVID. AVID is a program for elementary, middle and high school students. It is an "effort to create college-ready students" that encourages students to succeed in many areas such as "speaking, listening, self-advocacy, study habits, organization, note taking with an emphasis on writing and inquiry" (AVID, 2010, p. 1). Gilbert and Kotelman (2005) found that science notebooks "open the door to expository writing with procedural writing, narrative writing, descriptive writing, and labeling" (p. 30). They also concurred that the writing in science notebooks "helped students feel more comfortable with the writing process- and that this practice and the skills developed during it transferred to more formal writing assignments" "(p. 30). The implication here suggests that more content writing could be beneficial for students.

Writing in journals

In order to develop science inquiry in the classroom, educators must be able to teach children to think like a scientist through inquiry based activities. Children need to be guided into thinking like a scientist, reading like a scientist, and *writing* like a scientist (Saul, Pearce, Dieckman and Neutze, 2002). Unfortunately, some children want to hurry and get their science activity completed. They sometimes prefer multiple choice questions and dread any short and/or extended responses that require content writing to justify or explain. In fact, "It is suspected that students have been conditioned to expect a single correct answer to scientific inquiry, and that this level of change presents a serious challenge to their long-held thinking" (Ruebush, Sulikowski, North, 2009, p. 21). Writing in science can be used as a way for students to demonstrate their understanding of science concepts outside of the basic single correct answer method. Reardon (2002, believes through science inquiry, "children not only will think, read and write like a scientist but they will be able to talk, figure out, ask questions, and listen" (p 19). Through the science labs or workshops writing can be used as a segue between students thinking process and science inquiry. Even professional scientists use some form of writing notebooks for data, observations, and reflective thinking points. In an article by Garcia-Mila and Anderson (2007) they wrote about writing in science through inquiry. This article goes onto say that a "scientist cannot rely on memory alone and must record cumulative data for later examination….a notebook can serve as medium for communication and discussion of data, results and findings with others" (p. 1037). According to this research it could be said that writing within the science content through journals and notebooks, enables teachers to evaluate student's understanding and identify any misconceptions they may have.

Another study was conducted in 2001 where three fifth grade teachers' facilitated using notebook writing as part of their inquiry based science lessons. They found that "the use of notebooks in science inquiry based classrooms can encourage and make apparent the nature of student inquiry and knowledge development" (Baxter, Bass and Glasser, 2001, p. 138). However, in the article it was also acknowledged "that science notebooks are sensitive to teacher influence especially in elementary school" (p. 138). Teacher input would appear to be an important factor in using science notebooks. If a teacher contributes too much information, students are only copying what is presented and there is likely no true understanding. Keys (2000), explains that "writing about investigations can contribute directly to science learning". She also goes on to admit that writing in science "continues to be a research focus for scholars" (p. 676). Garcia-Mila and Anderson (2009) also agree that "the educational research on writing during scientific inquiry is limited" (p. 1037). There still needs to be more research conducted on what type of writing is effective in science to increase students understanding. There are some benefits to writing in science. According to Garcia-Mila and Anderson' article, "notes can help students to clarify their thoughts" (p. 1038). However, this article mainly addressed note taking in science and not writing heuristically. Keys, Hand, Prain and Collen (1999) found that some students were not sure what to take notes on. This would imply the importance of modeling what is important and what wasn't when taking notes.

Fulton and Campbell (2004) write that the student-centered notebooks can help students organize their thoughts and ideas through, "notes, lists, technical drawings, diagrams, charts, tables, graphs and written observations" (p. 28). This could also imply the use of science journals or notebooks needs to be taught very explicitly for writing, organizing, analyzing and evaluating science content. Science journals cannot elicit higher-level thinking, explanations and questioning on its own. A teacher must model and teach how to get students to dig deeper. The science journal can be used for students to express their thoughts and ideas in complete and detailed explanations. Klentschy (2005) wrote that a science notebook is a "central place where language, data and experience work together to form meaning for the student" (p. 24). Writing explanations is part of forming meaning for students. In an article from the National Research Council, it stated that "scientist develop explanations using observations (evidence) and what they already know about the worlds (scientific knowledge). Good explanations are based on evidence from investigations. "Scientists review and ask questions about the results" (1996, p. 123). Research supports that writing in science helps students to understand the content.

Lawrence Hall of Science, (2010) wrote that one of the benefits of using a science notebook is so that "students think critically about their thinking" (p. 4). Using the science notebooks enables students to go back and analyze their science investigations and "clarify their understanding of the science concepts" (p. 5) learned. The notebooks also reinforce the use of claims and evidence which support students learning and thinking about science. The Fossweb, which is created by Lawrence Hall of Science, maintains on their site that the science notebook is a way for students to "generate a sequential exposition of their reasoning and conclusions along with providing a place for student to write reflections about their thinking" (p.1). The assessment aspect of the science notebook could also be a benefit to teachers since it contains students' thinking. "A science notebook helps you think about and communicate the conceptual structure of the science topic or concept you are teaching" according to Foss Science Notebooks (2010, p. 5). This in turn could assist a teacher in finding out whether or not students have a clear understanding of the science topic or concept.

Misconceptions

Misconceptions can be identified through the student's explanations, pictorial representations or the type of questions they create within science journals/notebooks. According to Gilbert and Kotelman (2005) one of the reasons that it is beneficial to use science notebooks is because teachers could determine what their students were thinking and "what they do and don't understand, what misconceptions they have" (p. 30). This would be very beneficial in determining where misconceptions originated during a lesson. In conjunction with this idea, Ruiz-Primo, Li and Shavelson's, (2002) research on science notebooks discuss how science notebooks can give a measurement of what students know such as, "were student's communications in the notebooks complete? Did they indicate conceptual understanding of the content presented?" (p. 3). They felt that the science notebook can give "reliable and valid information on student performance" (p. 3). In addition, Klentschy (2005) also wrote that the science journal can help teachers "examine student understanding of the concept being taught, identify any misconceptions, and plan subsequent instruction" (p. 25). The science notebook can help to assess what students ideas are about science concepts. Using a science notebook or journal with explicit explanations, diagrams, pictures, questions and reflective thinking could lead students to a deeper understanding about science concepts and help eliminate science misconceptions.

Driver, Squires, Rushworth and Wood-Robinson (1994) found that children can have misconceptions about physical science. Many times children attribute matter to “mean those things that are required to make objects” due to the science verbiage of using the word “material” in relation to matter. Students can create misconceptions based on the different ways words are used in the science constructs. It is important to make sure students understand the science word in context to the topic or concept and not on prior knowledge of the word. Use of a science journal can reveal such misconceptions in students writing as students use the vocabulary to explain their thinking. Driver *et al*, also wrote that when dealing with density, students at times may have misconceptions based on the “arrangement, the concentration and the mass of the particles” (p. 78). Students come into the classroom with preconceived ideas about science. Driver et al wrote that “children’s conceptions about science are shaped by personal experience” p. (3). However they go on to say that “individual’s ideas are affirmed and shared by others in classroom exchanges and has a part to play in shaping the knowledge construction process” (p. 3). In utilizing science journaling and encouraging students’ communication about the science content, there could be an impact on identifying student misconceptions.

Scientific journaling is a tool teacher’s can use to recognize student misconceptions of scientific concepts. Hewson and Hewson (1981), article on conceptual change strategies, discuss in a study they conducted in the early 1980’s about “the importance of a student’s existing knowledge in influencing that person’s subsequent learning” (1981, p. 1). Too often, teachers assume that students *get it* or they rush through concepts to cover all the expectations not realizing the number of misconceptions that students may have or create as they are learning science using traditional methods. The use of journaling or science notebooks can allow for those misconceptions to be more easily recognizable by teachers and they can in turn attempt to help students reconceptualize important scientific concepts. The science notebook, science journal and interactive science notebooks contain the same qualities of scientific thinking and writing. However, the organization of them appears to vary depending on the teacher's objectives and focus. Through the writing in journals, notebooks or interactive science notebooks, students' thoughts and ideas can be analyzed and misconceptions likely could be identified.

Summary

This chapter examined the research related to implementing Interactive Science Notebooks. The basic research regarding teachers being competent in teaching has been discussed. There does appear to be a need for additional support and instruction in the science content areas especially for teachers in grades 5-8. Also according to the research examined, the ISN can be implemented through guided inquiry so that students are able to show their process of learning through writing and engaging input/output activities. Writing in the content area of science would appear to be a very important venue as far as research is concerned. However, I did not locate as much information regarding the implications of writing in the science content. It also became apparent that more research is needed in the content area, and in using the ISN's in an elementary school setting. In articles examined through this literature review, researchers agreed that misconceptions of science concepts could be addressed through the use of writing in science journals/notebooks.

Chapter three contains the methodology to which this action research was implemented. It will explain the design of this study along with the school and classroom settings. This chapter also described the instruments that were used and analyzed the data that was gathered.

CHAPTER 3: METHODS

Introduction

My overall question for this study was "How did the implementation of Interactive Science Notebooks (ISN) impact students writing in Science?" My sub questions were:

1. How did the use of ISN affect student's use of claims and justifications in their written responses?
2. How did the use of the ISN affect student's use of science vocabulary in their writing?
3. How did the implementation of ISN affect student's reflective writing about Physical Science?

Concepts that were included under the general topic of Physical Science were: *matter, density, mass, physical change and chemical change*. In chapter 3 I explain the research design, school and class setting, and data collecting methods that were used in the implementation of the Interactive Science Notebooks.

Design of the Study

The design of this study was action research. Action research is "a type of research focused on a specific local problem and resulting in an action plan to address the problem" (Fraenkel and Wallen p. G1). This action research was conducted in my 4th grade classroom during the first semester of the school year 2009/2010. Guided by the research questions, I investigated my use of Interactive Science Notebooks and the affect they had on students writing in an elementary science classroom.

In order to maintain credibility and trustworthiness in this action research, I triangulated across data sources to analyze students writing through focus groups, one-on-one interviews and rubric to analyze students' reflections. Using an action research design the ISN was examined according to the four stated research questions. .

School Setting

This elementary school is located in an affluent, urban area in Central Florida. The action research was completed on one classroom of twenty three students. This K-5 population consisted of 626 students. Of that enrollment, 15.3% of the students receive free and reduced lunch. The school population consisted of 81.8% Caucasian, 1% Hispanic, 12.8% African American, and 2.7 % are other and multiracial. Fifty one percent are boys, 48.9% are girls. The Exceptional Education (ESE) population is at 23.6% and the ELL population is 3.4%.

Classroom Setting

The participants in this study, who are in a self-contained inclusion class, range in age from 9 – 10 years of age in this class. It is an inclusion classroom. All of the students in this class participated in this action research. There were 12 girls and 11 boys. Within this cluster of students, one student is an ESOL student (English Speakers of another Language) with more than 4 years in the program. Two students are classified as gifted. Seven students are classified with a Learning Disability (LD) which includes a current Individual Education Plan (IEP) in all subject areas and four students have a 504 plan which enables them to have more time on assessments and modified assignments. I have four African American children, two Hispanic children, two Asian children and fifteen other or Caucasian children. The 4^{th} grade class was representative of the schools ethnic population.

Methodology

The science topic studied in this action research was obtained from the Florida Science State Standards for 4th grade science (Table 1). As teacher and researcher, I based my order of instruction on the counties recommended scope and sequence for 4th grade Physical Science (Table 2). Activities and labs were presented according to these state requirements. As teacher and researcher, I implemented the use of Interactive Science Notebooks during the science block for a period of 16 weeks. Science lab was conducted on Tuesdays and Thursdays each week for approximately one hour. Fridays were sometimes used to finish writing reflections.

The IRB was contacted for permission (Appendix C) to work with students in this school district. Permission was also obtained from the county (Appendix D) in order to work with the students in this action research study. The principal of the elementary school was asked permission to work with students (Appendix E). A letter describing the study and assurance of confidentiality was written and given to all parents in the study classroom.

Confidentiality was assured since I was the only person having access to the data collected. Students were assigned pseudo names for data collection and reporting purposes. Confidentiality was protected since all the data collected was kept in a secured file cabinet in researchers' room. Parents were introduced to the study in a home visit prior to the beginning of school and I was able to answer any questions parents had. Parent consent forms were sent home the second week of school with details about the study (Appendix F). A phone call or e-mail was completed in order to do a follow up for those who do not return the forms. Students, who did submit the required documents of consent, were excluded in the final analysis of this study. In addition to insuring equity to all students, letters in native languages were available. Students were given the student consent form to sign after I read it to the class (Appendix G).

Table 1: Florida Sunshine State Standards 4th grade Physical Science

Sunshine State Standards Physical Science 4th grade
SC.A.1.2.1 determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers). *Identifies properties and uses appropriate tools to determine the properties of materials.* **SC.A.1.2.2** knows that common materials (e.g., water) can be changed from one state to another by heating and cooling. *Identifies how a change in temperature can alter a material's state of matter.* **SC.A.1.2.3** knows that the weight of an object always equals the sum of its parts. *Combines the weight or mass of components to get the total weight/mass of the combined object.* **SC.A.1.2.4** knows that different materials are made by physically combining substances and that different objects can be made by combining different materials. *Identifies different materials made by physically combining substances and/or identifies* *similarities and differences between mixtures and solutions.* **SC.A.1.2.5** knows that materials made by chemically combining two or more substances may have properties that differ from the original materials. *Identifies a change in properties as a result of a chemical change.* **SC.H.1.2.1** knows that it is important to keep accurate records and descriptions to provide information and clues on causes of discrepancies in repeated experiments. *Identifies and explains the reasons for documenting scientific activities.* **SC.H.1.2.2** knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results. (Also assesses H.1.2.4 and H.3.2.2) *Identifies, explains, and describes, or applies the scientific process (i.e., accurately reporting and analyzing data, reaching logical conclusions that reflect the data, repeating investigations for validity, asking new questions, and communicating results).* **SC.H.1.2.3** knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions. (Not assessed) **SC.H.1.2.4** knows that to compare and contrast observations and results is an essential skill in science. (Assessed as H.1.2.2)

Table 2: Description of topics

Thinking Like a Scientist	Students brainstormed together in their groups to come up with ideas about what a scientist does and what instruments they use. Groups shared ideas by putting them on a classroom chart. Teacher gave "input" of what a scientist does: observe, communicate, ask questions, investigate, hypothesize, draw conclusions and reflect. Students then created an "output" entry of the five senses using a graphic organizer or foldable. "Output" contained pictures and explanations of what each looks like for a scientist. Segue into "The apple of my eye" lab. Students observed the properties of an apple and record their data (output). Teacher's "input" was specific science vocabulary to be used in reflection: matter, mass, properties, and senses. Groups shared findings and wrote their first reflection about "Thinking Like A Scientist" at the back of their ISN.
Matter	Introduction to the three states of matter. Students "input" were a checklist of questions. They were given three bags: one with water, one with air and one with solids. In their groups, students discussed the questions/checklist and came up with two characteristics of what matter is. Students created a graphic organizer or foldable that represented the three states of matter with picture and description of what it looks like and how the particles move in each. Students shared their findings with each other. Concluding activity was writing a reflection about "What is Matter?" in the back of the ISN.
Mass	Discussion on the tools a scientist uses/connection to math (measurement). Students conducted a lab of observing a solid. The "input" was a lab sheet called "A Closer Look". Students were given a tray of measuring tools and a white seltzer tablet. Students wrote down the properties of the tablet, drew what it looked like with the unaided eye, a hand lens and a microscope. They also determined the best unit of measurement to use inches or centimeters to measure the diameter of the tablet. Students also used a scale to measure the mass in grams (rounding it to the nearest whole gram). Then the lab had students crush the tablet and make their observations on the properties as well as weigh the solid again. Students created an "output" foldable on scientific tools, vocabulary and properties. After group discussions and partner sharing, students wrote their third reflection about what they learned about the mass of a solid in their ISN.
Density	"Input"- a lab sheet. Students combined various liquids (corn syrup, oil, water and food coloring) together and observed what occurred. Then they added solid objects (piece of rubber band, paper clip, penny and a piece of Styrofoam). Students came up with conclusions about the liquids and the objects depending on where they were in their clear cup. Students discussed how dense a liquid was by where it was in the cup. They also did the same for the objects. Students drew a diagram in their "output" side of what the liquids and solids looked like when they were all combined. Students shared their conclusions with other groups and then wrote a reflection at the back of their ISN.
Physical Change	Students conducted four labs on how to separate a solid by sorting, filtering, evaporation and sifting. Students came up with a definition of what a physical change was in their groups. In their ISN, students made a thinking map (tree diagram) of the four types of physical change. They drew pictures and wrote examples of each type of physical change. "Input" was lab instructions. Then students shared their information with a partner and wrote about Physical Change in their reflection at the back of their ISN.

