

SCIENCE TALKS  
A NEW KINDERGARTEN TEACHING STRATEGY

by

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A professional paper submitted in partial fulfillment  
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY  
Bozeman, Montana

July 2013

STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under rules of the program.

Tina Marie Brothers Tillinger

July 2013

DEDICATION

To my husband, Todd, and my sons, Dylan and Hayden, who survived and found the true meaning of, “it takes a village...”

## ACKNOWLEDGEMENTS

I would like to thank Ashley and Tami for their willpower and humor, as well as Dr. Woolbaugh for his insight, compassion, and encouragement.

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## ABSTRACT

Kindergarten students need more opportunities and explorations to increase their science observation and questioning skills. A new teaching strategy called Science Talks was designed to focus on these skills and it was administered for twenty minutes each day for one week. A total of three weeks of Science Talks were administered, and they were alternated with three weeks of science instruction that did not include a Science Talk. These talks began with a science question being posed that included two variables and the students worked with a peer to develop a testable investigation or question. Overall, the Science Talk teaching strategy showed improvement in both the students' observation and questioning skills during the mid-data analysis and a more dramatic improvement during the post-data analysis. The peer-peer communication and class discussions during the three-week treatment phases were also found to be beneficial to the students' learning and aided the teacher's instructional strategies.



## INTRODUCTION AND BACKGROUND

### Introduction

Kindergarten students are full of wonder and curiosity. As a kindergarten teacher, it is rewarding to see my students explore their environment and make connections with the world around them. For the past three years, I have been involved in the Science and Inquiry Learning in the Classroom (SILC) professional development program. The SILC classes developed my science content knowledge and increased my understanding of the pedagogy of Science Inquiry (Nisbet, 2008). As I used the Science Inquiry method of teaching, I found that my students were able to explore new concepts in a more meaningful way. The students began to make connections between what they were learning and the outside world. They also gained a deeper understanding of the science content we were studying. I could see the positive impact science inquiry was having on my students' learning, but I was struggling with finding time in my daily schedule to teach science.

Science was scheduled for twice a week, but was often bumped for extra activities. I began to wonder how I could find a way to further develop my students' science inquiry process skills (Appendix A) and teach science every day at the same time. I decided to focus on the two science inquiry process skills of observation communication and science questioning because they provide the building blocks for future science explorations.

After conducting research, I developed what I called a Science Talk teaching strategy. This strategy was modeled after a Math Talk strategy that another teacher in my building used. The Science Talks were designed as a quick twenty-minute talk conducted before each science lesson. These talks were connected to a unit of study so each cycle

of Science Talks consisted of questions on the same topic. The talks were taught every day before a regular science lesson or by themselves if needed. Each talk began with a science question being posed that included variables. The questions were related to the real world. I started the sessions by saying, "It is time for Science Talks," and used the words, "I wonder" to ask a question. For example, while studying shadows I began the Science Talk by saying, "It is time for our Science Talks, I wonder if we can make shadows anywhere?" Then I would continue and ask, "How can you make a shadow using this flashlight and book?" The students worked with a peer to develop a testable investigation and record their ideas on sketch paper. These ideas were immediately shared during a class discussion.

The Science Talks enabled me to teach science every day and provided a way to impact my students' learning by advancing their science questioning and observation skills. Using the Science Talk idea I developed the following primary question and additional sub-questions for my action research project:

Primary Question:

"What is the impact of a Science Talk teaching strategy on kindergarten student learning?"

Sub-questions:

1. "How does this strategy impact students' science observation skills?"
2. "How does this strategy affect students' science questioning skills?"
3. "How does this strategy impact me as a teacher?"

### Shared Findings

I shared my findings with my students, parents, principal, and other teachers in my building. In addition, other kindergarten teachers in the district were interested in receiving professional development for this teaching strategy so they can integrate it into their science curriculum. My principal has indicated that I could provide building staff development on this project.

### Support Team

For the writing of this Capstone, I assembled the following support team:

Dr. Walt Woolbaugh - Capstone, Committee Chair

Dr. Woolbaugh continued to provide invaluable input into the writing of this Capstone. I could count on him for stability, effective feedback, and continuous encouragement during the entire action research process. His insight was crucial as I navigated the design and implementation of the study as well as the writing process. He is a gifted educator who understands the needs of his Master's Degree students.

Dr. Chris Bahn - Reader of Capstone

Dr. Bahn provided productive feedback as a reader of my Capstone. His mastery of the English language and effective editing skills were appreciated as I finalized my paper.

Tami Jendro – Third Grade Teacher, Jim Darcy Elementary School

Tami is a natural teacher and a naturalist. Her sense of wonder and unique ability to see science through the “eyes of children” allowed me to keep my action research project focused on my students. She understood the rigors of balancing

a family, teaching, conducting action research and writing a capstone. I continued to brainstorm ideas with Tami throughout the entire process. She deeply understands how my project came to be and was invaluable as I moved through the treatment and non-treatment phases.

Ashley Milbrandt – First Grade Teacher, Jim Darcy Elementary School

I call Ashley my organizer extraordinaire! She helped me develop this action research project from day one. She is also my running partner, which provided me with many hours of uninterrupted time to “talk action research!” Ashley was very helpful at keeping me focused and on track with regard to my project. She understands young learners and provided assistance in analyzing student work. She always had tips and tricks to making things more efficient. I continued to use her throughout the writing of this Capstone.

Todd Tillinger – State Manager, US Army Corps of Engineers

Todd is my husband and has proven to be a strong editor for my papers. He has successfully published articles in Engineering and Scientific Journals. He also wrote the Special Area Management Plan (SAMP) for the Upper Yellowstone River. His attention to detail was exactly what I needed as I wrote this Capstone.

Brian Cummings – Principal, Jim Darcy Elementary School

As my building Administrator, Brian provided extra encouragement. He believed in my action research project and supported finding best practices for students. I used him as a sounding board during my treatment and non-treatment phases to look at student work and overall student achievement.

As you can see, I was fortunate to have the support and encouragement of many people as I completed my Capstone project. Along the way, it was rewarding to see my ideas blossom into a new kindergarten teaching strategy. My review of the research helped me focus on the best way to begin my project.

## CONCEPTUAL FRAMEWORK

This action research (AR) project was designed to develop a new teaching strategy to teach kindergarten students the two science inquiry process skills of communicating their science observations and developing their science questioning skills. It was designed to be taught every day in the elementary classroom. A review of relevant literature showed that other teachers have a desire to teach more science, but the continued emphasis on assessing a kindergarten student's literacy and math skills decreases the time available for science instruction. As a result, elementary teachers are simply trying to fit in science when they can (Samarapungavan, Patrick, & Mantizicopoulos, 2011; Pine, J., Aschbacher, P., Roth, E., Jones, M., McPhee, C., Martin, C., Phelps, S., Kyle, T., Foley, B., 2005).

A recent study from the *Journal of Research in Science Teaching* suggests that it is important to provide more science instruction and exploration opportunities in the early years “to develop fundamental science inquiry skills and understanding of basic science concepts, which subsequently may lay the foundation for the understanding of more complex science concepts in later grades ” (Sackes, Trundle, Bell, & O'Connell, 2010, p. 217). To further develop the new Science Talk teaching strategy, I found that the data supported using many different methods of science instruction. For example, students who were taught in science inquiry-based classrooms showed “significant gains across all

measures of science learning from the beginning to the end of the school year” (Samarapungavan, Patrick, & Mantzicopoulos, 2011, p. 416). Science inquiry encourages students to ask questions, develop testable questions and investigations, record their data, and communicate their findings.

Another teaching method that was supported by the research I conducted was Problem-Based Learning (PBL). The PBL method places “emphasis on self-directed learning and real-world problem-solving” (Zhang, 2011, p. 468). The PBL study showed that the students had opportunities to practice and grow their questioning skills. Using PBL, the students wait for the teacher to provide instruction in the form of a real-world problem that has many solutions. “PBL provides a discourse structure to engage young learners in discussing science” (Zhang, 2011, p. 469). After I reviewed many instruction methods, I integrated both Science Inquiry and PBL into the Science Talks teaching strategy.