Table 3: Scope and Sequence

Thinking like a scientist *(preliminary activity)*	Matter	Density	Mass	Physical Change
Week 3-4	Week 5-7	Week 8-9	Week 10-11	Week 12-14

Instruments

Rubric

The first instrument used to evaluate student writing was a rubric (Appendix A). The purpose of this rubric was to evaluate students' reflective writing entries in their Interactive Science Notebooks. Students' writing was evaluated on their use of claims and evidence, use of science vocabulary in context and their response to a question that pertained to the concept that was investigated after each science lab. These writing reflections were written and evaluated at the end of each science concept taught. I selected McNeil's and Krajcik's (2008) claims and evidence rubric from their study on science explanations. Permission was given via e-mail (Appendix B). In addition to the claims and evidence section, two additional sections were constructed based on the questions formulated for this action research by a panel of science specialists. The two additional sections were analyzed by a panel of two science specialists to ensure that students writing was being evaluated based on the needs of this research. This instrument was administered at the conclusion of each taught science concept that was a part of this study. Specific topics were in explained in the data collection section. I collected the ISN's and used the said rubric to evaluate student's writing based on the three questions presented in the research.

Focus Groups

Two focus groups were created to analyze and discuss student's writing from their ISN's. The two groups included six students in each group. Group 1 consisted of four boys and two girls. Group 2 consisted of three girls and three boys. These twelve students were placed in 2 heterogeneous groups. The purposive sampling of students included in this action research was selected based on their writing performances. Varied writing levels were represented in both groups. After a science topic and writing reflection was completed, these focus groups met separately to discuss their writing based on the following focus questions:

1. Did you use specific details and examples in your science explanations? Give examples
2. How does using science vocabulary in your writing help you to understand more about what you are learning?
3. How does writing help you understand Science?
4. If you don't understand something during a science investigation or discussion, what can you do?
5. How does writing a reflection about what you have learned help you better understand a science concept that you've been working on?

Students were videotaped during these focus group discussions and their conversations were transcribed and analyzed at a later time. After the student discussions were analyzed, themes that emerged were identified and discussed in Chapter 4.

One-on-one conferencing

Students from each of the two groups participated in one-on-one conferencing sessions. At the end of a science concept students completed a written reflection based on what they learned. Sentence starters were given to students to ensure a common focus for their writing reflections based on the science concept. Students were called upon one by one for a one-on-one conference to analyze and discuss their writing reflections based on the same questions used in the focus groups. The focus questions were given to students in a written format. Students written responses to the questions helped direct the one-on-one conferences. Observations were taken during these conferences and were compared to the responses from the focus group discussions.

Data Collection

Students using the ISN were instructed how to organize their notebooks using the input/output note taking strategies (Appendix H). There was also direct instruction and modeling for the various types of output products that could best represent students thinking. Students were able to choose from ideas such as graphic organizers, flip books, sketches and tables. Students were also instructed to write down all their ideas; draw models that helped explain their thoughts, higher level questions, reflective thinking, and justifications regarding new information learned with guided direction from their teacher. This guided direction was executed through discussion, modeling and examples of the expectations. All journaling was done in class to avoid other's input (parents, etc.). Students had two hour science labs on Tuesdays and Thursdays. The last fifteen minutes of each lab were used for the reflection piece of the science journal. If needed, students were given an additional day to complete written reflections. Students used the ISN during their designated Science lab times. Rubrics for written reflections were used after the science labs were completed. Students were given a sentence stem to start their reflection and used the rubric to guide them during their writing to ensure that their written reflection contained all the information required within the rubric. Then students handed in their ISN's and I used the same rubric to evaluate their writing samples. There were five reflective entries on physical science. These reflections were used to analyze students' writing responses.

The focus groups met six times to discuss their writing during this 12 week study. Students used their ISN to find examples of details, use of science vocabulary and meaningful questions from their writing. One-on-one interviews were conducted periodically to discuss students writing through the use of the rubric. Observations were written down during these interviews. This ended up being a time where I was able to see student's misconceptions based on their writing samples. Students were also able to go back and rewrite reflections. However, for this study the initial rubric score was used in the tables presented. The validity of this action research is supported through the triangulation of data collected from students writing and discussions in the form of a rubric, focus groups and one-on-one questioning and the alignment of activities taught with state standards guidelines.

This action research began by the teacher's introduction of the Interactive Science Notebook to the class. It took approximately two weeks (two, one hour days each week) to create the ISN with cover, table of contents, author's page, inside covers with expectations and instructions on the modified Cornell note taking of input and output. Since I had to create my own notebook, I modeled how to number the pages of the ISN, how to write in the table of contents and what the expectations were on the completion of the labs and reflections in the notebook. I also gave mini-lessons on the requirements of the input and output format.

All four groups in my classroom were involved in the science labs. Two groups were selected to be participants in this action research based on the wide range of abilities within both groups. This would give a broader picture of the affect the writing had on all students. At the beginning of this research there were 23 students. Half way through the term a new student was enrolled. The student's data was not included in the data gathered for this research. Each group member was given number to correlate with the jobs and/or tasks for each lab. For example: #1-

materials manager; #2- science captain; #3- measurer,; #4 recorder; # 5- helper and #6 – time keeper. The science unit explored in this action research was Physical Science.

In our third week of science, our first science lab consisted of brainstorming in the four groups and coming up with ideas about what scientists do prior to starting Physical Science unit. This first lab entry was modeled in front of students. Students created their first entry based on the format modeled to them. First students brainstormed a list of what scientists do in each of their four groups. Then the recorders from each group added their ideas to a large chart paper at the front of class. The input side (right side) of the entry consisted of a variety of students ideas such as: scientists make observations, test and retest, conduct labs, write notes, set up experiments, share their data, record their data, make predictions, and come up with conclusions. I also gave input on very specific ideas about what scientists do for students to add to their notes. For the left side (output), students created some type of graphic organizer, table or chart that could best represent what scientists do. Some students chose match books, others created a tree map or miniature flip chart to represent output. See student sample (Appendix I).

In the second lab, students wrote their first reflection on "What a scientist does" based on the discussion and activity from two days prior. This was a struggle. On this initial entry, I did not give them any guidance other than to give them a sentence stem of "I learned that a scientist…." Or "One thing I learned about being a scientist is……." Many of my students wanted to know what to write but since I wanted to see their initial thoughts and ideas for my data, I did not direct this reflection. After about a half an hour I found two relatively complete reflections that contained a claim, and evidence. I showed students these examples on the document camera.

Data Analysis

In this study I used the following methods to analyze students writing: rubrics, focus groups, and one-one-one conferencing. All writing samples originated from students Interactive Science Notebooks. The reflective writing piece within the ISN was used to analyze student's writing responses with the use of a rubric (Appendix A). Students were directed to write a science reflection by writing about what they learned, using examples and details from their labs, use the science vocabulary that was introduced and finally to write down any questions that were still in their minds. Writing samples in the form of student reflections were collected after each of the five science topics were completed and evaluated according to the rubric. The rubric scoring was based on a 0-3 point system for each section. The three sections included: using claims and evidence, (McNeill and Krajcik 2008), use of science vocabulary in context, and creating meaningful questions related to the science concept. The requirements of the ISN for organization and expectations were inserted at the beginning of the notebooks. Students were given a detailed explanation when these requirements were gone over in class at the onset of the ISN.

Focus groups were used to analyze students' responses regarding their reflective writing in science. The discussions were videotaped and transcribed word by word in order to determine whether or not students felt that the use of the ISN's had an effect on their writing in science. The focus questions (Appendix K) helped to guide the discussions so that the data collected was not manipulated in one way or another by random questioning.

One-on-one interviews were conducted so that students could analyze their own writing and discuss the positive and negative elements of writing about science in their ISN's. The same questions that were used during the Focus Groups were given in a survey format to individual students so that they could write with liberty about their own writing. See student sample

(Appendix L). The interviews may have helped to eliminate any self-consciousness the students had regarding sharing their writing reflections and discussing them.

Data generated in this study were examined across methods for emergent themes related to the implementation of the ISN and the effect it had on students writing in the content area of science. Credibility was ensured due to the triangulation of data from the rubric, focus questions one-on-one interviews. The reliability of the data gathered was reinforced by three different instruments. I also used a combination of "quantitative and qualitative data to clarify and validate my findings" (Fraenkel and Wallen, 2009).

Summary

This action research study of implementing Interactive Science Notebooks was attempting to analyze 4th grade students writing in the science content area. Students wrote a reflection at the end of each topic taught in the Physical Science unit. Within the reflections, students used claims and evidence, science vocabulary in context, along with meaningful questions that correlated to the content being studied.

In chapter 4 I discussed how ISN's have affected student writing with claims and evidence, use of science vocabulary and generating of meaningful questions related to the science topic and how my student learned to express their ideas about science.

CHAPTER 4: DATA ANALYSIS

Introduction

This action research study collected and evaluated students writing samples from Interactive Science Notebooks. Twenty three 4th grade students participated in this study during the fall of 2010. Throughout the descriptions of each method of gathering and analyzing data, the researcher explains what themes emerged. The following questions were used throughout this study.

1. How did the use of the Interactive Science Notebook (ISN) affect students' use of claims and evidence in their written reflections?
2. How did the use of the ISN affect students' use of science vocabulary in context within their writing?
3. How did the implementation of the ISN affect student's use of meaningful and related questions in their reflective writing?

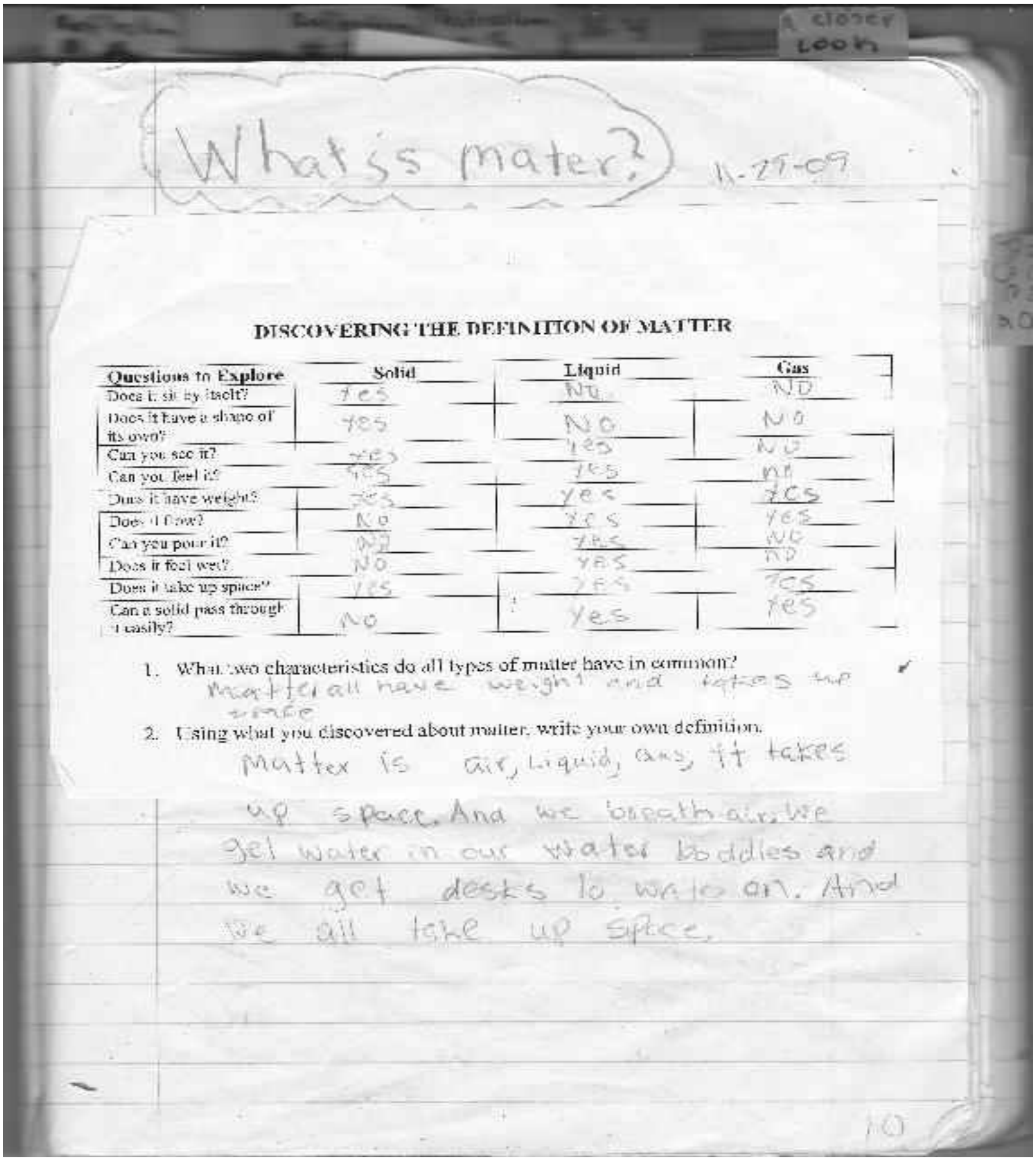
Implementation of the Interactive Science Notebook

The Interactive Science Notebook (ISN) was introduced as a means for students to show their thinking through writing about science. It took approximately two weeks (two, one hour days each week) to create the ISN with cover, table of contents, author's page, inside covers with expectations and instructions on the modified Cornell note taking of input and output. Since I was also creating my own notebook, I modeled how to number the pages of the ISN, how to write in the table of contents and what the expectations of were about the completion of labs and reflections in the notebook. I also gave a mini-lesson on the input and output requirements (Appendix H).