This AR project focused on the science inquiry process skills of questioning and communicating observations. Dr. Karen Ostlund mentions the correlation between these two skills in her article explaining the research behind science process skills. According to Dr. Ostlund, “Science begins with observations of objects and events; these observations lead to the asking of questions. Crucial to the method of science is the ability to ask the right question and make selected observations relevant to that question” (Ostlund, 1998, p. 1). These two process skills become important as students begin to problem solve, develop investigations and make sense of the world around them. The connection between the two skills, the ability of kindergarten students to use these science inquiry process skills, and the research supporting developing these skills were

the factors used to determine which science inquiry process skills were the focus of this AR Project.

Kindergarten students are not assessed in the area of science very often, but this research provided many data collection instruments. Most studies utilized a form of student journals and student interviews (Zhang, 2011). Two of the studies used a form of performance assessment (Zhang, 2011; Pine, et al., 2005). To administer this type of assessment, the teacher posed a problem that required the students to use the inquiry skills that they have mastered, but the students are not familiar with the exact problem that is posed. The performance is measured using a rubric. Another study's main purpose was to develop an assessment to evaluate the Science Inquiry skills of kindergarten students. This study collected data using the following assessments: embedded assessments, standardized and norm-referenced assessments, and unit tests of conceptual knowledge. (Samarapungavan, Mantzicopoulos, Patrick, & French, 2009). All of the authors suggested interviews and student work as the primary sources of data collecting and that pre-tests and post-tests are much more difficult to administer and collect valid and reliable data. This AR project used many of the recommended assessments such as student interviews, student drawings, and sketches.

To formulate the Science Talk questions to be used in the treatment phase, research was conducted on various theories. "Constructivist learning theory supports inquiry by placing the focus of learning on student ideas, questions, and understanding, and not teacher delivery of content" (Eick & Reed, 2002, p. 402). Piaget believes that young learners are ready to understand and master concepts once they have reached the appropriate stage of development.

Vygotsky agrees with Piaget, but believes that a child's social environment and interactions also lead to their development and ability to learn especially in the area of language (McLeod, 2011). According to Vygotsky, young learners need to speak about what they are learning and have conversations with their peers. This social interaction and communication promotes learning (McLeod, 2011). The theories of Vygotsky and Piaget were reflected on when the format and questions of the Science Talk teaching strategy were developed. The science content was appropriate developmentally for kindergarten students and the Science Talks enabled the young learners to communicate their science wonderings and investigations with their peers.

## METHODOLOGY

### Demographics

Jim Darcy School is a K-5 Elementary school in Helena, Montana, and has an enrollment of 305 students. This school is located in an area that has a rapidly expanding population. It is not uncommon for many parents to arrive several hours before the scheduled opening of registration to enroll their child for kindergarten. Each year, it is typical for approximately 24 kindergarten students to be routed to another school in the district due to space constraints. Siblings, Head Start students and Special Education Preschool students are automatically pre-registered before opening registration day. Our school has the lowest percentage of free and reduced lunches (20.3%) in the entire Helena School District. My class consists of 22 kindergarten students, and this year, all of my students presented the necessary kindergarten social readiness skills. Eleven of my students are boys and eleven are girls. Two of my students were transitioned from the Special Education Preschool and they are on an Individualized Education Program



(I.E.P). Another student is on an I.E.P. for Speech Services. This year our school made Adequate Yearly Progress (AYP). The Jim Darcy students consistently show improvement in both areas of reading and math.

### Treatment

My action research project consisted of six units. Each unit lasted for five lessons. Three units were treatment and three units were non-treatment. During both the treatment and non-treatment phases I taught one lesson each day for five days. Each lesson was taught for 20 minutes in the afternoon, and I used the Science Inquiry 5E's model that includes engage, explore, explain, extend, and evaluate. During the treatment phases, I added a 20-minute Science Talk before each lesson, and during the non-treatment phases I taught only the lesson. Science Talk questions related to our unit of study and provided the students with opportunities to use their science questioning and communicating skills. For example, during a treatment phase on the study of worms the Science Talks began with the statement "It is time for Science Talks," and then I asked questions like "I wonder if worms prefer/like light or dark?", "How can we investigate if they prefer light or dark?", or "What could we use or do to find out if they like light or dark better?" The students worked with a buddy on a spot on the floor to design their investigation. The students were paired with the same partner for one treatment cycle. Each new treatment cycle had new partner pairs. They drew their ideas on sketch paper and after 10 minutes, all the students were directed to the rug, sat in a circle, and shared their ideas. After their ideas were shared, the students and I separated them into three piles. Pile A was the students' drawings that repeated the question. We called these "reported drawings." Pile B was those drawings that were an idea for an investigation,

but it was not testable. We called these “non-testable drawings.” Pile C was an idea for a testable investigation. We called these “testable drawings.” We conducted the investigation for the day from the drawings in Pile C or “testable drawings.” Table 1 shows the units of study, treatment and non-treatment schedule and a sample of a single Science Talk question that was used during the treatment cycle.

Table 1  
*Treatment/non-treatment schedule*

Units- 5 lessons each	Dates for 2012-2013 school year	Treatment or Non-treatment	Sample Science Talk Treatment Question asked by teacher
Baseline Data Collection	10/15 – 10/26		No treatment questions
Leaves	11/15 – 11/9 Mon – Wed.	Non-Treatment	No treatment questions
Worms	11/26 – 11/30	Treatment  Science Talk	<ul style="list-style-type: none"> <li>I wonder if worms like/prefer light or dark? How can we investigate to find out?</li> </ul>
Water - Freezing/Melting	12/3 – 12/7		No treatment questions
Shadows/Light	2/11 – 2/15	Treatment  Science Talk	<ul style="list-style-type: none"> <li>I wonder if we can make shadows anywhere? How could we make a shadow in this classroom using a flashlight and a book?</li> </ul>
Electricity	2/25 – 3/1		No treatment questions
Magnets	3/4– 3/8	Treatment  Science Talk	<ul style="list-style-type: none"> <li>I wonder what objects attract to this magnet? How can we find five objects that attract?</li> </ul>

As you can see from the table, Science Talks provided the kindergarten students with extra opportunities to formulate testable science investigations and communicate

their observations. As the students became proficient at designing testable investigations, I asked them more probing questions. For example, during a unit on worms I asked, “What do you wonder about worms?” and “What would you like to investigate about worms?” These questions further developed their questioning skills and they began to formulate their own testable science questions.

### Sampling

I teach 22 Kindergarten students ranging in age from five to six. A stratified random sampling was used for all of the following assessments: student interviews, student drawings, classroom assessment technique (CAT), student sketches, and teacher field notes.

The stratified random sample contained nine students. Five were girls and four were boys. Prior to randomly selecting the students, I separated all of the students into three sets of achievers. I used a combination of the Fall 2012, Academic Improvement Measurement System based on the web (AIMS Web) data that our district uses to assess letter names and sounds fluency for kindergarten students and the students’ Fall 2012, math assessment to determine the three sets. Next, I randomly chose three students out of high achievers pile, three students out of the average achievers pile, and three students out of the struggling achievers pile.

### Data Research Instruments

To answer my primary research question and sub-questions I used qualitative data from my student interviews, teacher field notes, student sketches and student drawings. I also used quantitative data from student interviews, CAT, student sketches and student drawings. The research methodology for this project received an exemption by Montana

State University's Institutional Review Board (IRB) and compliance for working with human subjects was maintained. Evidence of this approval is provided in Appendix B.

Table 2 shows a matrix of the data collection methods that were used to answer each research question.

Table 2  
*Data Collection Matrix*

Research Questions	Data Collection Techniques				
	Teacher Field Notes	Student Sketches	Student Interviews	Student Drawings	CAT
“What is the impact of a Science Talk teaching strategy on kindergarten student learning?”	X	X	X	X	X
1. “How does this strategy impact students’ science observation skills?”	X		X	X	X
2. “How does this strategy affect students’ science questioning skills?”	X	X	X		
3. ”How does this strategy impact me as a teacher?”	X	X	X		

To ensure reliability and validity, Table 2 demonstrates that more than one data collection method was chosen to address each research question. The five data collection instruments shown in Table 2 are described below. Following the description, you will see Table 3 that outlines when the data collection methods were administered, the units of study, and the treatment and non-treatment cycles during this AR project.

1. Teacher field notes were written everyday during both treatment and non-treatment cycles. Prompts for the field notes (Appendix D) were developed after the first

non-treatment cycle. These notes provided valuable information on the day-to-day progress of the non-treatment and treatment phases. They also indicated any changes that were needed during the new teaching strategy.

2. Student sketches (Appendix E) were collected daily during the treatment cycles. Each student pair made their student sketches on a single, white piece of sketch paper. They would work with their buddy to formulate a testable investigation that answered the “I wonder” question that I posed. I wrote their explanations on their sketch paper as they shared their ideas with the group. The treatment cycle was indicated on the paper. The sketches of the nine students in the sampling were scored using a rubric (Appendix F). Three points was the highest score and one point was the lowest.

3. Student interviews were conducted three times (pre-, mid-, and post-study) during the action research project. An iPod touch was used to make audio recordings of the student interviews. A list of questions and probing questions was prepared before the pre-study interviews were administered. After the pre-study interviews, the questions (Appendix G) were modified. Each child was individually interviewed outside the classroom. To code the student interviews, four themes were identified and each theme was assigned a number, color, and letter (a, b, or c) to show the level of mastery. Table 3 below shows one theme and how it was coded.

Table 3  
*Themes and Coding*

Theme and number	Color	Level A	Level B	Level C
2. Can communicate observations.	Blue	Emerging 1-2 observations	Near proficient 3-4 observations	Proficient 4+ observations

The codes were written at the top of the interview page. All interviews were conducted using a stratified random sampling of nine students. Appendix H shows the full table of themes and codes for the student interviews.

6. Student drawings (Appendix I) were administered three times (pre-, mid- and post-study) during the action research project. This assessment was administered to all of the students, but the drawings of the nine students were assessed and scored on a rubric (Appendix J). During the assessments, each child was given one piece of white construction paper and asked a question regarding their observations about a former lesson. For example, after a unit on senses, I asked the students to draw what they observed when they explored the “feely (sense of touch) box” that was filled with different items. After they completed their drawings, they conferred with me to explain their work and I wrote their explanations on the front of the drawing. To make the instrument more valid and reliable, I modeled an example of a “1”, “2”, and “3” point student drawing and the students practiced using the rubric prior to the first assessment.

7. A CAT (Appendix K) in the form of a categorizing grid was administered three times (pre-, mid-, post-study) during the action research project. Each time the students were given a piece of white paper that was folded in half. At the top and on one side was the symbol XX and on the other side was the symbol XO. The students were shown two pictures side by side of objects that were similar. The students were asked to list or draw what they observed as similarities on the XX side and what they observed as differences on the XO side. I conferred with each student and wrote his or her responses. To make the instrument more valid and reliable, I modeled an example of how to perform this CAT using another pair of similar objects prior to administering the pre-study CAT.

Table 4 describes the schedule for the data collection instruments, the units of study, and the treatment/non-treatment cycles.

Table 4

*Treatment/non-treatment data collection instruments schedule*

Units	Dates for 2012-2013 school year	Treatment/ Non-treatment	Data Collection Instruments
Baseline pre-study data collection	10/15 – 10/26		<ul style="list-style-type: none"> <li>• Student interviews – pre-study</li> <li>• Student drawings – pre-study</li> <li>• Teacher field notes – pre-study</li> <li>• CAT - pre-study</li> </ul>
Leaves	11/5 – 11/9	Non-treatment	<ul style="list-style-type: none"> <li>• Teacher field notes–daily</li> </ul>
Worms	11/26 – 11/30	Treatment	<ul style="list-style-type: none"> <li>• Teacher field notes-daily</li> <li>• Student sketches-daily</li> </ul>
Water - Freezing/melting	12/3-12/7	Non-treatment	<ul style="list-style-type: none"> <li>• Teacher field notes–daily</li> <li>• Student drawings – mid-study</li> </ul>
Shadows and light	2/11 – 2/15	Treatment	<ul style="list-style-type: none"> <li>• Teacher field notes-daily</li> <li>• Student sketches-daily</li> <li>• CAT – mid-study</li> </ul>
Electricity	2/25 -3/1	Non-treatment	<ul style="list-style-type: none"> <li>• Teacher field notes–daily</li> <li>• Student interviews – mid- study</li> </ul>
Magnets	3/4 – 3/8	Treatment	<ul style="list-style-type: none"> <li>• Teacher field notes-daily</li> <li>• Student sketches-daily</li> </ul>
Post-study data collection	3/11 – 3/15		<ul style="list-style-type: none"> <li>• Student interviews – post-study</li> <li>• Student drawings – post-study</li> <li>• CAT – post-study</li> <li>• Teacher field notes – post-study</li> </ul>

Assessment of kindergarten students is limited because of the development of their academic skills; however, using the varied methods of data collection I was able to

measure the effectiveness of the Science Talk teaching strategy and answer my research questions.

## DATA AND ANALYSIS

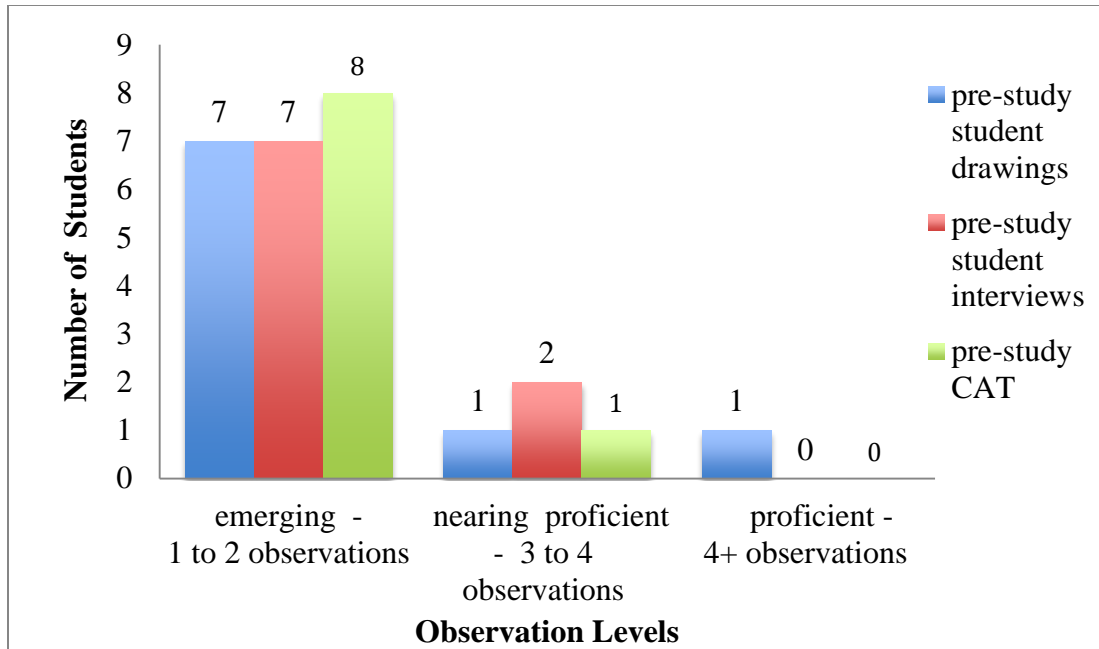
A combination of qualitative and quantitative data was collected throughout the action research project. I collected data from nine of my twenty-two students. To choose the nine students, I used a stratified random sampling of my class. Student interviews, student drawings, and CATs, were administered pre-study, mid-study, and post-study during the action research (AR) project. The student sketches were administered only during the treatment phase and teacher field notes were taken daily. All data was combined and analyzed to understand how a new Science Talk teaching strategy affected kindergarten students' science observation and questioning process skills.

I analyzed student interviews, student drawings, CATs and teacher field notes to answer the research sub-question, "How does this strategy impact students' science observations skills?" To compare the sets of data, I used part of the interview table of codes and themes and created an additional scoring rubric (Appendix L). I used this rubric to score the student interviews, student drawings, and the CAT. This rubric consisted of three levels of student observations. The three levels were as follows: emerging (1 to 2 observations), nearing proficient (3 to 4 observations), and proficient (4+ observations). As I reviewed the different sets of data, I noticed that during the pre-data collection stages most of the students (78%) were in the emerging stages of communicating their observations. For example, they reported one or two similarities and/or differences between objects or they described what they observed, but gave minimal or no examples. The student interview data showed that seven out of nine (78%)



students could communicate their observations describing only one observation. Similarly, the student drawings showed that seven out of nine (78%) students could only identify one observation to describe a prior science lesson. For example, when the students were interviewed and asked to explain what they observed when they explored the “feely boxes” for the sense of touch, these students responded with remarks like “I could feel a crayon.” or “I put my hand in and felt something.” The responses for their student drawings were comparable such as: “I reached into the box and felt a penny.”; “There was a block.”; and, “There was something squishy.”