My 23 students were assigned to four heterogeneous groups. Each group member was given number to correlate with the jobs and/or tasks for each lab. For example: #1- materials manager, #2 - science captain, #3 - measurer, #4 – recorder, # 5- spokesperson and #6 – time keeper/time on task manager.

Typical Science Day

The science workshop was conducted twice a week on Tuesdays and Thursdays in the afternoon. The investigation on matter began with students gluing in their lab activity sheet onto the right side (input) of their notebook as shown in figure 1 (permission to use by Dr. L. Chew, UCF). This topic on matter is used as a framework to demonstrate the various kinds of activities, and products used in my instruction during our science block.



What's mater? 11-27-09

DISCOVERING THE DEFINITION OF MATTER

Questions to Explore	Solid	Liquid	Gas
Does it sit by itself?	yes	No	No
Does it have a shape of its own?	yes	No	No
Can you see it?	yes	yes	No
Can you feel it?	yes	yes	no
Does it have weight?	yes	yes	yes
Does it flow?	No	yes	yes
Can you pour it?	No	yes	No
Does it feel wet?	No	yes	No
Does it take up space?	yes	yes	yes
Can a solid pass through it easily?	No	yes	yes

1. What two characteristics do all types of matter have in common?
Matter all have weight and takes up space
2. Using what you discovered about matter, write your own definition.
Matter is air, Liquid, gas, it takes up space. And we breath air. We get water in our water boddles and we get desks to wrie on. And we all take up space.

Figure 1: Matter lab sheet

The objective of this guided inquiry was for students to name the characteristics of the three states of matter based on their checklist Students were assigned their jobs for that lab activity. The materials manager came up to collected their container of materials. The science captain read the lab instructions. All students recorded their observations in the ISN, but the recorder of the group would write the group's findings on the class observation chart. The "time on task" manager monitored the time used for observations on the three bags. The three bags contained: a) water, b) air, c) various solid objects like a cube, marble, pencil, counter, and paperclip. The science captain helped direct the observations of each bag and fill out the checklist on the lab sheet. The other two students' jobs were spokesperson and measurer. This particular activity did not call for any measuring. Students analyzed the data that they collected and the science captain read the questions to the group. Students engaged in a discussion about the questions and formulated their conclusions based on the discussion. Then students recorded their conclusions in their ISN. The recorder added their "collective" conclusions to the classroom chart. After all groups recorded their information, the class engaged in a discussion on their findings regarding the basic characteristics of matter. The spokesperson for each group shared their conclusions and the justification for their conclusion. If they needed assistance with the explanations, the spokesperson could call on one person in their group to assist them. After students had their discussions, they went back to their groups and created their own graphic organizer, diagram or other representation of what they learned about matter. Many students used a tree map to represent the three states of matter as seen in figure 2.

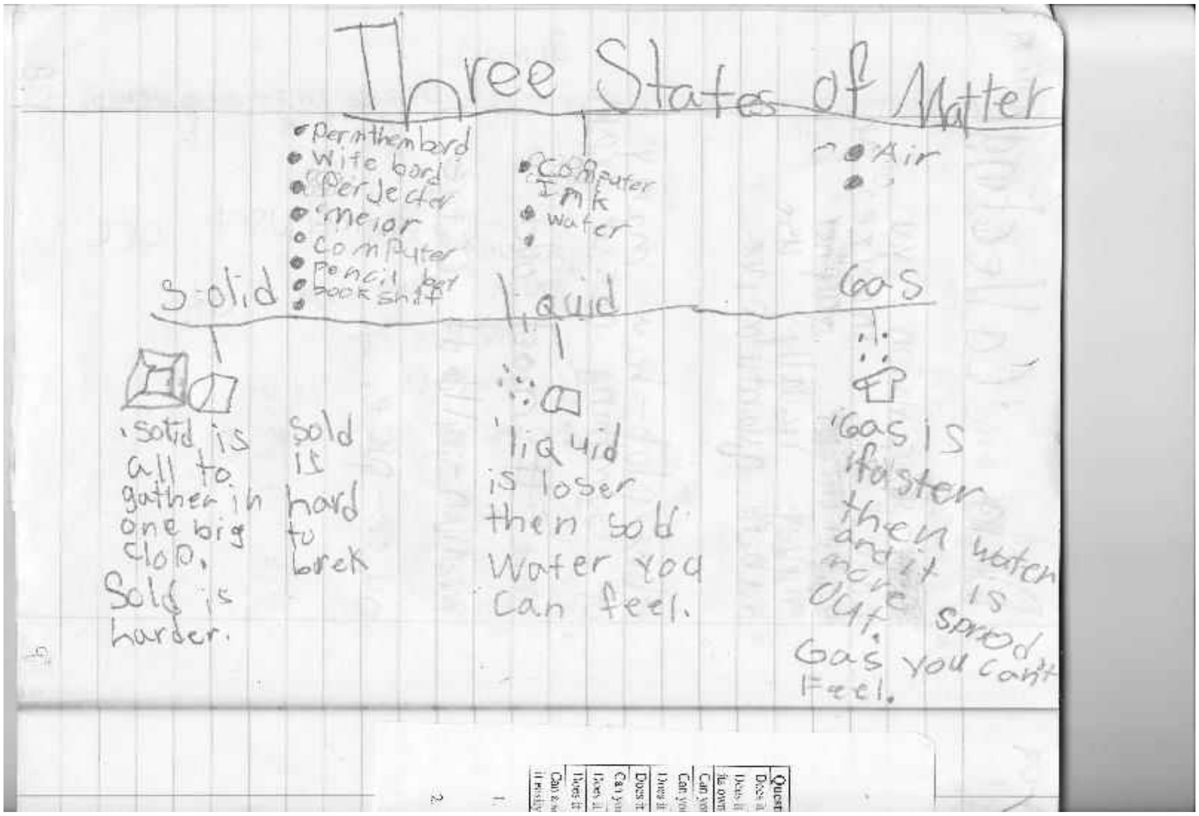


Figure 2: States of matter tree map

Other students used mini flip books. The criterion of the output (left side) activity was for students to synthesize the information about the three states of matter and their distinct characteristics.

The second day in the first week of the science workshop, students shared with a shoulder partner what they learned during the previous science workshop. Students' work samples from their output activities were selected to share with the class on the document camera for students to see the variety of activities. Further discussion and investigation went on to discuss how the particles move within the three states of matter. Students added this new information into their output sections. Again, students work samples were shared with the class. During this particular workshop we went outside to demonstrate how the particles moved in each state. Students had to work together in their groups to "act out" the part. At the end of the workshop and discussion, students were instructed to write a reflection (at the back of the ISN) about what they learned about matter. The only directions students were given regarding the reflection was that they needed to include evidence for every claim they made based on the actual labs. They also needed to use the science vocabulary related to the science concept in context. Finally, students came up with at least one meaningful and related question at the end of their entry. This was one week of activities in our science workshop. The next week students investigated each state of matter more thoroughly. The basic science workshop format consisted of: input (from teacher), guided lab inquiry, discussions, recording, sharing/justifying, output (synthesis by students), sharing/discussions and writing reflections.

Results

Writing reflection entries

After the initial instruction of creating the organization, requirements and format of the ISN, we began our science unit. The introductory concept was called, “Thinking like a scientist” and began during our third week of school; our first science lab began with brainstorming in each of the four groups. Students came up with their own ideas about what a scientist does and how do they use scientific thinking. This first lab entry was modeled in front of students so they could see what the input and output consisted of. Students created their first entry based on the format modeled to them. The input side consisted of: basic vocabulary words (which they investigated the meaning of through discussion and context of reading text), and 2) what does a scientist do? (from their group discussions). Students were given instructions to come up with some type of graphic organizer that could best represent their information. Some students chose a match book foldable, others created a tree map foldable or miniature flip charts. Students also came up with the idea that scientists must also use their five senses. The five senses ended up being the focus some of the students' entries on "What do scientists do"? Students used the five senses of hearing, touch, sight, taste and smell and related them to how scientists use their senses.

The next lab, students wrote their first writing reflection on "What does a scientist do?" based on the discussion and activity from two days prior. This was a challenge. On this initial entry, I did not give them any guidance other than to give my ESE students a general sentence starter of "One thing I learned about being a scientist…." Many of my students wanted to know what to write but since I wanted to see where they were in their writing about science, I did not direct this reflection. After about a half an hour, I found two relatively complete reflections and showed students the work sample on the document camera (Appendix J). I could hear "Oh is that what you want?" and "I didn't know I could write that". I realized from this initial writing reflection, I would need to be more explicit with my expectations and format. Modeling what a claim is and how to use evidence from the lab was going to have to be my first focus in order to direct my students in becoming successful scientific writers. Not only did I need to model the organization of the ISN, I also needed to model how to write a thorough science reflection. Listed in Table 4 is the breakdown of group one and group two's first writing reflection containing the three writing components that I am focusing on in this study. The entries listed were scored based on the rubric. Each component was given a score of a 0-3 points for each category with a culminating score. Based on the rubric, students could receive up to 3 points for each section. There were a total of 9 points possible. Within the rubric is a breakdown of the criteria needed to attain a 0, 1, 2, or 3 score (Figure 3).

Interactive Science Notebook Rubric

Reflections

Criteria	Notes
What did you learn? Claim & Evidence (Explained the science concept learned) 0 not present 1 *lacking:* little evidence 2 *meets:* contains a claim and evidence from lab 3 *exceeds:* contains a claim and more than one piece of evidence	
Science vocabulary used in context (underline) 0 no science words used 1 1 - 2 science words used 2 3 – 4 science words used 3 5 or more science words used	
What is one question that you have? 0 not present 1 loosely related to science concept 2 related to science concept 3 related to science concept and connects to bigger picture	
Total	

Figure 3: Rubric for science writing reflection

The table below indicates students' scores on this first writing reflection on "Thinking like a scientist".

Table 4: Reflection 1 "Thinking Like A Scientist"

Group 1 Reflection 1	**Claims and Evidence**	**Use of science vocabulary words in context**	**Meaningful questions related to the science topic**	**Total rubric score**
Mark	1	3	2	4
Matt	1	3	2	6
Richard	1	1	1	3
Mary	1	3	0	4
Susie	1	3	2	6
Karen	1	1	0	2
Group 2				
Ana	2	2	1	5
Jack	2	3	0	5
Scott	2	3	2	7
John	1	3	1	5
Thomas	1	3	1	5
Sarah	2	3	0	5

According to students' first sample of writing a reflection in Table 4, the sample shows that approximately 67% of the students scored a 1. Thirty-three percent of those students scored a 2 based on the rubric requirements. It is apparent that most of the students in both groups did not know how to write a claim with evidence and that additional modeling was needed.

Quite surprising was the fact that students were more adept at using science vocabulary in their writing even more so than what I had anticipated. The table shows that 75% of students scored a 3 on the use of science vocabulary in their writing reflection. As shown with Marks entry, (figure 4) this student is very capable of using science vocabulary but lacks use of claims and evidence in his written entry. Mark has a good understanding of the particles in matter but doesn't go further to give examples or evidence of his claims.

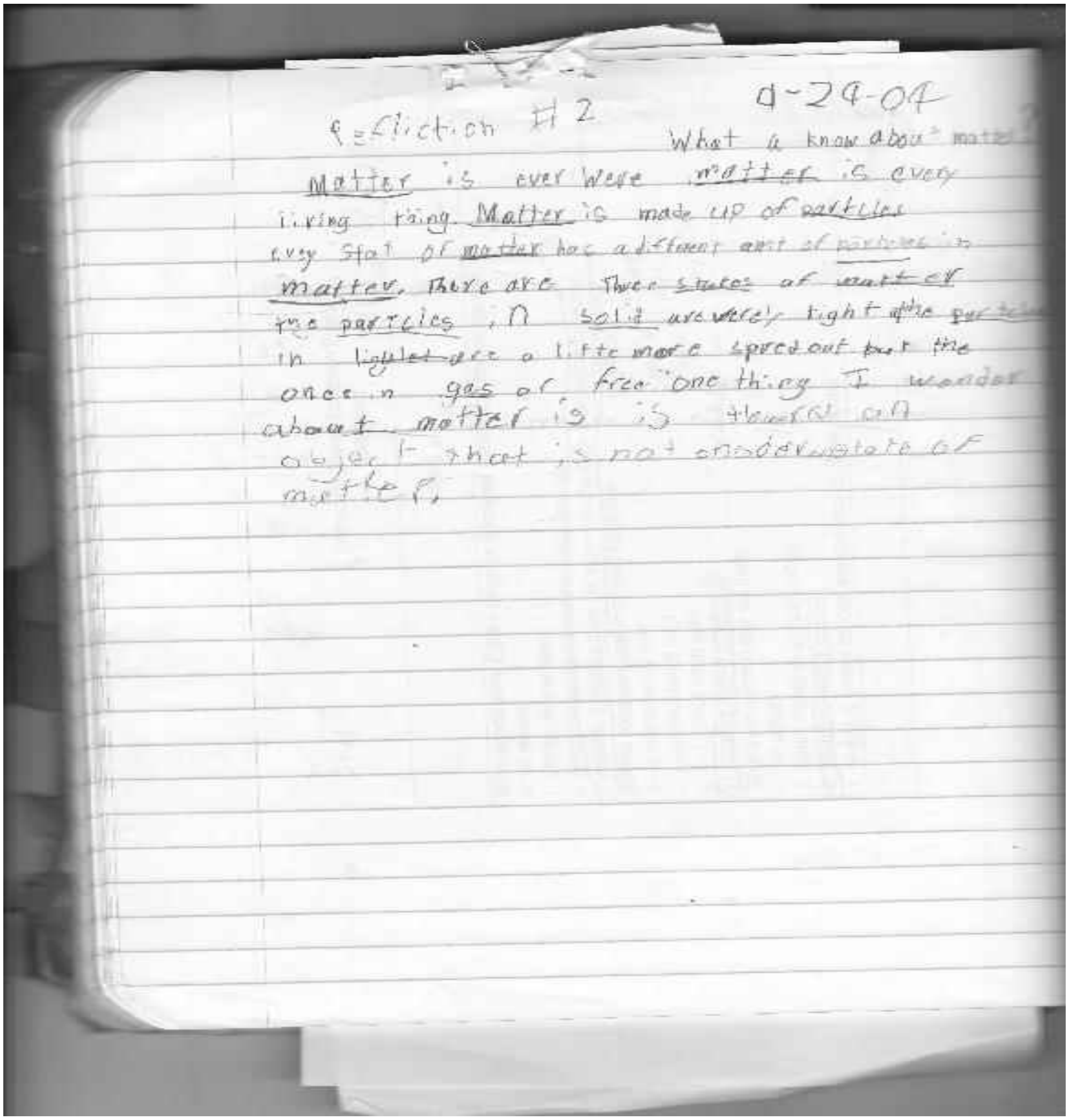


Figure 4: Marks reflection with the use of vocabulary

As for the use of a meaningful question that related to the topic, students demonstrated some idea of creating meaningful and relevant questions after they had written their science reflections. For example, Richard's reflection in figure 3 demonstrates his thinking about what scientists do. Then he wraps it up with a question, "How heavy is space?" By the information he wrote about scientist beings responsible, digging deeper, finding out information, figuring things out he connected to a bigger question.

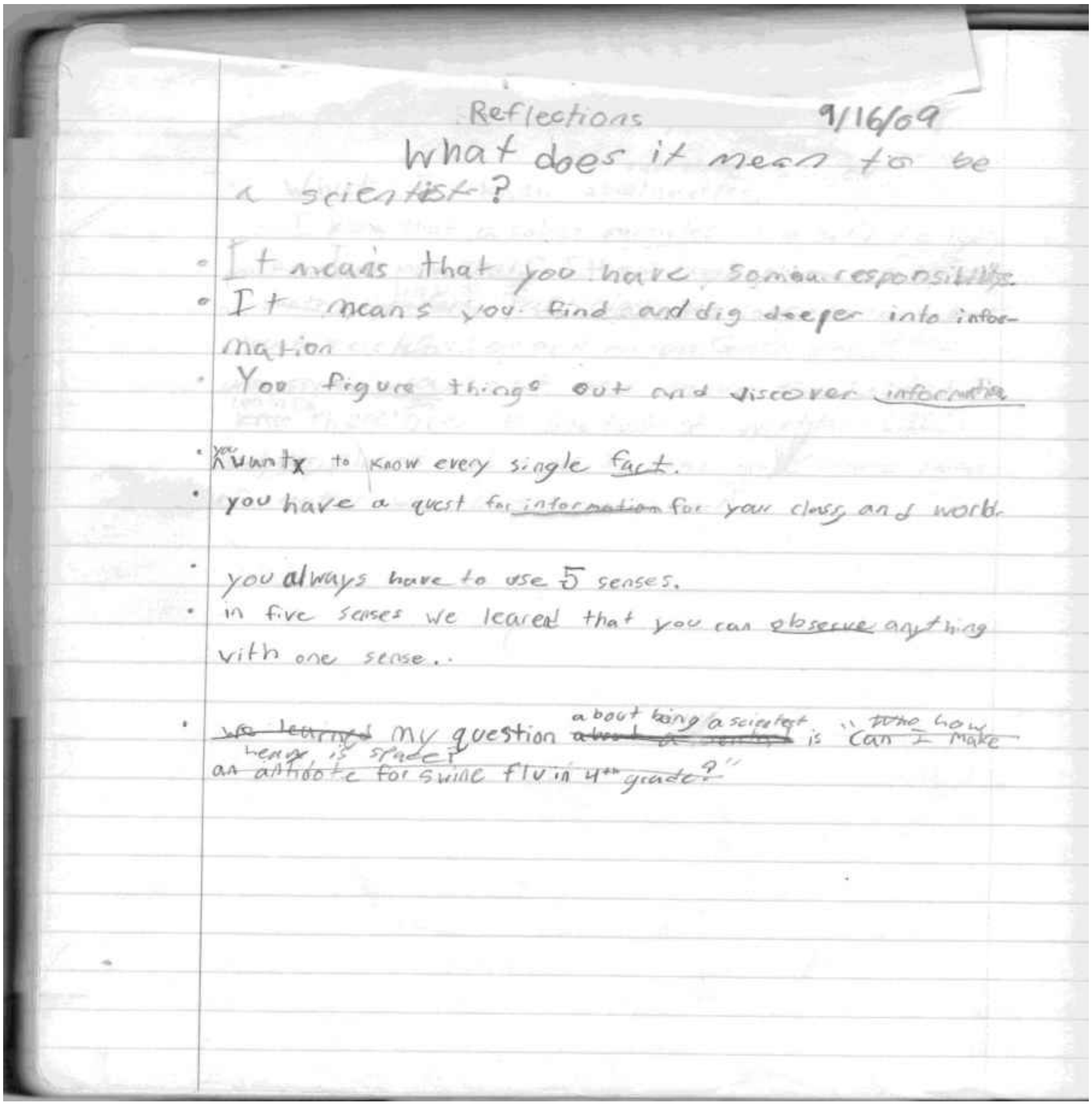


Figure 5: Richard's use of a "meaningful" question

The zeros represented were students who just did not write a question at all. The 1's designated students writing a question, but it was not related directly to the thinking like a scientist lab.

The second reflective writing called "What's the matter?" This lab investigated characteristics of the three states of matter have. In students ISN, I noticed that unless I gave my students *other ways or examples to represent* what they learned; they would keep using the same things over and over again. To clarify the science concept, students worked with their shoulder partner to discuss the three states of matter along with sharing examples of each. Prior to the reflective writing, I conducted a mini-lesson using the rubric and samples of writing that used claims and evidence, science vocabulary and questions. The rubric was shown on the document camera and we went through each criteria of claims and evidence, use of vocabulary words and writing meaningful questions. The largest focus of the discussion was spent on the claims and evidence section. A sample of a writing reflection was shown and analyzed by the class using the rubric in all three sections prior to their writing.

Table 5: Reflection 2 "What's the matter"

Group 1 Reflection 2	Claims and Evidence	Use of science vocabulary words in context	Meaningful questions related to the science topic	Total rubric score
Mark	1	3	2	6
Matt	2	3	2	7
Richard	1	3	3	7
Mary	1	3	1	5
Susie	3	3	2	8
Karen	2	3	2	7
Group 2				
Ana	2	3	2	7
Jack	2	3	0	5
Scott	1	3	0	4
John	2	3	2	7
Thomas	2	3	3	8
Sarah	1	3	1	5

In Table 5, Reflection 2 showed some student improvement in the reflective writing with the addition of claims and evidence. According to this table, only 41% of students scored at a level 1. Modeling using the rubric on a writing sample and the discussion prior to their writing appears to have helped students in their use of claims and evidence. Again students demonstrated their competence at using science vocabulary in their writing that may facilitated their understanding of the content. Students showed some progress in creating meaningful questions but at this juncture students needed some additional reinforcement and modeling with generating questions. For example here are some student responses:" What types of matter are we?" "Are there more than four states of matter?" "What state of matter is fur?" "Is lead in a pencil a solid as we write?" "Is there anything that is not a state of matter?" "Is plasma a real state of matter?"

The fourth lab was on density. This was a guided inquiry lesson. Guided inquiry is an approach to discovering science. Pearce (1999) explains that “the process of inquiry includes asking questions, solving problems, developing experiments, gathering data, observing results and drawing conclusions” (p. 5) Adding the *guided* aspect to inquiry means that the lab or lesson is guided by the facilitator. Students examined and observed a variety of liquids and solids as they were combined in a clear container. Students conducted observations and had discussions based on what was happening with the liquids. They also used a variety of solid objects to drop in to the liquids. As shown in this students ISN (Appendix M). Students wrote down and drew their observations into their ISN. As they added different objects into the liquids students observed what those objects did in relationship to the liquids. After observations and discussions, students mixed the liquids and left them over night to observe at the next lab. Students made their second observations and discussed their findings. This set of labs and class discussions took two weeks. Before students began their writing reflection, they met with their shoulder partners to share what they had learned. As I walked around monitoring student’s discussions, I was now hearing the terms “claims and evidence” as students were discussing their conclusions. For example, Richard asked his partner, “What is your evidence that the corn syrup is denser than the corn oil?” After this discourse, students went on to write their third reflection on Density. However, due to students’ requests I passed out the rubric prior to their writing, many of the students wanted to use it as their guide while writing. I observed more students looking back at their labs more than once during this writing reflection.

Table 6: Reflection 3 "All about density""

Group 1 Reflection 3	Claims and Evidence	Use of science vocabulary words in context	Meaningful questions related to the science topic	Total rubric score
Mark	1	3	2	6
Matt	2	3	1	6
Richard	3	3	3	9
Mary	1	3	1	5
Susie	2	3	2	7
Karen	2	3	2	7
Group 2				
Ana	2	3	2	7
Jack	3	2	1	6
Scott	1	3	2	6
John	3	2	2	7
Thomas	2	3	2	7
Sarah	3	3	0	6

As shown in Table 6, more students added claims and evidence into their writing reflections. In order to receive a 3, students must have a claim and two pieces of evidence. At this point in the reflective writing process there are now four students who have a 3 in claims and evidence as shown in figure 5 by Jack's writing reflection.

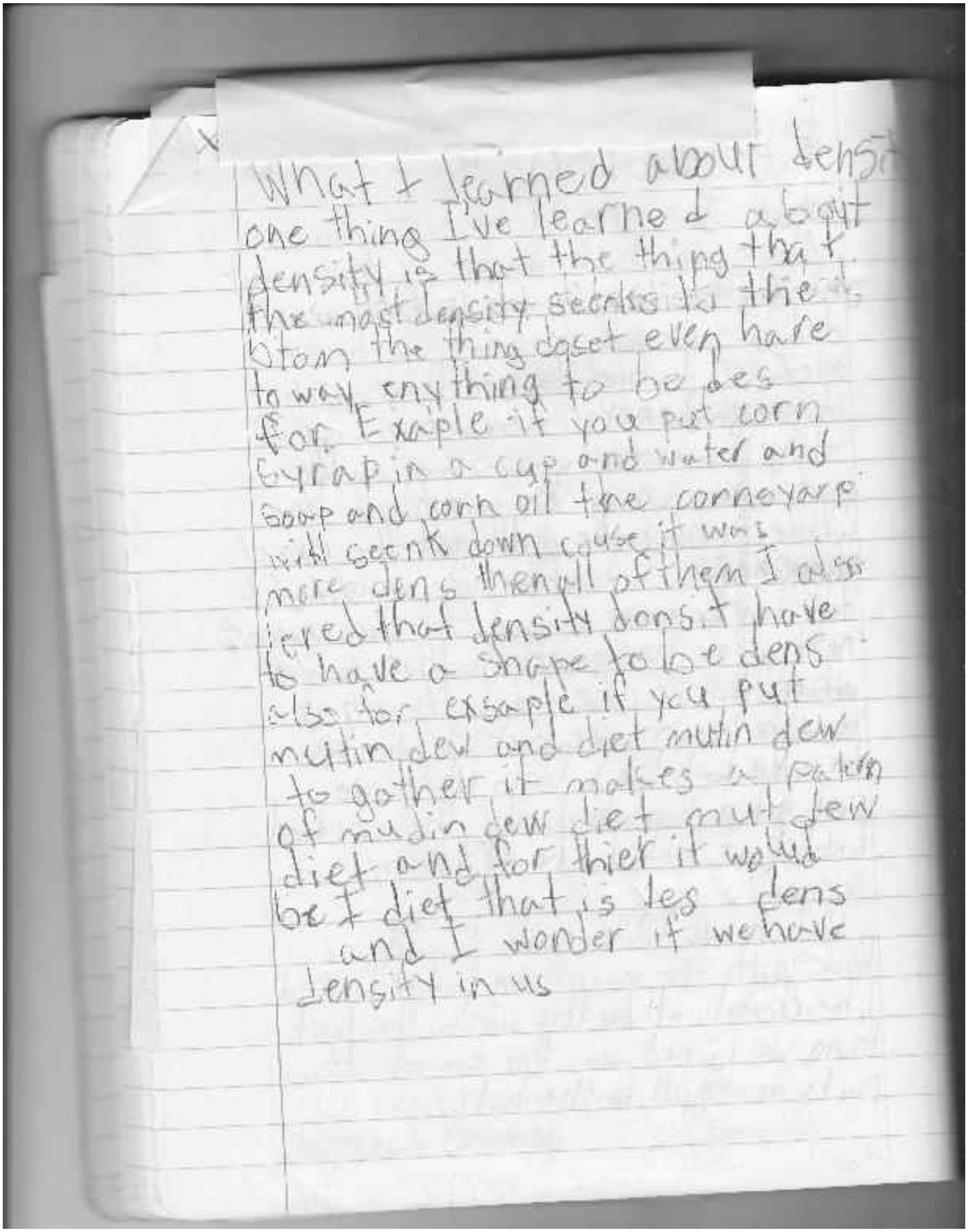

What I learned about densi
one thing I've learned about
density is that the thing that
the most density seenks to the
btom the thing dosnt even have
to way enything to be des
for Exaple if you put corn
syrap in a cup and water and
soap and corn oil the corneyarp
will seenk down couse it was
more dens then all of them I also
lered that density donsit have
to have a shape to be dens
also for exsaple if you put
mutin dew and diet mutin dew
to gather it makes a patern
of mudin dew diet mut dew
diet and for thier it wold
be t diet that is les dens
and I wonder if we have
density in us

Figure 6: Jack's reflection on density with two pieces of evidence.

Jack discussed the liquids he put into the cup and how the denser liquid sunk to the bottom and then he referred to the Diet Mountain Dew and regular Mountain Dew that he put in the tub at home. He had noticed that the regular Mountain Dew sunk and the Diet Mountain Dew did not. Five students have a two which shows that they have a claim and at least one piece of evidence. Only 25 o% of the students scored a 1 which implies that they are becoming more proficient at using claims and evidence or in generating meaningful questions in their writing reflections.

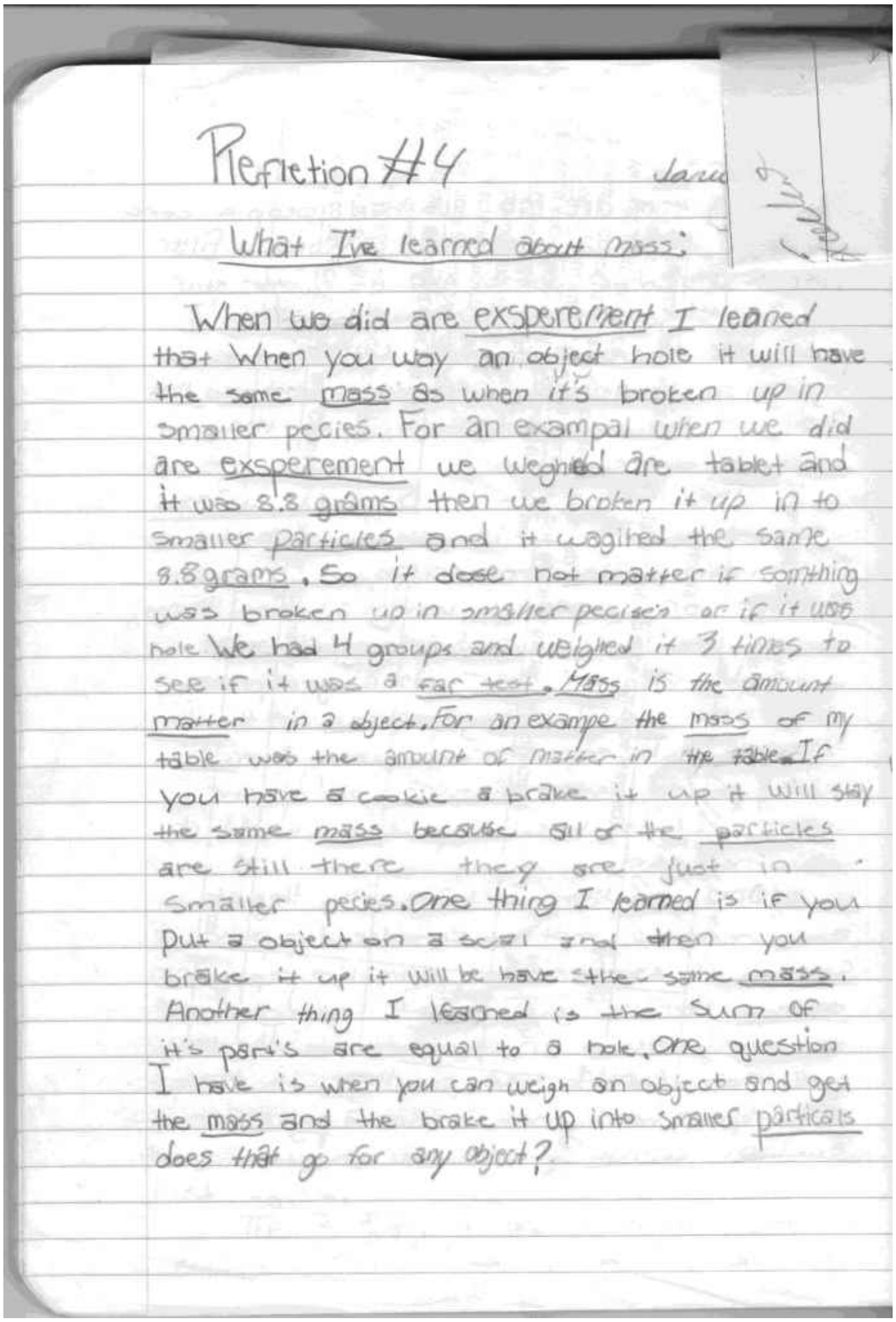
One thing that was viewed and recorded in my observations was that in between reflection 2 and 3 I observed that students enjoyed talking about their reflections before they started writing. This observation also came up during the focus groups and one-on-one interviews. Students felt that sharing, discussing and asking each other questions helped them to write better reflections. This was a topic of discussion during the focus group and one-one-one interviews. After each lab, students turned to their shoulder partners and discussed what they learned, stated a claim (or two) and shared with their partner what their science question was. The discourse between students has encouraged students to explain more of what they meant, go back to their journals to verify facts and talk out loud about science before they actually write about it. This is something that I had not considered prior to conducting this study.