The CAT pre-study data also showed the same results as the previous two data sources. During this assessment, eight out of nine (89%) of the students were in the emerging stage of communicating their observations. They could list at least two observations when asked to draw their observations about two different leaves. For example, the students responded with similarities like, “They both have stems.” or, “They both have veins.” and the differences included, “They are different colors.” or, “One is bigger and the other is smaller.” Although a majority of the students were in the emerging stage of communicating their observations, one or two students were in the nearing proficient and proficient stages. Figure 1 below shows the relationship between the student drawings, student interviews and CAT data regarding the levels of the students’ observation skills during the pre-study data assessment.



*Figure 1:* Levels of student observations for pre-study data collection methods.

Each assessment was scored regarding how many observations the student could communicate and the results were entered into the bar graph. The bars indicate the number of students in each of the three categories (emerging observations, nearing proficient observations and proficient observations) for each data collection method. The data also shows that only one student is proficient in communicating their observations when the pre-study student drawings data was collected. This student is a very good reader and began kindergarten reading at a second grade level. The student also has an extensive vocabulary and semi-phonetic writing skills that would contribute to a higher level of communicating of observations. The pre-data assessments support what I have experienced as a kindergarten teacher. Each year, most of the students enter kindergarten with little or no ability to communicate their observations and that is why I developed this Science Talk teaching strategy.

The mid-assessments and post-data collections (student interviews, student drawings and CAT) were analyzed to determine if there was any growth in the students' ability to communicate their observations after the treatment phases. This data showed an increase during the mid-assessments and an additional increase during the post-assessments. Table 5 shows the changes in the students' level of communicating their observations between the mid-assessments and post-assessments.

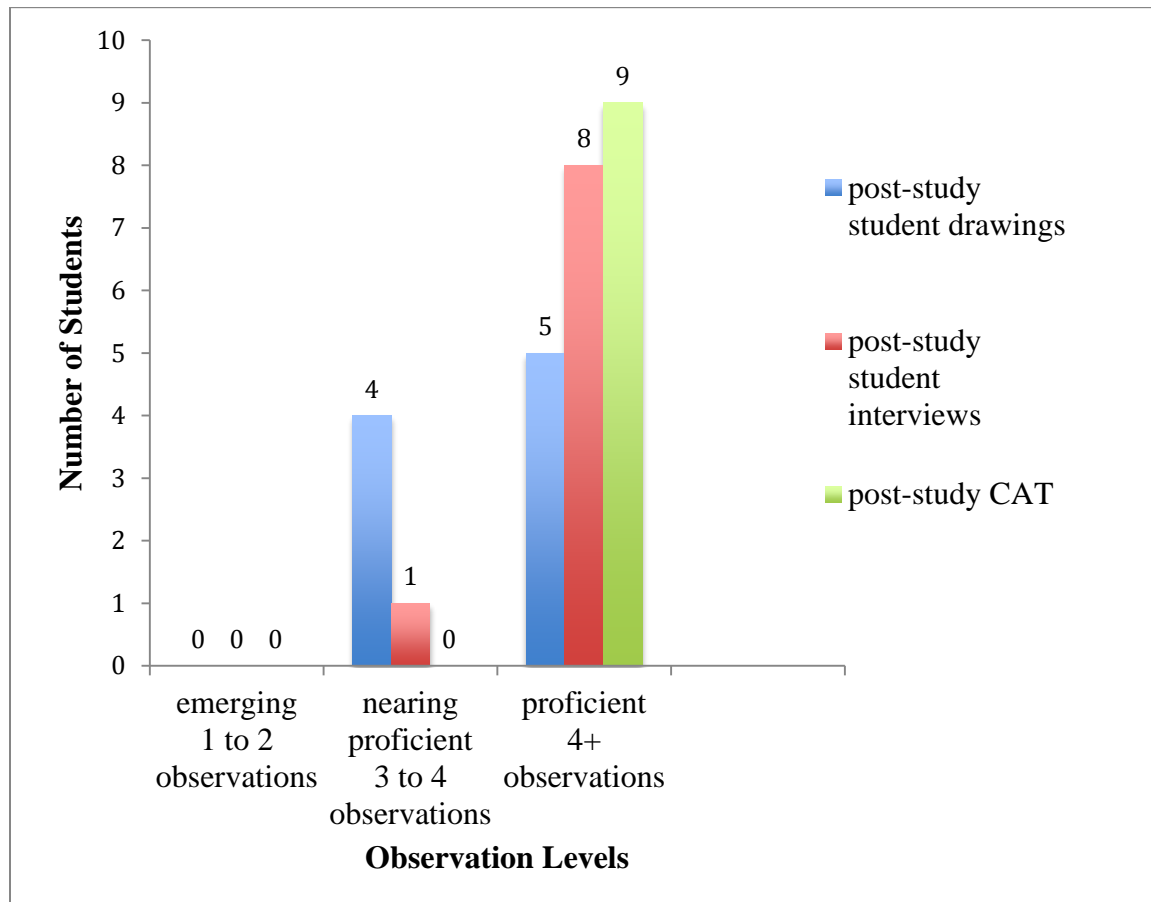
Table 5

*Comparing pre-assessments and post-assessments of students' observations, (N=9)*

Data methods	Emerging mid-study	Emerging post-study	Near proficient mid-study	Near proficient post-study	Proficient mid-study	Proficient post-study
Student drawings	2/9=22%	0/9=0%	5/9=55%	4/9=44%	2/9=22%	5/9=56%
Student interviews	1/9=11%	0/9=0%	5/9=55%	1/9=11%	3/9=33%	8/9=89%
CAT	2/9=22%	0/9=0%	4/9=44%	0/9=0%	3/9=33%	9/9=100%
Averages of data methods	18%	0%	51%	18%	29%	82%

Table 5 indicates that an average of 18% of the students were still in the emerging stage of communicating their observations at the mid-assessments and 0% were in the emerging stage during the post-assessments. Similarly, an average of 51% of the students were nearing proficient during the mid-assessments and only 18% were nearing proficient at the post-assessments. The numbers decreased in both the emerging and nearing proficient because many students developed their skills and moved to the next level (nearing proficient or proficient). An average of 29% were proficient at the mid-assessments and 82% were proficient at communicating their observations at the post-assessments. Figure 2 shows the post-study data results of all three assessments. The

data illustrates the number of students that are in the near proficient and proficient stages at the end of the AR project.



*Figure 2:* Levels of student observations for post-study data collection methods.

The three sets of data results were very closely related. All three sets showed that the students' increased their ability to communicate their observations. More students were able to communicate their observations using the CAT method of assessment. This was not surprising since this method was very consistent and the students were asked to do a specific task. They needed to name as many similarities and differences as they could find.

The student interviews also showed more students in the proficient range during the post-study assessments. I think this was because during the student interviews, I

could ask probing questions. This enabled the students to expand on their original observation. For example, one student said, “I saw a shadow when I was on the sidewalk” and I asked a probing question, “how did that happen?” and he replied, “it was caused by the sun and I saw the shadow was on this side because the sun was on the other side and I was blocking the sun.” He followed that statement with, “then I saw the tree had a shadow too.” The probing question led to further communications of the student’s observations.

The student drawings had the fewest proficient students and I think this was reasonable because the students were asked to draw about the process of a former investigation and what they observed. They didn’t have as much experience with this type of format. Even though I had modeled this format, they were only assessed using this format three times. They did not have enough practice to be able to effectively respond with drawing or writing to a question that asked about the process of an investigation.

After I analyzed the above data, I referred to my teacher field notes to see if I felt that the students were continuing to improve their observations. This data source proved valuable because I could see that in the beginning stages of the AR project my entries included the following observations:

“had to work with the students on simple observations”, “needed to model how to describe observations and I used the word, ‘observation’, many times”, “students needed help with specific similarities and differences”, “we talked a lot about what we observed and only two students could identify that they observed the

worms moving towards the box.” “I need to work on how they can explain their observations” (11/12 entry).

During the later stages of my AR project my entries were more consistent with the growth I was observing. I wrote the following entry:

“They love to talk about their observations. They still use the word ‘observe’ many times when they are doing their sketches.” One student said, ‘did you observe the magnets hold the paperclips?’ and the other students said, ‘ya, I observed it! I observed it!’ I also wrote, “they are making great observations” (3/13 entry).

At the time I knew the students were showing improvement, but I was so involved in teaching and helping the students who were struggling that I didn’t know the overall success of the treatment.

All three data sources showed that the kindergarten students’ communication of their observations improved from the three treatment phases. The phases gave them multiple experiences and provided the practice they needed to move from the level of emerging to the level of proficient. It also indicates that it is easier for the students to describe the similarities and differences of objects that are directly shown to them than to describe their observations when posed with a question about the process of their investigation. For example, they can look at two objects that are presented and say how they are the same and how they are different, but if they are asked “what did you observe when we did the feely box?”, it is much harder. This is not surprising because working on similarities and differences is one of the initial ways that I teach the beginning steps of observations. These types of observations are also taught in other curricular areas in

kindergarten. The data supports the constructivist theory that kindergarten students need many opportunities and consistent practice to develop the important process skill of communicating their observations.

I analyzed the student interviews, student sketches, and teacher field notes to answer the sub-question, “How does this strategy affect students’ science questioning skills?” The preliminary data showed that initially most of the kindergarten students could not communicate testable questions about science. For example, during the pre-study student interviews, I asked the question, “What do you wonder or have questions about in science?” Three of the students said, “I don’t know”, five of the students made a statement about something they knew about science, but was not testable, and one student was able to ask a question, but it was not related to science.

The student sketches were used during the treatment phases. I posed a question that began with, “I wonder” and contrasted two variables. For example, during the first treatment phase, I said, “I wonder if worms like light or dark better?” After the students discussed and sketched their ideas with a buddy, they shared the sketches with the whole group. As a class we determined if their sketches belonged in one of the following levels: reporting (restating the question), untestable investigation, or testable investigation. Each time the students shared their sketches we sorted them into the three levels and put them in piles. From the piles I collected the data of the nine students that I was assessing and scored the sketches using the rubric (Appendix E). I found that during the first treatment phase seven out of nine (78%) of the students simply restated the question or made a statement about the science we were studying. Only two out of nine (22%) students were able to develop a testable investigation such as “lets put a box on

one side and (put) the light from the document camera here and then put the worm in the middle and see what he does.” The two students who were able to produce the testable investigation entered kindergarten knowing all of their letter names and sounds and they comprehend math and reading concepts very quickly with minimal instruction.

During the first treatment phase, my teacher field notes also reflected that most of the students were in the reporting phase of science questioning skills. I wrote the following:

“I observed that as the students shared their student sketches during the first treatment phase, most of the sketches were sorted into the reporting pile.” And “The students don't understand how to formulate a testable question. This age group wants to TELL you what they are doing or observing. I need to think about how to get them (the students) to produce testable questions or at least testable ideas (investigations) for explorations” (11/12 entry).

The field notes prompted me to change my instruction for the next lesson. I began by clarifying what I wanted them to do and I added, “How can we find out?” and “What can we do?” to the end of my I wonder questions. For example, I said, “I wonder if worms like rough or smooth better?”, “How can we find out?”, and, “What could we do or use?” This change made it easier for them to give ideas that led to testable investigations. Some of the students' ideas included: using sand paper and a regular piece of paper; using the sand in the sand table and the top of the sand table; and using their literacy folder and the top of their table. During the Science Talks, the students were also given many opportunities to formulate their own science questions and test them. As they became more efficient at developing testable investigations, I would ask



“What do you wonder?” questions and modeled how they could produce their own testable questions and then create testable investigations. For example, while we were involved in unit on magnets, I would say “What do you wonder about magnets?” so they could develop their own testable science questions. The table below shows the three levels of the questioning skills and the percentage of student sketches at each level. The third level includes the students’ ability to produce testable investigations or questions. The first and fourth sketches of each treatment phase were used to compare the student’s level of questioning skills.

Table 6  
*Student sketches and level of questioning skills, (N=9)*

Level of questioning skills	Treatment 1		Treatment 2		Treatment 3	
	Sketch 1	Sketch 4	Sketch 1	Sketch 4	Sketch 1	Sketch 4
Reporting	7/9 = 78%	0/9 = 0%	2/9 = 22%	0/9 = 0%	2 = 22%	0 = 0%
Non-testable investigation	0 = 0%	3/9 = 33%	0/9 = 0%	0/9 = 0%	3/9 = 33%	0/9 = 0%
Testable investigation or question	2/9 = 22%	6/9 = 67%	7/9 = 78%	9/9 = 100%	4/9 = 44%	9/9 = 100%

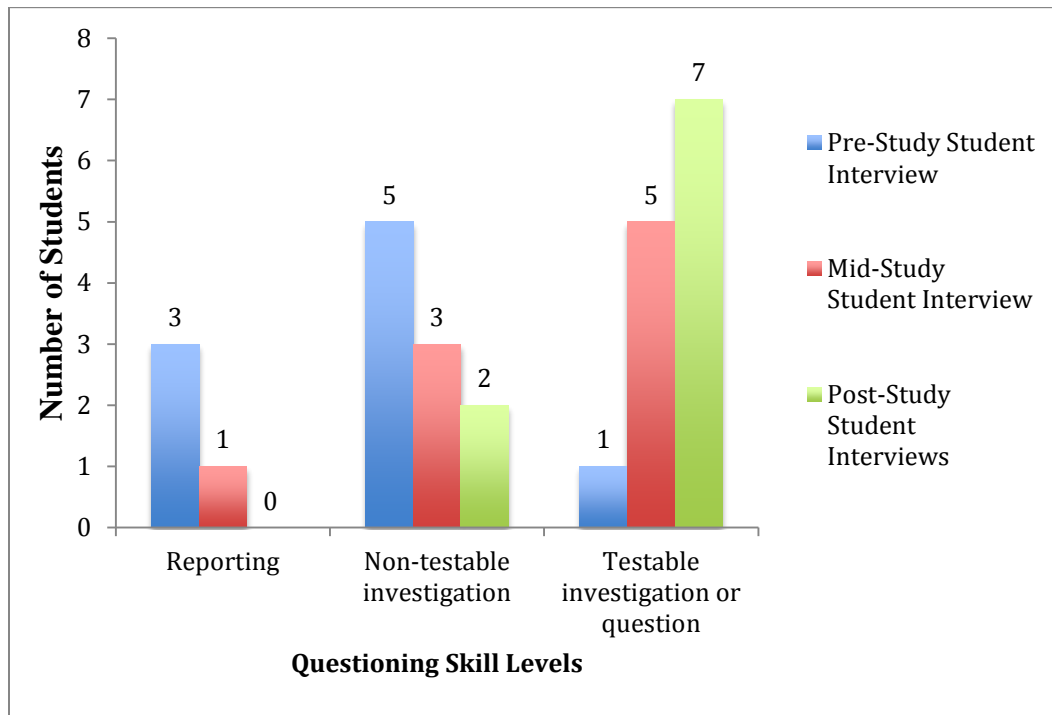
The data from the student sketches showed an improvement in the students’ questioning skills in each treatment phase. During sketch one of the first treatment phase 78% of the students’ ideas were in the reporting column. The fourth sketch in that same treatment cycle showed that none of the students’ sketches were in the reporting column and 67% of the students could produce a testable investigation or question. Each treatment cycle produced more growth and by the fourth sketch in the second treatment cycle, 100% of the students’ were able to produce a testable investigation or question.

This data illustrated that after eight sketches and class discussions, the students were able to produce a testable investigation or question. Their skills moved from reporting the science questioning to giving ideas that were not testable and then to providing testable science investigations or questions. Each day the students were encouraged to develop their own questions, determine their variables and set up their own investigations during the Science Talks. This was accomplished by using “What do you wonder?” questions. By the fourth lesson and sketch, it was easier and easier for them to come up with a testable investigation or question. For example, as we were studying worms on the last day of the first treatment phase, one student said, “I wonder if worms like concrete or the table better? Hmm.. I wonder where I could get some concrete?” This was exactly what I was hoping the students would be able to accomplish from the exposure to the Science Talks.

During the non-treatment phases I did not use the student sketches during my science lessons. This was important to consider when I analyzed the data because each time a new treatment period started 22% of the students reverted back to the reporting stage and needed more practice to advance their skills. However, by the fourth sketch they were able to again produce a testable investigation or question.

I compared the data from the student sketches to my mid-study interviews and post-study student interviews, and I found similar results. For example, during the mid-study interviews the students were still struggling with responding to the question, “what do you still wonder or want to investigate about shadows?” Some of the students were able to produce a science question but not a question that they could use to develop an investigation. One student responded, “I wonder if there are dinosaurs?” Figure 3

shows the levels of the students' questioning skills during the pre-study treatment, mid-study treatment and post-study treatment interviews.