The fifth lab was about mass. The objective was for students to discover that t*he sum of its parts equal the whole*. Students were asked to find out what the diameter of a tablet was, and weigh the tablet using the metric measurement system. The recorder would write the group's findings on a class chart so that student could analyze and compare their data. Students made predictions on whether or not the tablet would weigh the same if they crushed it. Many students concurred that the mass would be less because the tablet was broken up into smaller pieces. Then students crushed the tablet and weighed it again. The results were added to the class chart. Class discussions after the results, concluded that even if they crushed the tablet, the mass would remain the same. Students also extended their understanding by using other examples such as a cookie or a banana. This science topic took approximately two weeks with reflection 4 being written at the conclusion.

Table 7: Reflection 4 "What I learned about mass"

Group 1 Reflection 4	Claims and Evidence	Use of science vocabulary words in context	Meaningful questions related to the science topic	Total rubric score
Mark	2	2	2	6
Matt	2	3	2	7
Richard	abs	abs	abs	abs
Mary	2	3	2	7
Susie	3	3	2	8
Karen	3	2	2	7
Group 2				
Ana	2	3	3	8
Jack	2	2	1	5
Scott	1	3	2	6
John	3	3	2	8
Thomas	2	2	2	6
Sarah	3	3	3	9

This is the fourth reflection shown in Table 7. The topic was "What I learned about mass" with a focus on the sum of its parts is equal to the whole. Eight-three percent of the students were able to give at least one piece of evidence with their claim on this reflection. Only one student scored a level 1 and one was absent. It is evident that students were becoming more confident in writing evidence along with their claims. I noticed students' use of vocabulary has remained consistent throughout all four entries. Eighty-three percent 3% of students have also ended their reflections with a thoughtful and relevant question related to the topic. Figure 5 shows Sarah’s reflection on mass.



Refletion #4

What I've learned about mass:

When we did are exsperement I leaned that When you way an object hole it will have the same mass as when it's broken up in smaller pecies. For an exampal when we did are exsperement we weghed are tablet and it was 8.8 grams then we broken it up in to smaller particles and it wagihed the same 8.8 grams. So it dose not matter if somthing was broken up in smaller pecises or if it was hole We had 4 groups and weighed it 3 times to see if it was a far test. Mass is the amount matter in a object. For an exampe the mass of my table was the amount of matter in the table. If you have a cookie a brake it up it will stay the same mass because all of the particles are still there they are just in smaller pecies. One thing I learned is if you put a object on a scal and then you brake it up it will be have the same mass. Another thing I leaned is the sum of it's part's are equal to a hole. One question I have is when you can weigh an object and get the mass and the brake it up into smaller particals does that go for any object?

Figure 7: Sarah's reflection on mass

Sarah was competent in the use of vocabulary words, meaningful question. She also had two pieces of evidence with the example of the tablet and a cookie when they were broken down into smaller pieced, but contained the same mass.

The fifth lab was on physical change. The first phase introduced sorting. Students were given a cup with a mixture in it. In their groups, they decided how they were to separate it. Recorders would add their data to the class chart and students had a discussion on the different ways you could group the items in the cup. Students did not know the term *sort.* The second phase was sifting. Students need to explore how to separate the ingredients from another mixture which consisted of corn starch, sand, and rock salt. They were given materials that could or could not help them with this task. The third phase was on evaporation. Students combined salt with water and discussed whether or not they could separate the two substances. After each group discussed what they should do, they set up their own experiment to separate it. Some students used the fine mesh, some used the filters and two groups left the solution in the cups and asked if they could just leave them over the week to see if the water would evaporate. The fourth phase was on filtering. This lab was demonstrated to the whole class using students to filter a solution of a powder and a liquid using coffee filters. The student A held a filter which was place over a cup. Another student poured the solution into the filter and cup. Student A then poured their solution into student B's filter and cup. This continued through six students. Students stopped and discussed what would happen to the solution by the time it got to the tenth person. As an extension, the filters were left out over night to observe them next morning. This topic took about two and a half weeks. Students wrote reflection 5 on what they learned about a physical change.

Table 8: Reflection 5 "What I learned about Physical Change"

Group 1 Reflection 5	Claims and Evidence	Use of science vocabulary words in context	Meaningful questions related to the science topic	Total rubric score
Mark	2	3	2	8
Matt	3	3	3	9
Richard	3	3	3	9
Mary	2	3	2	7
Susie	3	3	3	9
Karen	2	3	2	7
Group 2				
Ana	3	3	3	9
Jack	3	3	2	8
Scott	3	3	2	8
John	2	3	3	8
Thomas	3	3	2	8
Sarah	3	3	3	9

In Table 8, students written responses were consistent across the board in claims and evidence. Table 4 shows some examples of students' responses. Sixty- seven percent of students scored a level 3 with claims and evidence. Only 25% scored a level 2 while no one scored a level 1 or 0. Within their written reflections students were able to explain what physical change was and they used at least two examples from their labs. The groups data that was used in this study also demonstrated their ability to use the given science vocabulary throughout their writing in context. The use of creating meaningful questions is one area that still needs to be addressed.

Focus Groups and One-on-One Interviews

I met with my two groups on two occasions to discuss their writing in science. I also conducted one-on-one conference with students from these groups to get their feedback on their writing in the content area using the same focus questions. Students brought their notebooks to the focus groups and interviews in order to answer the focus questions about their writing. Students also used their ISN to refer back to during the discussions. In these focus groups I used the questions that were created early on in this study and students discussed each question as it related to their writing. Students also shared their evidence from the ISN's to support their analysis of their own writing. The students' responses in the focus groups were videotaped in one session and in the second session students filled out a questionnaire about their writing and I conducted a one-on-on conference to discuss their answers. I transcribed the conversations from students' responses and took notes during the one-on-one interviews. The first question presented in the focus groups was:

"*Did you use specific details and examples in your science explanations (claims and evidence)?* Students read through their reflections and immediately said yes. It appeared they thought I would just move on with that affirmative answer. However, when I asked them to give me examples of how they used details and examples they went back and reread their entries. Here are a few of the student responses to question one regarding what they learned about matter from the focus groups and interviews. Since the focus groups and one-on-one interviews were conducted at different times, students' answers and writing examples reflect different science concepts at the time of the discussions.

Matter

Thomas: "Yes, I did because I said that there were three types of matter a solid, liquid and gas and that solids particles are tighter than liquid particles and liquid particles are tighter that gas particles".

Matt: "I did because I said air is a gas that actually has weight, it's just spread apart".

Mass

Sarah:" I used the evidence of if you have a cookie and broke it up it would weigh the same amount as it did when it was whole."

Jack: "Well I said if you cut up a banana it will still have the same weight as a banana not broken."

Density

Ana: "I said if something like a liquid is more dense it will always sink to the bottom like the corn syrup."

Richard: "I wrote about putting egg beaters in vinegar and oil at home. I also wrote about using corn syrup, soap, colored water and corn oil at school"

In each response from the students in the focus groups, they referred to the details they wrote in their writing reflection at the back of their Interactive Science Notebooks. Out of the 12 responses, six of the students went back and found where they used details and examples. Two students did not answer the question, one was absent and three students had vague examples. Students looked through their writing reflections for this question and needed to read their written responses to demonstrate that they did have a piece of evidence to support their claim. Students in the group would discuss whether or not they did.

The second question was. “*How does using science vocabulary in your writing help you to understand more about what you are learning?* Students again went through and analyzed their writing reflections.

Note: Questions 2 – 5 did not require students to specifically refer to one of the science concepts, therefore they are not noted.

Sara: “It helps you to remember what you are explaining and that you know what it means because you can go back and look at it.”

Mary: “It helps me because when I go back and read what I wrote”.

Matt: “It helps me understand what my teacher is talking about so if she uses the word like density and I don’t know what it means, I can go back and read.”

Susie:”It helps me because when my teacher talks about density and I don’t write it down, I’ll forget easily what it means”.

Scott: “It helps to get more science words in my reflection”.

Thomas: “It helps me because instead of using a boring word you can help use the right word.”

Matt: “It helps you use the words to describe what you are saying.”

Students understood that they needed to use the science vocabulary words within their writing in order to understand them better. Many of the students commented that they used the words because they needed to go back and look at how the word was used to remember what it meant.

The third question presented was, *"How does writing help you understand Science*?" Students responded:

Mary: "It helps me remember what we did about each science experiment and what I learned too."

John: "Because you write what you did."

Ana: "It helps me put the details so you don't forget".

Thomas: "By writing down my facts, it helps me a lot because instead of remembering it all in your head you can write it down and look back at it."

Scott: "You can go back later to remember it."

Susie: "It helps me remember things for example, if I had to write a whole essay and I can only look back in my journal, it would be there so I can write it down."

Matt: "To me it is easier to memorize when I'm writing it down than when I'm just listening." I do not memorize it as well as I would if I write it down."

Sara: "Writing something helps you remember stuff even when someone tells you."

Student responses indicate that they do understand the need for writing in science. However I'm not sure that they comprehend fully that writing is a way of understanding and processing what they've learned and it is simply not just remembering facts...

The fourth question was, "*If you don't understand something during a science investigation or discussion, what can you do?* Student's responses were:

Sara: "You should go back in your labs or ask someone in your group."

Matt: "I would go to the lab page we're talking about and get caught up or to our reflection".

Susie: "Either go back in my notes or reread things to help me remember."

Scott: "Go back at my writing".

Thomas: You can go back in your science book and look up what the words mean that they are saying or ask a question.

Ana: "Ask a tablemate what does that mean".

Maria: "I can always go back to one of those four reflections and I can remind myself about what the teacher is talking about."

I was very encouraged at three of the responses that said they could go back to their written reflections for clarification and understanding. I was also striving for students to write down questions that they had before, during and after the labs that they could answer at a later time. Since I did not teach or model how or when to write meaningful questions, I feel that students did not quite understand what *meaningful* meant or that they could write down questions at any time. I have truly seen the need for modeling through this process even in writing about science. I can't assume that since I model how to show your thinking when solving math problem or how to write a five paragraph essay that students can write a science reflection and know what I am looking for. Modeling and showing examples are so important for students to see.

My final question in the focus groups was H*ow does writing a reflection about what you have learned help you better understand a science concept that you've been working on?* Students' responses were:

> **Maria:** "It helps me by telling me what I learned and what I need to work on and by helping me by using more science words more often."
>
> **Ana:** "It helps me put more vocabulary and thinking in my writing".
>
> **Thomas**: "When I write a reflection it helps me understand better by putting examples and evidence."
>
> **Scott**: "It helps me put in more examples and details'.
>
> **Susie**: "How it helps me is when I go back it gives me details, examples and evidence."
>
> **Matt**: "Well, it helps me in a lot of ways but the most important way would be when I write stuff down it would give me more ideas like evidence and claims. I mean it also helps if I write examples and details."
>
> **Sara**: "When you write it, it's helping you remember and think about it more. You ask questions in it then you learn from it."

Students realized that writing a reflection about what you have learned can have an impact on their understanding, use of vocabulary words and thinking about what they did in lab. Two of the boys, Mark and Matt are both very interested in Science. They said they thought writing was a way to put down what you were thinking about science. Mark told me in one focus group session that he really hates writing, but he likes writing about science. Sarah wrote one reflection that represented all three components of the rubric (Appendix M). Using modeling, examples, and having meaningful discussions can help students writing in the content area.

My overall question for this action research was, *How did my practice of implementing Interactive Science Notebooks (ISN) affect students' writing in Science***?** According to the data collected, I observed that students' writing was impacted by the Interactive Science notebooks. In comparing student's first entries to their 5th entry the level of writing increased. Students learned to use their labs as a basis for getting ideas for their reflections. Even the length of their on-task writing increased throughout this study. Although students' time spent on writing was not a part of this action research, it was observed that students' time on task in writing increased. Based on student's responses in our group discussions and in the one-on-one interviews, students enjoyed using the ISN for their labs and writing reflections. Observations and notes concluded that many of the students were engaged in their writing of observations and conclusions. They also looked back at their previous labs while they were writing reflections. Students were observed discussing the science ideas with their partners and used their ISN's to show the other what they had written. There were only a few students who did not utilize the ISN to its fullest potential as evidenced by their writing samples. Their writing contained vague observations and details about the lab. They also did not include the science words into their writing. If they included a question, it was not related to the content covered. I have also determined that using the ISN has helped my reluctant boy writers. They have become more enthusiastic about their writing. During the focus conferences and one-one one interviews, two of the boys expressed their disdain at needing to write in science. They already had to write those narrative and expository essays. As stated previously, Mark told me in one focus group session that he really hated writing, but he likes writing about science. Four of the girls, who expressed that they didn't like science at the beginning of the unit, shared that they liked using the ISN and writing about science.

I broke down my overall question into three smaller questions. The first question asked was *How did the use of ISN affect students' use of details, support claims and justifications in* *their written responses?* The data that I gathered showed that students demonstrated more proficiency at including evidence for their claims by the time they completed reflection 5. In group 1, five out of six students demonstrated a consistency of using evidence with their claims in their written reflections. In group 2, four out of six students demonstrated more proficiency in the use of evidence with their claims. In fact, the largest success from writing claims and evidence in science was how my students integrated this process (using claim and evidence) into other subject areas. Using claims and evidence has become a standard across our subject areas in our discussions. Students ask one another "what is your evidence" or "why did you make that claim? My students understand that you need to justify your claim with the use of evidence.