*Figure 3:* Students questioning skill levels for student interviews.

During the mid-study interviews five out of nine (55%) students could produce testable questions and during the post-study interviews seven out of nine (78%) students could ask science questions that were testable. For example, during the post-study interview I asked the question, “What do you wonder or have questions about in science?” The students’ responses included “I wonder if my backpack would give a shadow the shape of my backpack?”, and “I wonder if magnets hold more nails than paper clips?”

My teacher field notes reflected the students’ growth during the treatment phases. The following field note was taken during one treatment phase.

“Two students had a wonderful ‘ah ha’ moment! They were trying to figure out how to test if worms like rough or smooth and they were walking around the room feeling all the surfaces to decide what to use for their sketch. I heard them say ‘no this is the same, not rough we need to find rough.’ On their sketch they said ‘we could try the table and we could try the rug’ I feel like they understand how to formulate testable ideas (investigations) and they know they need two different variables. WOW! I am hearing a lot of these kind of statements from the groups” (11/12 entry).

The data from all three sources showed that students need many repeated experiences to develop their questioning skills. Even though I wasn’t analyzing peer-peer collaboration, I found it to be beneficial to this teaching strategy. I wrote this observation in my teacher field notes:

“The peer-peer collaboration and peer modeling is powerful at this age level. As they discuss their explorations they come up with more and more ideas to try and they begin to question each other. During the treatment phases, I found the peer-peer work to be a valuable tool to help students understand how to develop science questions. I just love to sit and listen to the students’ discussions during science” (3/13 entry).

All of the methods that I used to assess the students questioning skills showed that kindergarten students develop their questioning skills in stages. First, they begin by making statements, then they proceed to producing ideas for investigations, but they are not testable and finally they produce testable investigations or questions. The data showed that it was important to give the extra prompts and use the questions “What do

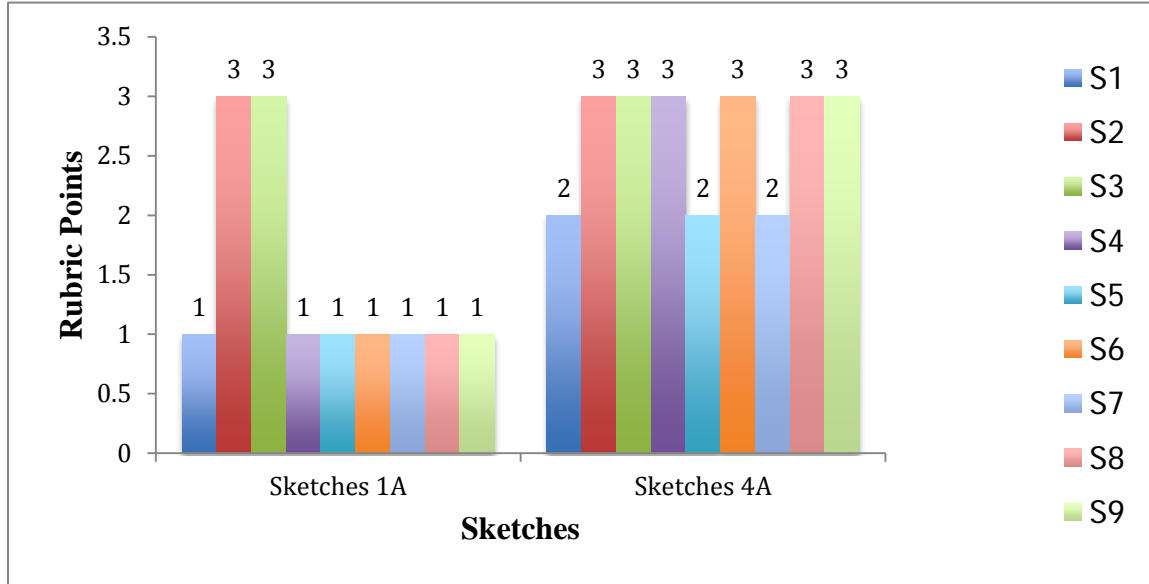
you wonder?” to help students advance to the last stage of questioning. The data also supports Vygotsky’s theory (DeVries, 2000) that students need many social interactions to develop all of their skills. As the data suggests, the science questioning skills were advanced during the project because the kindergarten students had many opportunities to work together and conduct science investigations.

I used my teacher field notes, student interviews and student sketches to answer my third sub-question “How does this strategy impact me as a teacher?” Throughout the research project, I used these data sources to drive my instruction. The most common theme that I found in analyzing the early data was that I needed to adjust my instruction to help my students make progress in communication of their science observations and questioning skills. First, I analyzed the student sketches to determine how I could provide more support, and I quickly realized that I needed a more efficient scoring system for my sketches. I developed a rubric after the first treatment period (Appendix E). As I discussed previously, I changed my questioning techniques to impact my students’ questioning skills. It was apparent that I needed to provide more steps for them to successfully develop their science questioning skills, so I developed a strategy to scaffold the lessons and to teach each stage of questioning skills. For example, if they began in the reporting stage I would pose the “I wonder” question, ask what could we do or what could we use and give them one idea if they needed it. Students would then work up to developing their own ideas even if they were not testable. Finally, I would model producing testable investigations by asking them “What do you wonder?” and wondering out loud about the lesson. I felt energized and focused each day because I was constantly assessing, refining my teaching, and recording the results.

While I was using the new Science Talk teaching strategy, I felt like I was making a difference in how the kindergarten students were observing and questioning during science lessons. I could see that they loved collaborating with a buddy to produce a testable investigation. The following field note entry was written during the first treatment phase. It shows my attitude about the new teaching strategy.

“I love teaching this new strategy. The students know what to expect and they are getting better at their student sketches. I don’t really want to teach the non-treatment phase, but I don’t want to mess with the plan and not have enough data to analyze” (11/12 entry).

The growth that I found in the students’ questioning skills between the first (1A) and the fourth (4A) student sketches during the first treatment cycle (A) was notable. As I assessed how this strategy affected my teaching, I looked at the students’ individual growth to understand why the new teaching strategy left me feeling like I was making a difference. I found that seven out of nine (78%) of the students showed improvement from the first sketch to the fourth sketch during the same treatment cycle. Figure 4 shows the students’ rubric scores on these sketches. Each stage was given the following point values: reporting -1 point, non-testable investigation – 2 points, testable investigation or question – 3 points. The letter S followed by a number (S1, S2, S3 etc.) represents the nine students.



*Figure 4:* Student sketches comparing 1A and 4A.

The data represented in Figure 4 shows that seven of the students began the treatment cycle only able to repeat the posed question. After completing four days of treatment and by the fourth sketch, every student showed improvement. Three out of nine students (33%) improved one level and four out of nine students (44%) improved by two levels. The remaining two students continued to provide testable investigations or questions throughout the sketch process. These two students read extremely well and are above average academically. The data showed that three of the students that struggled academically showed the biggest gains. They moved from the reporting stage (1 point) to the testable investigation or question stage (3 point) in one treatment cycle. As I looked at the data from all of the sketches, those students also dropped a level between non-treatment and treatment. This indicates that they need many repetitions to improve their questioning skills. This is consistent with what I am seeing in the classroom. When I am teaching any new concept these same students need multiple repetitions for the

information to be stored in long-term memory. All three of these students have strong self-help skills and they spend a great amount of time playing outdoors increasing their problem solving skills. Two of the students are extremely social and academics are not as important to them. However, they loved these science lessons and their strong problem solving skills and self-sufficient nature helped them catch on quickly.

Another one of the students is very strong academically, but had a difficult time advancing through the questioning stages. I think this is because she has spent a great deal of time in her primary years doing phonics and academics and not much time problem solving. She processes very slowly, so the sketches were hard for her to accomplish in the time that she was given. I think if she is given more opportunities the newness would wear off and it would be easier for her to improve her observation and questioning skills.

I saw the students' overall growth over a short amount of time and that made it exciting and challenging to teach this strategy each day. As I analyzed the data, I could see that the changes that I had made to my "I wonder questions", increasing the "What do you wonder?" questions, and scaffolding the teaching of the questioning stages proved effective for the students.