The second question to be analyzed was *How did the use of the ISN affect students' use of science vocabulary in their writing?* The data from this question yielded the most surprise for me. I assumed that my fourth graders would not be confident in using science vocabulary in their writing and that this would need to be a focus of instruction for myself. From the first reflection through the fifth reflection, I found that the majority of my students were able to use the science terms sufficiently and within the correct context of the word based on their reflective entries. Five out of six students in group one started out with a level 3 in their use of vocabulary terms. All six students in group 2 attained a level 3 in their first entry. The use of vocabulary in context was consistent throughout all five entries. I do feel that the discourse prior to the written reflections were key to students use of the vocabulary words. Students were instructed to use the correct term in discussing with their group or partner the science concept. Students would re-teach the concept to their partner for better understanding. Partner 2 was instructed to ask clarifying questions if they did not understand what their partner was saying or if their partner did not use the correct science terms in their mini-explanation.

Finally, the third question addressed was *How did the implementation of the ISN affect student's reflective writing about physical science?* The data collected was very exciting for me. As I read through the science reflections, I was able to see that students of all levels were able to write about the science concept they learned in Physical Science. Although some students needed to work on the evidence portion within their reflections, the science concept was evident in their written reflections. Since I have a high percentage of students with IEP's (Individual Education Plans), this was the most encouraging piece of data.

Students' attitudes about writing did surface throughout the focus group and one-on- one discussions. One disadvantage of the focus groups was that some of the 4th graders wanted to continue discussing the science concept instead of completing the writing component that surrounded the concept. Another disadvantage that emerged was that some students were not as verbal as others within the two groups or they agreed with the stronger voices within their groups

Summary

To sum up my findings of the data collected through students writing reflections, focus groups and one-one-one interviews, I observed that all of my students benefited from the implementation of the Interactive Science Notebooks with varying levels of progression. Students' writing in science was still emerging. Through this writing process students became more effective writers in science. Becoming better writers in science may help students understand science concepts more thoroughly. ISN's are a way for students to show their thinking and understanding through writing in a variety of ways.

The first theme that emerged during this action research was that student's were already competent at using science vocabulary in their writing reflections. I initiated this action research with the assumption that this would need to be a targeted skill. Another positive theme that emerged was that students in their focus groups and interviews responded that writing actually helped them understand what they were learning better. It became evident that a theme emerged as a need for modeling how to write reflections using claims and evidence and generating meaningful questions. Students needed to see more examples of what claims and evidence looked like along with practice of writing claims and evidence. This also held true for generating meaningful questions based on the content they were learning. Overall, according to the triangulation of data collected, students' reflective writing, where they used claims and evidence to support their ideas improved.

Chapter five will verify the literature that was reviewed for this study. It was also explain the implications of the implementation of the Interactive Science Notebook and students writing. Limitations will be discussed and further recommendations will be addressed.

CHAPTER 5: CONCLUSION

Introduction

The purpose of this action research project was to determine whether or not my practice of implementing Interactive Science Notebooks would impact students writing in science. The focus questions investigated through the action research were:

1. How does the use of ISN affect students' use of details, support claims and justifications in their written responses?
2. How does the use of the ISN affect students' use of science vocabulary in their writing?
3. How does the implementation of the ISN affect student's reflective writing about physical science?

The goal of this action research study was to investigate my practice of implementing the Interactive Science Notebook in order to determine if students' writing in science was affected by its use.

Literature Review

For this action research study, students were introduced to the Interactive Science Notebooks. Campbell and Fulton (2003) stated in their book that students writing could be impacted by using the ISN through many different processes such as predicting, organizing, drawing, questioning and reflecting. The students found the ISN to be an engaging tool to learn about science along with those processes. They especially enjoyed creating their own products to demonstrate their understanding of the information about a specific science concept. Students were enthusiastic about the writing of their science reflections at the back of the ISN. The ISN was set up in an input-output based organizational format which was in contrast to what Campbell and Fulton recommended. They felt that the notebook should be a student's choice and that students should be able to plan themselves how their ISN would be organized. However because I had not implemented the Interactive Science Notebooks before, I needed an organizational format to create and follow for myself. I used the same format for my students. This did work well for them especially since I have 10 students who either have an IEP (Individual Educational Plan), a 504 plan (a plan to give students additional support) or an ANI (Academic Needs plan for ESOL students). Students were engaged in writing that included using evidence to support the claims they wrote about in their reflections. This aspect of writing went along with the philosophy of the National Research Council (2006) which stated that scientists should use their observations to support explanations about science. I observed my 4th grade students using this strategy by going back to previous labs so that they could get additional information and details for their reflection writing pieces. Not only did students add science content words to their writing, but they also reread the lab in order to create a meaningful question for the end of their reflection. Students were engaged in going back into their ISN and using their own work. The ISN became very personalized to each student. Fulton and Campbell also referred to the notebooks as a way to "facilitate ownership" (p.27). This was evident in how the students utilized their ISN during labs, discussions and writing.

Although there is much speculation on how students learn science, I align myself with Dewey's philosophy that science should not be taught in a broad sense. Students should be given time to investigate science concepts thoroughly. Students in this 4th grade classroom were not rushed through the unit on Physical Science. They explored, discussed and wrote about the many aspects of Physical Science. It was obvious through group and partner discussions that the students were able to converse and discuss science concepts presented in this unit. Dewey stated that the "attitude toward the study of science is, and should be, fixed during the earlier years of life" (p. 3). Observing my 4th grade students engaging in guided science activities and discussing their observations from their ISN with enthusiasm reinforced that fact. Using the interactive aspect of the ISN and taking additional time to complete science labs has shown that my students enjoy science. They want to learn about it, talk about it and write about it. Although, I do need to specify that the time used in instruction, lab work, group discussion, pair sharing and writing has put the class behind as far as the state's expectations of the order of instruction for 4th grade science. However the impact on the students understanding, writing and conversation about Physical Science is unquestionable.

As per some of the research on teacher's *lack of content knowledge* from the National Academies Press of Washington D.C., I discovered that as a teacher and researcher, I readily researched and read various resources, lesson plans, as well as the state standards and task analysis that would create authentic guided inquiry practices on the ISN and on Physical Science. I focused on activities that would best use the ISN along with fulfilling the requirements of the science content for my 4th grade students. Although there may be some teachers that have a lack of content knowledge, I found that there is a vast amount of resource to help teachers understanding science content. I also utilized other teachers and science coaches to help understand the content more thoroughly. I also felt that I needed to research the topic so that I would be prepared for what students could ask or discover during the labs. I did not see myself as one the statistics that the National Academies Press of Washington D.C wrote about in regards to the lack of teacher's preparedness in teaching science.

The science workshop was set up as guided inquiry activities. Pearce (1999) wrote that students need to have the opportunity to explore and reason in order to gain that scientific understanding. My 4th grade students were engaged in guided inquiry activities where they were given opportunities to explore, question, test and discuss the various aspects of the investigation within their groups. In their ISN they would record their observations and use those observations to discuss science with one another. Students arrived at their conclusions without being told they were right or wrong. Data from the activities were used to discuss as a class. Many times students were able to sift through the discussion points and see where they were confused or had a misconception about a concept. Pearce talked about assessments in his book, Nurturing Inquiry. He wrote that by using inquiry based instruction, there was "so much more to observe and evaluate" (p. 132). By using the ISN in conjunction with the guided inquiry instruction, I have been able to assess students understanding of the science concepts through their observations, notes, explanations, labs and reflections. I also assessed how groups worked together, asked questions and discussed science. The ISN has been a record of students thinking and understanding. The National Science Teachers Association, (2000) also emphasized that science inquiry helps students understand science. This was reaffirmed in our guided inquiry activities/labs. As students interacted with one another through discussions, questions and writing, they emerged from the investigation with a deeper understanding about the science concept. Their writing samples communicated their understanding in their ISN's.

Saul, Pearce, Dieckman and Neutze (2002) felt that children needed to be shown how to read, think and write like a scientist. Although inquiry may be a natural aspect of children's natural inquisitive nature, thinking and writing like a scientist needs to be taught. Students needed to see examples of what claim and evidence were in relation to their labs. They also needed to have good scientific explanations in writing modeled. The expectations needed to be shown not just spoken to the students. Students did demonstrate displeasure at the onset of the ISN due to the writing component required in the journal. However, after the 5th reflection, students were more enthusiastic about writing a science reflection due to the modeling and examples of what it looked like. I found that explicit modeling, showing of other student samples along with students sharing their entries with one another were crucial to students success in writing their reflections in the ISN. Saul (et al), wrote that "entries must progress through a series of steps…student peer review is an essential part of this process" (p. 52). I found that students' reflections were more complete when students shared their reflections and asked each other questions about their writing. Even more revealing was the conversations that went on about science. The ISN has been a successful tool that has helped energize interest in science and writing.

Garcia-Mila and Anderson (2007) conducted a study on scientific note taking. They claimed that, "through note taking the process of making one's thoughts explicit helps to clarify and focus also, the conventions of writing promote explicit relating of statements to supporting evidence" (p. 1038). As evidenced in my students ISN, their note taking during labs demonstrated putting their ideas and thoughts down on paper. Through this form of communication, students were better able to share their ideas about science. In the reflection at the back of the ISN, students went back to those labs to find the evidence they needed to use along with their claims. This study was limited to giving the participants an option of writing. With the ISN, all of the 4th graders were required to write in their labs, take notes and write reflective entries after science topics. The study also analyzed the types of note taking as assertions or comments; assertions being statements that contained justifications or explanations (p. 1046). The data collected in this study included participants of adults and children. The study stated that children needed to understand why they should take notes. For most of the children participants they felt that it wasn't necessary especially when it was given as an *option*. I think that through utilizing the ISN as a source for labs, questions, explanations and reflections, students learn that there is a need to take notes and in those notes have justifications of why they are writing what they are. Through this action research, students have used the ISN labs and reflections to show what they were thinking during the lab process with their groups, questions they had and finally their written reflections on what they learned about the science concept.

Students writing contained claims and evidence. In some entries, students were able to use more than one piece of evidence that they connected with to the activity they did in class.

Baxter, Bass and Glasser conducted a study using three fifth grade classrooms. In this study, they looked at science notebooks. Students were given detailed instruction regarding how they would organize their notebooks and how they would write in it. In this study Baxter (et al) felt that teachers "influenced the quantity and quality of student's notebook entries" (p. 125). This did make me very aware of my role when students were using their science notebooks, that they could be influenced by my input. I was very cautious when directing the activities and discussions so that students would not be given too much help during their entries in the ISN. Students were encouraged to work with groups during the labs, ask questions, read their notes and make observations to one another. To ensure that I did not influence students too much, I had students get with their science partner and discuss what they learned, the questions they had and the evidence that proved their claims. With this format, students were able to write their reflections without too much input from me. If I was asked a question, I did attempt to answer them with another question to get them thinking about the concept. As in the study by Baxter (et al), my 4th grade students needed to come to some conclusions based on their guided inquiry investigations and discussions in order to write complete reflections in their ISN. Even though there has been steady improvement, student's responses are still not where I would like them to me. Baxter (et al) wrote in their conclusion that "writing to learn requires that students and teachers take an active role in making the writing process apparent, purposeful and relevant" (p. 139). This takes time. In addition, students have had a limited practice of utilizing all of the components of the ISN. One thing that did arise was that during these *Think, Pair and Share* discussions (Kagan™), I found that what Keys discussed about students writing contributing to their understanding of science was true. The more my 4th graders discussed, questioned and wrote about science the better understanding they had of the concept.

Implications

According to action research study, one of the implications could be that the use of science notebooks can impact students writing in science. As evidenced by the improvements in students' reflections, their writing in the content area has increased in regards to using evidence from their labs in order to justify the claims they have made in their writing.

In addition, it became evident that students' use of science vocabulary was a more natural integration in their writing when presented with the terms prior to the science inquiry and in being encouraged to use the science vocabulary in their group or partner discussions. The data gathered in this study showed that students used the science vocabulary from the beginning of the implementation of the ISN's. This could imply two trains of thought. First, students were comfortable and knowledgeable about using the science words in their writing and had more background knowledge about the concept they were learning from the previous year. Keys (1999) also concluded that student's writing could have been impacted by their "prior knowledge" in her study. The other possible implication could be that due to the focus of science vocabulary written in their journals on the input side, and the encouragement of using the terms during discussions, may have impacted students use of the words in their writing therefore adding to the validity of their explanations' in their writing.

Another implication in this study is that students emerged from a science topic with a better understanding. Keys (2000) study indicated that some of the students in her study "generated new knowledge and explanations specifically from the act of writing while others did not." In my 4^{th} grade classroom students were first introduced to the input (right side) format of teacher giving information or lab activities. Second, they needed to synthesize that information in a format that best represented what they learned in the output (left side). Third, students discussed the science concept(s) in their groups and with their partners on numerous occasions.

They went back and looked at their lab notes to verify information. Fourth, they were asked about the writing in focus groups and in one-on-one interviews which included discussions about science. Finally, students were asked to write about the science concept and given a criterion for using claims and evidence, using the science vocabulary and to write one meaningful question about the concept. As per their written reflections, it does show that many students were able to use more detail and justifications in their writing about the concept therefore demonstrating their better understanding of the topic. Klentschy (2005), wrote that the notebook "is a central place where language, data, and experience work together to form meaning for the student" (p.24).

A final implication is that our educational system has tried to cram too much in their standards and expectations for students to learn in one school year or for a teacher to teach effectively. This year we are faced with the New Generation Sunshine State Standards (NGSSS). It seems that finally the depth of learning and teaching is being considered. Although my action research lasted longer than the states recommended order of instruction, it did benefit my students. The big ideas that are being presented have brought a new challenge to educators of really delving into the content and exploring it. My other concern is that it seems that science is not focused on enough in our elementary schools until they reach 5th grade this is due to 5th graders are then tested in science.

Limitations

One of the limitations to this study was regarding the time element spent on Physical Science. According to the 4th grade Sunshine State Standards order of instruction, this science topic should have only taken 4 – 6 weeks. Due to the implementation of the ISN, the formatting such as: the input/out, labs, discussions, interviews, reflections, and organization, it practically doubled the amount of time spent on this topic of Physical Science. This was a new instrument for 4th graders. Just the organizational part of the ISN was a challenge. I should state the three studies from Keys (1998, 1999 and 2000) were conducted on middle school students. Klentschy (2005) did use the notebooks for elementary school children along with Fulton and Campbell (2003 and 2009). This could possibly be another limitation of age appropriateness. I do feel that even though it took a longer amount of time, the use of the ISN and its components had a positive impact on student's learning in science.

Another limitation was the time spent per week on science. Science was scheduled for Tuesdays and Thursdays. At the onset of the action research, it was my intention to use one of the other days for students to complete their reflections. However, that did not occur due to scheduling of a writing pilot conducted by 4th grade, pull-outs for speech, occupational therapy and ESE students. I am an inclusion class; therefore this impeded my progress and plans on other days. Also, when I observed that the conversations within the groups, interviews, and partners was so full of rich discussion, I continued with that type of discourse which also added to the amount of time spent on some concepts in Physical Science. Dewey (1909) discussed in his paper how he was concerned with the amount of science that teachers needed to teach their students. He felt that the science was wide in topics but shallow in scientific thinking. During this study, I have realized that the amount of time on the science concept has impacted students learning the concept better.

Recommendations/future research projects

I plan to continue implementing this action research plan through the end of this school year. I am hoping that I will be able to loop with my 4th graders for the upcoming school year. Since I have already implemented the ISN, I will not need to use the first three weeks to model, and explain to the extent of what I had to do this year with the ISN. I am aware that I will need to go over the expectations of the ISN again. I also plan to keep students ISN's as samples for students to refer back to if I am able to loop, or for my new class to look through. It will be interesting to see if the continued use of the ISN will have a major impact on students learning in science and on their performance on the FCAT Science in the spring of 2011. If I could carry out this into a continued research study, I would like to look at the impact of the ISN on student's FCAT science performance. In the future I plan to take anecdotal notes while students are working with others to document their conversations regarding their science investigations. This will help me to determine student misconceptions at an early stage and monitor students understanding. I would also like to see what students have learned about science by creating a pre and post test to assess student's knowledge of the science topics taught. The ISN in its entirety was not assessed during this study, but I feel that students work throughout the ISN should be a part of their assessment since it demonstrates what students investigated and how they interpreted the information in order to create more meaning about the science they learned.

I found this action research to be very eye opening into my own practice as well as to my students learning about science. I realized that I need to be a continual learner myself in science. As an educator I can't just rely on a teacher edition of the science text. Some of the research that I read referred to teacher's lack of content knowledge or preparedness in science. Through this study, and continued research I know that I am responsible for what and how I teach. It does impact students learning.

Another aspect of this study, that had a big impact on my practice, was that I observed students' discourse through writing and discussions. Students were actively engaged in learning about science. Students received their "input" from their teacher in guided inquiry labs and activities surrounding the vocabulary words. They constructed their own understanding through the output section of the ISN in visual models. Students discussed the concepts, proved their conclusions to one another in group and peer discussions. The concluding activity was their written reflections which demonstrated their understanding of the science concept. This was powerful to me as an educator. Not just one aspect of the ISN impacted students learning, but it was a combination of guided inquiry labs, discussions, questions, and writing together. The major components of the ISN elicited student's authentic involvement in learning about science. They enjoyed the organization of it once they got the hang of it. Those first few weeks were challenging especially since I have an inclusion class and many of their IEP's include organization and writing. Students especially enjoyed the guided inquiry labs. Inquiry based activities has been and will continue to be one of my goals in teaching science. I plan to use more inquiry based activities as I teach science with a focus on questioning for my students and myself.

Summary

The purpose of this action research study was to determine whether my practice of implementing the Interactive Science Notebook would have an impact on students writing. Students' writing was analyzed for the use of claims and evidence, use of science vocabulary words in context and in creating meaningful questions related to the science concept. The implementation of the ISN has had a positive impact on students writing. Students have demonstrated, through their writing of reflections, the use of claims and evidence, the use of science vocabulary in context to the science concept, and in creating meaningful questions that related to the science concept that the implementation of the ISN did have a positive impact on their writing. According to Lee and Songer (2003),

> It is important to use authentic situations to develop rich understandings about scientific knowledge and the design of tasks that prepared students to participate in social practices valued by the science community (p. 923).

I acknowledge that throughout this study I have attempted to create authentic learning situations which have surrounded the implementation of the ISN. I also feel that through the various learning tasks as an indirect or direct result from the ISN, students have used their writing to show their understanding of science. My interpretation of the social practices that Lee and Songer refer to is the continued discourse by students that I witnessed through written and verbal communication about science. That is what scientists do. This will be a tool that I will continue to utilize and learn more about.

APPENDIX A: WRITING REFLECTION RUBRIC

INTERACTIVE SCIENCE NOTEBOOK REFLECTIVE ENTRY Criteria	Points
What did you learn? Claim and Evidence (Explained the science concept learned) 0 not present 1 *lacking:* little evidence 2 *meets requirements:* contains a claim and evidence from lab 3 *exceeds:* contains a claim and more than one piece of evidence/connection	
Science vocabulary used in context (underline) 0 no science words used 1 *lacking:* 1 - 2 science words used 2 *meets requirements:* 3 – 4 science words used 3 *exceeds:* 5 or more science words used	
What is one question that you have? 0 not present 1 *lacking:* loosely related to science concept 2 meets requirements: related to science concept 3 *exceeds*: related to science concept and connects to bigger picture	
Total	

APPENDIX B: RUBRIC PERMISSION

From: Kate McNeill [kmcneill@bc.edu]
Sent: Saturday, February 06, 2010 10:21 AM
To: Braxton, Eva J.
Subject: Re: FW: research article

Hi Eva,

The rubric was created by the research team (authors of the paper). You are welcome to use it in your own work. You just need to cite the journal article in your use.

Good luck with your work!!!

Kate

Braxton, Eva J. wrote:
> ________________________________
> From: Braxton, Eva J.
> Sent: Friday, February 05, 2010 8:13 PM
> To: kmcneill@bc.ed
> Subject: research article
>
> Hello,
>
> I am a graduate student at the University of Central Florida. I am currently in the Lockheed-Martin Math and Science scholar program. In conducting my research for my thesis topic, I've read your article on "Science Explanations" and will be using it as one of my sources.
> I would like to ask permission to use the rubric (Appendix B) for my action research. My study is about 4th grade students writing in science. I want to focus on their use of claims and evidence in their reflective science entries. I've implemented the use of Interactive Science Notebooks to collect students writing samples. Could you tell me if this rubric was created by a team, the authors/researchers or another source?
> Your response would be very much appreciated.
>
> Eva J. Braxton, NBCT
> Dommerich Elementary
> Maitland, Florida
>

APPENDIX C: IRB PERMISSION

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice of Exempt Review Status

From: **UCF Institutional Review Board**
FWA00000351, Exp. 10/8/11, IRB00001138

To: **Eva Braxton**

Date: **August 18, 2009**

IRB Number: **SBE-09-06373**

Study Title: **Looking at writing in Science through Interactive Science Notebooks.**

Dear Researcher:

Your research protocol was reviewed by the IRB Vice-chair on 8/17/2009. Per federal regulations, 45 CFR 46.101, your study has been determined to be **minimal risk for human subjects and exempt** from 45 CFR 46 federal regulations and further IRB review or renewal unless you later wish to add the use of identifiers or change the protocol procedures in a way that might increase risk to participants. Before making any changes to your study, call the IRB office to discuss the changes. **A change which incorporates the use of identifiers may mean the study is no longer exempt, thus requiring the submission of a new application to change the classification to expedited if the risk is still minimal.** Please submit the Termination/Final Report form when the study has been completed. All forms may be completed and submitted online at https://iris.research.ucf.edu.

The category for which exempt status has been determined for this protocol is as follows:

2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures, or the observation of public behavior, so long as confidentiality is maintained.
   - (i) Information obtained is recorded in such a manner that the subject cannot be identified, directly or through identifiers linked to the subject, **and/or**
   - *(ii)* Subject's responses, if known outside the research would not reasonably place the subject at risk of criminal or civil liability or be damaging to the subject's financial standing or employability or reputation.

***Please forward a copy of the Orange County School District approval to the IRB when it becomes available. This study may not commence until that approval is obtained.**

The IRB has approved a consent **procedure which requires participants to sign consent forms.** Use of the approved, stamped consent document(s) is required. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

On behalf of Joseph Bielitzki, M.S., DVM, UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 08/18/2009 11:12:57 AM EDT

APPENDIX D: COUNTY PERMISSION

Submit this form and a copy of your proposal to:
Accountability, Research, and Assessment
P.O. Box 271
Orlando, FL 32802-0271

Orange County Public Schools

RESEARCH REQUEST FORM

Your research proposal should include:
- Project Title
- Purpose and Research Problem
- Instruments
- Procedures and Proposed Data Analysis

Requester's Name Eva J. Braxton

Date July 29th, 2009

Address 1663 Bomi Cr. Winter Park, Florida 32792
Street City, State Zip

Phone 407-462-1858

Institutional Affiliation UCF

Project Director or Advisor Dr. Jeanpierre

Phone 407-823-4930

Address 4000 Central Florida Blvd 115H Orlando Florida

Degree Sought: (check one)
☐ Associate ☐ Doctorate ☐ Bachelor's ☐ Not Applicable ☒ Master's ☐ Specialist

Project Title: Looking at writing in Science through Interactive Science Notebooks

ESTIMATED INVOLVEMENT

PERSONNEL/CENTERS	NUMBER	AMOUNT OF TIME (DAYS, HOURS, ETC.)	SPECIFY/DESCRIBE GRADES, SCHOOLS, SPECIAL NEEDS, ETC.
Students	28	2 days, one hour each day	4th grade at Dommerich Elementary
Teachers	1	2 days, one hour each day	4th grade at Dommerich Elementary
Administrators	1		support and approval
Schools/Centers	1	during school hours	Dommerich Elementary
Others (specify)			

Specify possible benefits to students/school system: more detailed writing in Science, use of science vocabulary in writing, better understanding of science concepts, helps students have more of a positive attitutde toward writing in Scienc, encourages students to provide written products that they get to chose (not all the same) addressed students different learning modalities, and will provide for the greater good of the discipline.

ASSURANCE

Using the proposed procedures and instrument, I hereby agree to conduct research in accordance with the policies of the Orange County Public Schools. Deviations from the approved procedures shall be cleared through the Senior Director of Accountability, Research, and Assessment. Reports and materials shall be supplied as specified.

RECEIVED AUG 25 2009

Requester's Signature Eva J. Braxton

Approval Granted: ☒ Yes ☐ No

Date: 8-25-09

Signature of the Senior Director for Accountability, Research, and Assessment Lee Baldwin

APPENDIX E: PRINCIPAL CONSENT

DOMMERICH ELEMENTARY SCHOOL

Robin R. Matthes
Principal

June 30, 2009

To Whom It May Concern:

I am writing this letter in support for Eva Braxton, a 4th grade teacher at Dommerich Elementary School. I am aware of her upcoming action research project, Implementing Science Interactive Notebooks, for her thesis project at UCF. Eva has my full support of implementing the notebooks as an authentic learning tool to enhance the science curriculum for her classroom during the 2009-2010 school year. She is a professional and will act in the best interest of her students for this action research.

Please feel free to contact me if you have additional questions or concerns.

Sincerely,

Robin R. Matthes

Robin Matthes
Principal

ORANGE COUNTY PUBLIC SCHOOLS

1900 Choctaw Trail • Maitland, Florida 32751 • (407) 623-1407 • FAX (407) 623-5735
"The Orange County School Board is an equal opportunity agency"

APPENDIX F: PARENT CONSENT

University of Central Florida

Looking at writing in Science through Interactive Science Notebooks

Informed Consent from a Parent for a Child in a Non-Exempt Non-medical Research Study

Principal Investigator(s): Eva J. Braxton, 4th grade teacher

Faculty Supervisor: Dr. Jeanpierre, Ph.D

Sponsor: UCF Department

Investigational Site(s): Dommerich Elementary
1900 Choctaw Trail
Maitland, Florida

Researchers at the University of Central Florida (UCF) study many topics. To do this we need the help of people who agree to take part in a research study. You are being asked to allow your child to take part in a research study which will include about 28 students. Your child is being invited to take part in this research study because he or she is a student at Dommerich Elementary school. You can read this form and agree right now for your child to take part, or take the form home with you to study before you decide.

First, Eva J. Braxton, 4th grade teacher will be conducting the research. She is a graduate student of the UCF Lockheed-Martin Math and Science program. Mrs. Braxton's faculty supervisor in this study is Dr. Jeanpierre in the *Teaching and Learning Principles* department. Dr. Jeanpierre will guide Mrs. Braxton through this action research study.

What you should know about a research study:

- Someone will explain this research study to you.
- A research study is something you volunteer for.
- Whether or not you take part is up to you.
- You should allow your child to take part in this study only because you want to.

- You can choose not to take part in the research study.
- You can agree to take part now and later change your mind.
- Whatever you decide it will not be held against you.
- Feel free to ask all the questions you want before you decide.

Purpose of the research study: The purpose of this action research study is to determine how the implementation of Interactive Science Notebooks impact students writing in Science.

What your child will be asked to do in the study: As a part of your student's regular academic schedule, students will be introduced to an Interactive Science Notebook in their Science block. This is a journal of what student's think about during labs and discussions in Science class. I will model how the Interactive Science Notebook will be organized with a table of contents, page numbering system, note taking which includes explanations, justifications and reflections. Students will be shown how to use charts, tables, graphs, thinking maps, drawings, and/or diagrams in their notebooks. Since this is part of our Science class, I am only asking to use the information your child provides (without his/her name attached) as part of a research study. This study is to see how well this new method of teaching is working. Science labs will be held once a week and class discussions will be held on another day either in the student's classroom or in the Science lab. This science unit on "matter" will last for approximately 6 – 8 weeks beginning in September 2009. I will only be using student's writing samples from their Interactive Science Notebook for my study. All science concepts related to matter are a part of what 4th graders need to learn according to Florida' Students will be expected to complete his/her regular classroom work as scheduled. There are no expected risks for taking part in this study.

Voluntary participation: You should allow your child to take part in this study only because you want to. There is no penalty for you or your child for not taking part, and neither you nor your child will lose any benefits. The Science content used in this study will be taught regardless of your child's participation in this study due to the mandates of the Sunshine State standards for 4th grade Science. If you choose to decline participation for your child, only the data derived from their writing samples will be omitted. You have the right to stop your child from taking part at any time. Just tell the researcher that you want your child to stop. You will be told if any new information is learned which may affect your willingness to allow your child to continue taking part in this study.

Benefits:

Benefits to participants may include but are not limited to:

*more detailed writing in Science

*use of science vocabulary in writing

*better understanding of science concepts

*helps students have more of a positive attitude toward writing in science

*encourages students to provide written products that they chose (not all the same way) addresses students different learning modalities

*will provide for the greater good of the discipline

Study contact for questions about the study: If you have questions, or concerns please contact Mrs. Braxton at 407-623-1407 or 407-462-1858.

IRB contact about you and your child's rights in the study or to report a complaint: Research at the University of Central Florida involving human participants is carried out under the oversight of the Institutional Review Board (UCF IRB). This research has been reviewed and approved by the IRB. For information about the rights of people who take part in research, please contact: Institutional Review Board, University of Central Florida, Office of Research & Commercialization, 12201 Research Parkway, Suite 501, Orlando, FL 32826-3246 or by telephone at (407) 823-2901. You may also talk to them for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You want to get information or provide input about this research.