To further answer this question, I compared the student interview data with the other two sources, and I realized that the interviews were tough in the beginning because of the amount of "I don't know" answers. I used the data I received from the interviews to change how I interviewed the students and understand what instructional changes I needed to make. First, when the students responded that they did not know any science, I knew that I needed to start my teaching strategy by saying, "It is time for Science,"



during both the treatment and non-treatment phases. During the treatment phase I would say, “It is time for our Science Talks.” Also, the students’ were in the beginning stages of questioning and observing in the pre-study interviews and that led me to understand how hard these concept skills are for some students. As I completed the mid-study student interviews, I was able to quickly assess what changes I still needed to make to my treatment phases. For example, I realized that I needed to continue to say the word “observation” and I needed to encourage more students to develop their own “I wonder” questions during the Science Talks by asking, “What do you wonder?”

The post-study student interviews were truly a conversation with the students. For example, when I asked, “What do you wonder about shadows?”, one student said, “If I put these books on top of each other how big will the shadow be? Will it be bigger than the big book on the easel?” After the “I don’t know” that I received at the first interviews, it was encouraging to hear this original questioning from the students. The students had so much to say about science that it made the interviews fun to administer.

Overall, the data from all of the methods showed the following: I enjoyed teaching this new strategy; I was able to adjust my teaching to accommodate my students’ needs; it was beneficial to focus on two science process skills; and the new Science Talk strategy resulted in growth in the students’ observation and questioning skills.

## INTERPRETATION AND CONCLUSION

This study confirmed that kindergarten students enter their formal education able to make many discoveries, but they have difficulty communicating their observations and

developing their own testable science questions. Observation and questioning are two of the science inquiry process skills that build a foundation for meaningful future science explorations. To advance these skills, I developed a new teaching strategy to provide many experiences for the students to develop these two skills. This strategy was called Science Talks. The talks were designed to give a better understanding of the impact of a new teaching strategy on kindergarten students' learning. The results showed a measurable increase in the students' questioning skills and ability to communicate their observations during the mid-study data collections, and a more dramatic increase at the post-study data collections.

The data regarding the students' ability to communicate their observations was analyzed and the pre-study data collections were averaged. This data showed that 82% of the students were at the emerging stage of communicating their observations and 11% were at the proficient stage. At the post-study data collections, the results were flipped: no students remained at the emerging stage and 82% were at the proficient stage of communicating their observations. In addition, the teacher field notes indicated that the peer-peer communication was effective for the students and gave the teacher insight regarding the students' development of their observations. The Science Talk classroom discussions gave the teacher many opportunities to listen to the students and determine what adjustments needed to be made to the teaching strategy to meet the students' needs and improve their communication of their observations. The following changes were made during the teaching strategy: the teacher used the word "observation" many times during the Science Talks, and the teacher began the Science Talks using the word

“science” and saying, “It is time for Science Talks” to identify that the investigations were science and science is taught daily.

The data regarding the students’ questioning skills produced similar results. The pre-study data collection of student sketches and student interviews showed that an average of five out of nine (56%) students were in the reporting stage and three out of nine (33%) were in the final stage (able to produce a testable science investigation or question). Comparatively, the post-study data showed significant growth in the students’ questioning skills. No students were in the beginning stage and an average of eight out of nine (89%) were in the final stage of their science questioning skills. This data shows that this teaching strategy was also effective in improving kindergarten students’ questioning skills.

The teacher field notes indicated that class discussions and sorting the sketches enabled the teacher to identify those students who still struggled with this skill and make changes in the teaching strategy to meet the students’ needs. The pre-data suggested that more experiences were needed so the students could master each level of the questioning skills. For example, the Science Talk questioning techniques were changed and the teaching strategy was changed to include a scaffold teaching approach to help students advance through the skill levels.

It was apparent that many students needed to begin with reporting or repeating the question. After they reported or repeated questions many times, then they were able to give ideas for investigations, but the ideas were not testable. After many experiences at giving non-testable ideas, they were able to produce a testable investigation or question. At each level the students built the skills they needed to master that level by using

prompts and questioning techniques until they could produce their own testable science question.

The data from the teacher field notes, student interviews and student sketches showed that this strategy had a positive impact on the teacher. The teaching strategy was enjoyable to teach and the teacher found that it was valuable to listen to the students' converse about science with a peer and during the Science Talk class discussions. The flexibility to adjust and modify the teaching strategy after analyzing the data and hearing the students' conversations was successful for both the teacher and the students. These changes resulted in a more effective teaching strategy. In addition, it was noted in the field notes that it was rewarding for the teacher to see the students improve their skills or have a "light bulb" moment.

Overall this new teaching strategy was beneficial because it focused on two science inquiry process skills. The repetition, modeling and peer-peer communication gave the students many opportunities to practice and advance their skills. The treatment phases gave the teacher many opportunities to assess the students' needs and make changes to the teaching strategy that benefitted student learning.

## VALUE

The data indicate that this new teaching strategy provided me with the techniques I needed to effectively develop my students observation and communication skills. The Science Talks focused on two skills for twenty minutes each day and gave my students the opportunity to improve their science inquiry process skills at a faster pace.

The data showed that the new teaching strategy provided a 71% growth in the students' ability to communicate their observations after only three treatment phases. The multiple data collection methods revealed that it was easier for the students to describe similarities and differences than describe an observation from a previous exploration. Next year, less time will be needed on similarities and differences because kindergarteners are taught similarities and differences in other curricular areas. Using the results of this study, I would like to design future Science Talks to include more observations and include the other science process skill of inferring. During the Science Talk class discussions, this skill could be developed with the observation skill to enhance the students' observations, help them make sense of their observations, and improve their communications about these observations.

As a side-note, I observed that the peer-peer communication and the class discussions were a crucial part of the Science Talk teaching strategy. This observation again supports Vygotsky's (DeVries, 2000) finding that communication gives students a greater understanding of their observations. In future teaching, I would add more peer-peer communication into other areas of the curriculum.

The data also showed that the students' questioning skills improved after four sketches that were administered during the Science Talks and more significantly after 12 sketches. During the pre-study data collections seven out of nine (78%) of the students were at the beginning stage of their questioning skill level. This means that seven of the students could only report or repeat the question that was posed during the Science Talk. After the fourth sketch 33% of the students advanced in their questioning skills one level to be able to produce a non-testable investigation from variables that were given.

Another 33% advanced two levels and had the ability to produce a testable investigation or question on their own. After twelve sketches, the post data showed that 71% of the students developed their questioning skills and were able to produce a testable investigation or question themselves. This data indicated that students develop their questioning skills by practicing at each level. Next year, using this data, I will design the Science Talks to focus on each level of questioning skill during the class discussions. I will use formative assessments to determine which level each student is on and use those assessments to assign my buddy pairs. I will also include time for the teacher to continue to model each science questioning level of the sketches assessment rubric during the Science Talk.

Additionally, the sketches rubric showed that some students showed a decrease in their questioning skills after a non-treatment phase, indicating that they need constant everyday practice using their questioning skills to attain mastery and permanent retention. This showed that the everyday approach of this strategy was a better way to meet the needs of the students. During the next year, I will have the opportunity to implement this teaching strategy as a part of my daily curricular routines. I look forward to starting the strategy at the beginning of the year and giving the students more opportunities to be successful. The Science Talk teaching strategy showed greater growth because of the modifications that were made while using it. I want to explore more ways to refine the strategy to meet the needs of all of the students.

The combined assessment tools were effective data collection methods to assess student growth. Throughout this study, I found that I strengthened my assessment techniques and analyzed my data much more effectively. This constant practice enabled

me to do a better job of using the data to drive my instruction, make instructional changes, and impact my students' development of their observation and questioning skills. Next year, I would like to use these assessment techniques in other areas of the curriculum to impact my students' learning.

Lastly, the focus on this new teaching strategy was to focus on two of the science inquiry process skills. Next year, I would like to see if there is also a similar impact on the students' content knowledge as a result of improving these science process skills. A pre-test and post-test on content knowledge could be administered and analyzed to see if there is a correlation. This could be another benefit of the Science Talk teaching strategy. The conversations that were noted in the teacher field notes indicated a stronger content knowledge among students. I would then like to analyze the content knowledge data to see if I found the same correlation as Dr. Ostlund found in the study on science process skills (Ostlund, 1998).