Your signature below indicates your permission for the child named below to take part in this research and to the use and disclosure of this child's protected health information

Name of participant

Signature of first parent or guardian | Date

DO NOT SIGN THIS FORM AFTER THE IRB EXPIRATION DATE BELOW

- ❑ Parent
- ❑ Guardian (See note below)

Printed name of first parent or guardian

Signature of second parent | Date

Printed name of second parent

If signature of second parent not obtained, indicate why: (select one)

- ❑ IRB determined that the permission of one parent is sufficient
- ❑ Second parent is deceased
- ❑ Second parent is unknown
- ❑ Second parent is incompetent
- ❑ Second parent is not reasonably available
- ❑ Only one parent has legal responsibility for the care and custody of the child

Assent

- ❑ Obtained
- ❑ Not obtained because:
- ❑ IRB determined that assent of the child was not a requirement
  - ❑ The capability of the child is so limited that the child cannot reasonably be consulted.

Printed name of person obtaining consent and assent

My signature and date indicates that the information in the consent document and any other written information was accurately explained to, and apparently understood by, the participant or the participant's legally authorized representative, and that informed consent was freely given by the participant or the legally authorized representative.

Note on permission by guardians: An individual may provide permission for a child only if that individual can provide a written document indicating that he or she is legally authorized to consent to the child's general medical care. Attach the documentation to the signed document.

APPENDIX G: STUDENT ASSENT

University of
Central
Florida

Child Assent Template for use with children 7 to 17 years of age

My name is Mrs. Braxton. I am doing a research project at UCF on how students write in Science. This year in Science, we will use an Interactive Science Notebook. This just means that student's will be able to write and draw inside their Science notebooks. Mrs. Braxton will be looking at how you write what you're thinking during and after science activities for my research. Your parents have already given permission for you to be included in my project.

This will not affect your grade. In 4th grade we need to learn about matter in Science and the Interactive Science Notebook is just another opportunity or way to show me what you've learned. You will not get extra credit for doing this. Would you like to take part in this research project?

_____ I want to take part in Mrs. Braxton's research project.

______________________ ______________________
Student's Signature Date

______________________ ______________________
Student's Printed Name

UCF University of Central Florida IRB
IRB NUMBER: SBE-09-06373
IRB APPROVAL DATE: 8/17/2009

APPENDIX H: INPUT/OUTPUT

LEFT SIDE
OUTPUT
HIGHER LEVEL THINKING
STUDENT-DRIVEN

The left side of the notebook is used to show your understanding of the new concepts you are learning in science. This is where you kick your thinking up a notch! You will be working with the information from the right side, or input side, of your notebook…you'll take the information from the right side and present it in your own way, with your own style. You may use words or pictures/diagrams, or a combination of both. Here are some ideas:

- **Summary/Conclusions** 
- **Brainstorming Diagrams** 
- **Thinking Maps** 
- **Questions you have** 
- **Graphing** 
- **Applying learning to the real world**

- **Making Connections** 
- **Pictures** 
- **Reflections** 

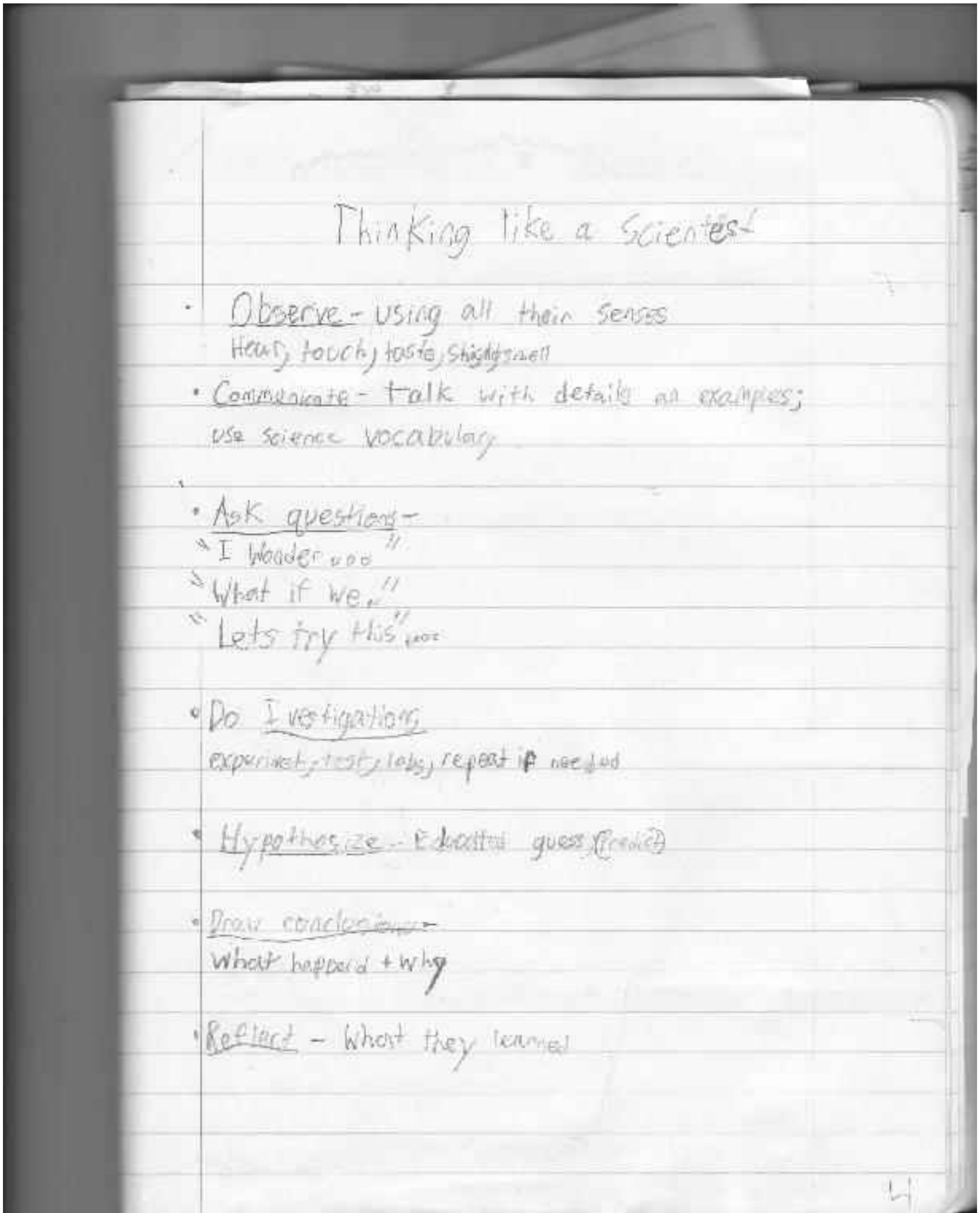
RIGHT SIDE
INPUT
FACILITATED LEARNING
TEACHER-DRIVEN

The right side of your notebook is for your facilitated, or directed, learning. This side is mostly used for the work you do in class, with your teacher and other classmates. This is where you put information you have been given or you have read in your science book, etc. Here are some ideas:

- **Cornell Notes** 
- **Lab Procedures** 
- **Data Collected** 
- **Tables/Charts** 
- **Observations** 
- **Vocabulary/ "Book" Definitions**

- **Key Questions (Teacher)** 
- **Hypothesis** 
- **Book or Video Notes** 

APPENDIX I: THINKING LIKE A SCIENTIST



Thinking like a Scientest

• Observe - using all their senses
Hear, touch, taste, sight, smell

• Communicate - talk with details an examples;
use science vocabulary

• Ask questions -
"I wonder..."
"What if we..."
"Lets try this..."

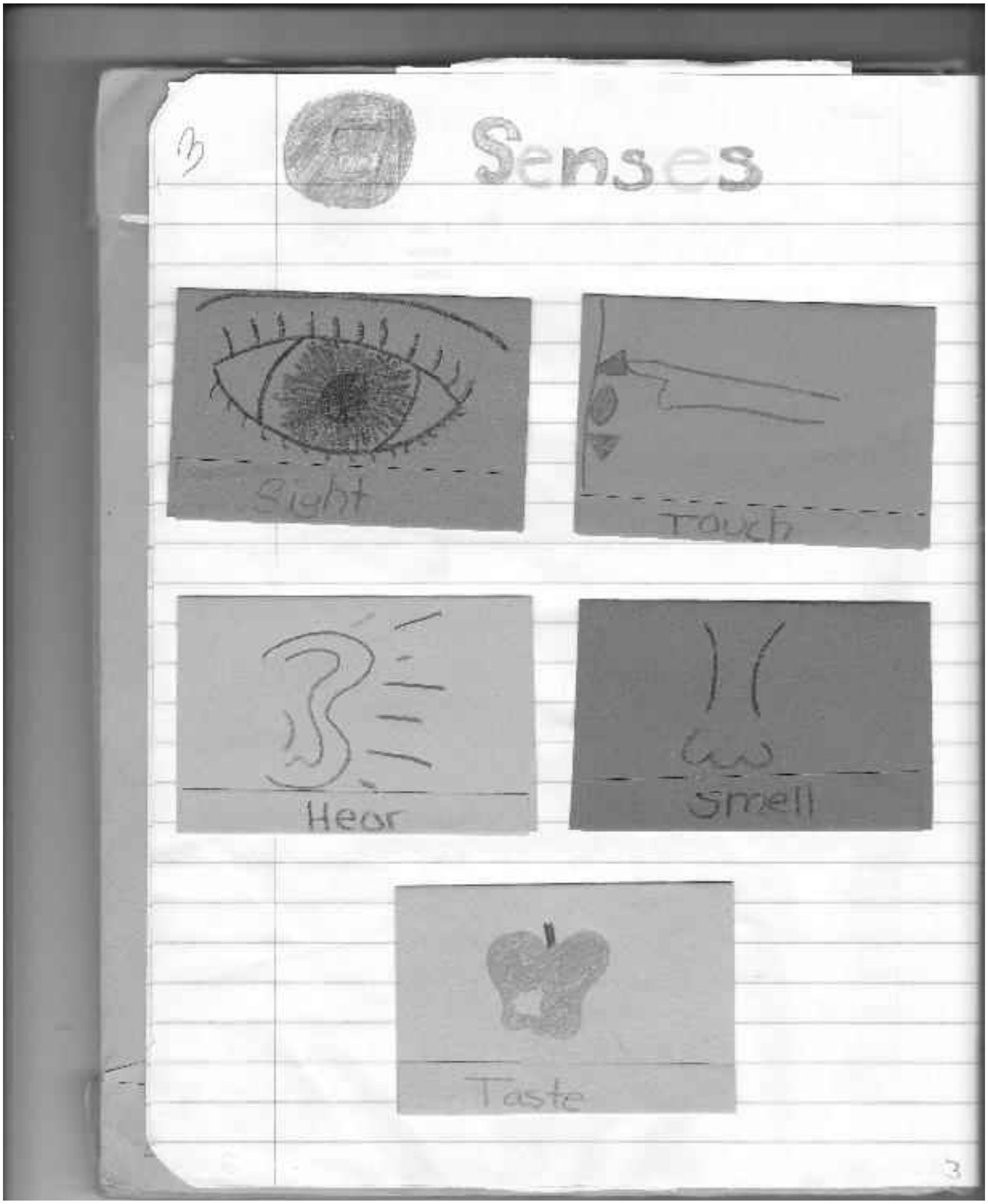
• Do Investigations
experiment, test, labs, repeat if needed

• Hypothesize - Educated guess (Predict)

• Draw conclusions -
What happend + why

• Reflect - What they learned

4


3
Senses
Sight
Touch
Hear
smell
Taste
3

APPENDIX J: REFLECTION THINKING LIKE A SCIENTIST

What it meons to be a scinentist?

you take notes obsurvatio
you'se senses (for example) touch, hear, smell, see taste. you have questions. test it in test tubes. They geuss predict. They have to an experament more than 3 times to make Sure they are right. They have to be careful and needs to be obsurving every detail. Scientists can be rong or right. As a scientist you have to taste things you can taste and determind What it taste like. They hypothisize (predict) things. Scientists also, communicate, they do envestigations.

APPENDIX K: FOCUS GROUP QUESTIONS

Questions for Focus Groups

1. Did you use specific details and examples in your science explanations? Give examples

2. How does using science vocabulary in your writing help you to understand more about what you are learning?

3. How does writing help you understand Science?

4. If you don't understand something during a science investigation or discussion, what can you do?

5. How does writing a reflection about what you have learned help you better understand a science concept that you've been working on?

APPENDIX L: ONE ON ONE INTERVIEW RESPONSE

Questions About Writing in the ISN

1. Did you use specific details and examples in your science explanations? Give examples

   Yes, I used specific details. For example, in my density explanation, I ~~told~~ wrote about putting egg beaters, in vinegar and oil at home. I also wrote about using corn syrup, soap, colored water and corn oil at school.

2. How does using science vocabulary in your writing help you to understand more about what you are learning?

   Using science vocabulary is helpful because it expands my vocabulary and gives me precise words to explain things.

3. How does writing help you understand Science?

   Writing helps me understand Science because I have to think about it and make it come out in my own words.

4. If you don't understand something during a science investigation or discussion, what can you do?

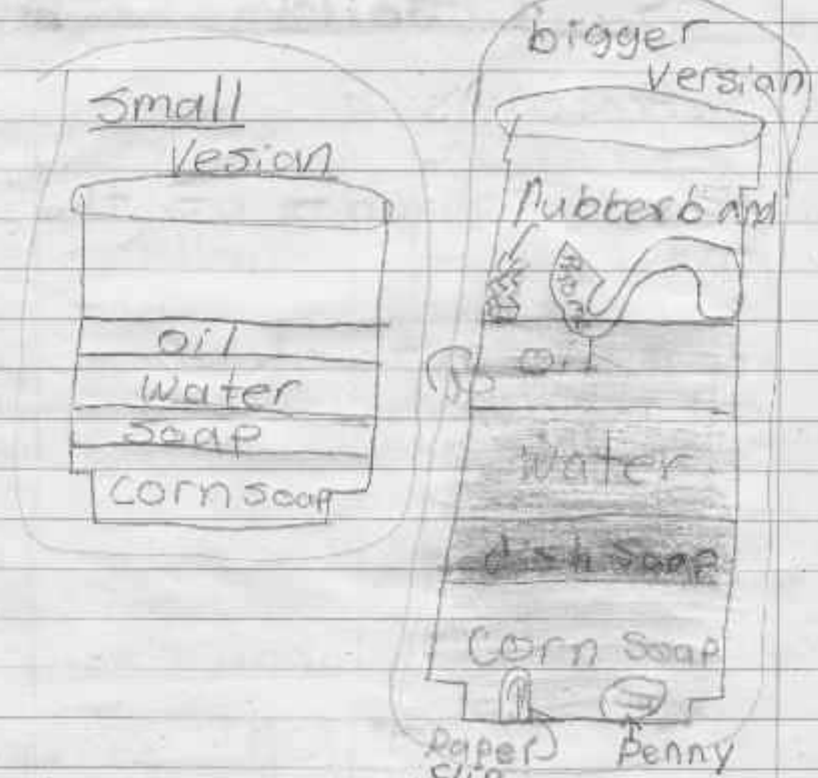
   If I don't understand something I ask other people or go back through my notes to see if I have already written it down.

5. How does writing a reflection about what you have learned help you better understand a science concept that you've been working on?

   It helps me refresh my memory and summarize what I've learned.

APPENDIX M: REFLECTION 2 “DENSITY”

(12)



We mixed all of the liquids and I think the liquids will go back to the same colour. to the Same lairs. lowest Density to highest Density.

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