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APPENDICES

APPENDIX A

SCIENCE INQUIRY PROCESS SKILLS

## Appendix A: Science Process Skills

A sometimes bewildering variety of interpretations of process skills, including their number, order, and relative importance, exists in local, state, and national science education standards. Here we suggest one possible interpretation of seven of the process skills of science (Harlen and Jelly, 1997):

- \_ **Observing**—watching carefully, taking notes, comparing and contrasting
- \_ **Questioning**—asking questions about observations; asking questions that can lead to investigations
- \_ **Hypothesizing**—providing explanations consistent with available observations
- \_ **Predicting**—suggesting an event in the future, based on observations
- \_ **Investigating**—planning, conducting, measuring, gathering data, controlling variables
- \_ **Interpreting**—synthesizing, drawing conclusions, seeing patterns
- \_ **Communicating**—informing others in a variety of means: oral, written, representational

(Ash)

APPENDIX B

IRB CERTIFICATE

## Appendix B: IRB Certificate



**INSTITUTIONAL REVIEW BOARD**  
**For the Protection of Human Subjects**  
**FWA 0000165**

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**MEMORANDUM**

**TO:** Tina Brothers Tillinger and Walter Woolbaugh  
**FROM:** Mark Quinn, Chair *Mark Quinn ex'*  
**DATE:** October 17, 2012  
**RE:** "The Effects of a Science Talk Teaching Strategy on Kindergarten Students' Learning" [TBT101712-EX]

The above research, described in your submission of October 16, 2012, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX C

INFORMED CONSENT FORM FOR STUDENTS

## Appendix C: Informed Consent Form for Students

**Informed Consent Form for Students in the Research Study**

I, Tina Brothers, will be performing action research this year in my classroom for my final project towards my Master's Degree in Science education. The purpose of my research is to see the effects of a new Science Talk teaching strategy on students' science learning. I will be analyzing students' drawings in their sketchbooks as well as completing student interviews, and quick assessments. None of these are anything out of a regularly used assessment technique in the classroom.

All students involved will be kept completely confidential. Names and any other identifying characteristics will not be included in any of the research.

Your child's participation in this action research project does not include any foreseeable risks. All of the treatment and data collection will be administered as normal classroom instruction techniques. There will not be grades given and will not affect any grade throughout the year.

Student participation in this project will provide me with valuable information and help me to greatly improve my teaching styles and techniques in science and most likely, other subjects.

Please feel free to contact myself with any questions of concerns via email, phone or in person.

Student Name \_\_\_\_\_

\_\_\_\_\_  
Parent Signature: \_\_\_\_\_

Date: \_\_\_\_\_



APPENDIX D

FIELD NOTE PROMPTS

Appendix D: Field Note Prompts

Unit:

Lesson #/Date:

This lesson's objective:

What happened?:

1.

2.

3.

Exciting moments:

Frustrating moments:

Successful/unsuccessful feelings as teacher:

Need to do:

Assessment:

APPENDIX E

EXAMPLE OF STUDENT SKETCH

Appendix F: Example of Student Sketch – developing investigation on lesson about worms.



Set worms on  
bumpy carpet  
rough      and      Set some  
on the  
table  
Smooth



APPENDIX F

STUDENT SKETCHES SCORING RUBRIC

## Appendix F: Student Sketches Scoring Rubric

Student Sketches		Lessons			
Name:					
Unit:					
Points	Identifiers	1	2	3	4
1	Reporting				
2	Non-testable investigation				
3	Testable investigation or question				

APPENDIX G

STUDENT INTERVIEW QUESTIONS

## Appendix G: Student Interview Questions

*You may stop at anytime and your grade will not be affected if you choose to not answer any question.*

**Question #1** - I would like to talk to you about science. Do you like it when we talk about science in school? This is the lead in question.

**Question #2** - Can you tell something that you know about science?

Probe – How do you know that? Do you do any science at home? Can you describe some of your favorite things?

**Question #3** - How do you like to learn about science?

Probe – Why do like to do that? Are there any other ways?

**Question #4** - What do you wonder about science?

Probe – Do you wonder about anything else in science? What else do you want to know?

**Question #5** - What did you see/observe during our science that you want to know more about?

Probe – Can you tell me what we did and what we found out?

**Question #6** - What is your favorite science activity?

Probe – Why did you like it?



APPENDIX H

TABLE OF STUDENT INTERVIEW THEMES AND CODES

## Appendix H: Table of Student Interview Themes and Codes

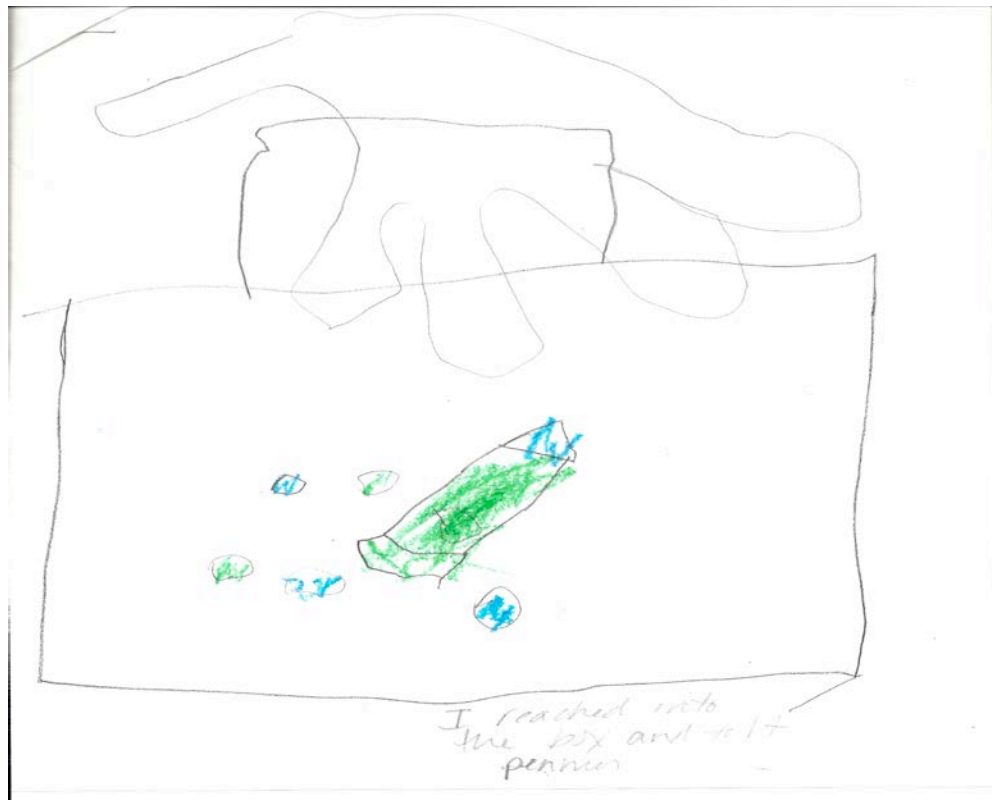
Table 1  
*Themes and Coding*

Theme and number	Color	Level A	Level B	Level C
1. Can communicate answers to questions	Green	Unable to give answers, responds with "I don't know."	Can communicate answers, but not relevant to science.	Can communicate answers that are relevant to science.
2. Can communicate observations.	Blue	Emerging 1-2 observations	Near proficient 3-4 observations	Proficient 4+ observations
3. Can communicate examples of "what science is."	Orange	Unable to give examples	Can communicate examples, but not relevant to science.	Can communicate examples relevant to science.
4. Can communicate their wonderings or questions.	Pink	Unable to communicate questions, responds with I don't know.	Can communicate some wonderings or questions, but not relevant to science.	Can communicate wonderings relevant to science.

APPENDIX I

EXAMPLE OF STUDENT DRAWING

Appendix I: Example of Student Drawing – student drawing of their hand reaching into “feely” box for sense of touch lesson.



APPENDIX J

STUDENT DRAWINGS SCORING RUBRIC

## Appendix J: Student Drawings Scoring Rubric

*Rubric for student drawings*

Points	Identifiers
Beginning – 1pt	Student is able to communicate a minimal amount of observations related to the investigation.
Almost mastered – 2 pts.	Student is able to communicate a few observations about the process of the investigation.
Fully Mastered – 3 pts.	Student is able to communicate many observations about the process of the investigation.

APPENDIX K

EXAMPLE OF A STUDENT CAT ASSESSMENT

Appendix K: Example of a student CAT assessment

XX  
The root has STEM  
The root has LEVS  
The root has VEINS

XO  
The root has WIKOLLS  
Peg  
Pants  
The root has a curved  
stem  
straight

(u)





APPENDIX L

SCORING RUBRIC FOR OBSERVATION DATA

