USING INTERACTIVE SCIENCE NOTEBOOKS TO ENHANCE SCIENCE INSTRUCTION

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

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July 2013

DEDICATION

This paper is dedicated to the second grade students at Jefferson elementary as well as to my administrator for allowing me to conduct this research project in my classroom. I hope the research that I have done allowed my students the opportunity to receive a more successful science learning experience. I have enjoyed this journey and have grown tremendously as an educator because of it.

ACKNOWLEDGEMENTS

For my understanding and supportive family, my loving parents who have always allowed me to be me and pursue my dreams Allan and Jayne Davis, my husband Jarad, my amazing children Taelyr, Jaxan and Lauryn, Mary Larsen my science coach and leader who introduced me to inquiry style teaching which opened my eyes to a whole new way to let students learn, my boss Lona Carter-Scanlon who never stopped believing in me, all of my wonderful students in Helena, Montana who allow me to do what I love each and every day and all the staff I have had the pleasure to work with in the MSSE program at Montana State University. Thank you!

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ABSTRACT

Implementation of interactive science notebooks using an inquiry approach into elementary classrooms was the topic of this research project. The term interactive comes from the interaction that occurs when using the notebooks with peers and instructor. Two groups of second grade students were used to conduct the research. Units on the topics of matter and weather were taught to each group. One group was taught using science notebooks receiving inquiry based instruction, while the other class was taught using a lecture format without the use of science notebooks. The research concluded that students who used science notebooks with inquiry instruction showed greater gains than those who did not.

INTRODUCTION AND BACKGROUND

Jefferson Elementary School is located in Helena, Montana School District #1. Helena, the state capital, is located in the western part of Montana and is the county seat of Lewis and Clark County. The 2011 census report put Helena's population at 28,180 (Bureau, 2011). Jefferson is an elementary school within the city limits of Helena and is a K-5 school. Student enrollment at Jefferson is around 265 students each year with 12 full-time teachers. The majority of the students at Jefferson are Caucasian with our school's poverty level at 30%, which is the highest it has ever been (Carter-Scanlon, 2012). Jefferson is well known for its arts program, and we believe that art education is the foundation for learning in all subject areas.

I began my teaching career at Jefferson in 2005 at the kindergarten level and looped up with a group of students through second grade. At the end of that year, I was able to stay at the second grade level and that is where I am today. I had 20 students in my second grade class this past school year. All of the students in my class were Caucasian, and three of those students were identified as learning disabled as well as qualified for speech and language services.

In 2008 I was introduced to our district science coach, Mary Larsen. Mary began my passion for inquiry based teaching in science and got me started on my graduate degree through Montana State University. Up until that point in my career, I never had much of an interest in science. Inquiry really opened my eyes to how exciting learning science could be. When deciding upon a research project I knew I wanted it to revolve around inquiry instruction in some way. I saw firsthand how excited students were about their learning when taught with this approach, and I wanted to continue that enthusiasm within my classroom and show the effects it had on their attitudes and content knowledge.

I was impressed one day when I was observing a science classroom that implemented interactive science notebooks into their daily routine. Students seemed to take ownership in their learning and were able to have an ongoing rich dialogue with their instructor. Everyone in the classroom appeared excited and engaged with this process. At this point, I decided that I wanted to introduce interactive science notebooks and inquiry into my daily science routine too.

The purpose of this research was to investigate how using science notebooks and inquiry in an elementary science classroom would affect students' overall attitude and content knowledge in the subject. The students who participated in this research were all second grade students, and a treatment/non-treatment design was employed. My students were instructed with the incorporation of interactive science notebooks using an inquiry approach, while the non-treatment class was taught using a lecture only format without the use of notebooks. In terms of science content, two of the same units, matter and weather, were taught to both classrooms.

The focus question that guided the research for this study was: How will implementing interactive science notebooks and inquiry into an elementary classroom affect students' attitudes towards science as well as content knowledge learned?

CONCEPTUAL FRAMEWORK

Teaching in a manner that connects students to real world experiences while providing adequate learning is an ongoing challenge for elementary teachers. Scientific inquiry refers to the *abilities* students should develop to be able to design and conduct scientific investigations and to the *understandings* they should gain about the nature of scientific inquiry (Dow et al., 2000). Secondly, scientific inquiry refers to the teaching and learning strategies that enable scientific concepts to be mastered through investigations (Newman et al., 2004). Inquiry-based instruction motivates students by using hands-on activities to stimulate students' abilities to comprehend subject matter.

In order to implement inquiry learning adequately, it is necessary to have a sound understanding of the concept. Inquiry teaching gives all students the problem-solving, communication and thinking skills they need to be effective workers and citizens in the 21st century. Inquiry-based instruction increases students' interest in learning new skills while helping them retain what they have already learned and internalizing lifelong learning skills. This instruction also reflects the problem-based approach used in the workplace. Many of the 21^{st} century skills, including critical thinking, problem solving and collaboration are all promoted through the inquiry teaching technique. Students gain knowledge by actively thinking, organizing and integrating information with what they already know. Inquiry is a multifaceted activity that involves making observations, posing questions, planning investigations, gathering, analyzing and interpreting data and communicating results (Dow et al., 2000). As mentioned in the National Science

Education Standards (2000), a guide for teaching and learning, the term "*inquiry*" is used in two different ways. Inquiry is referred to as the abilities students should develop in order to be able to design and conduct scientific investigations and to the understandings they should have about the nature of scientific inquiry. In order to be able to design and conduct scientific investigations and understand the philosophy around scientific inquiry, certain abilities need to be developed. Inquiry is also defined as the learning strategies and teaching that enable scientific concepts to be mastered through investigations (Dow et al., 2000). The reported and anticipated positive effect of inquiry-based learning will occur only after a clear understanding of the concept is obtained (Minner, 2010).

In order to comprehend the value of inquiry-based learning, it is necessary to examine and understand associated problems that may occur. Even though these may suggest a negative connotation about the strategy, recognition of these dilemmas can have an overall positive outcome. Identified dilemmas include varying definitions of inquiry, the struggle to provide sufficient inquiry-based science-learning experiences, perceived time constraints, determining how much course time should be slated for science instruction versus pedagogy instruction, instructors' and students' lack of inquiry-based learning experiences, grade versus trust issues, and students' science phobia (Newman et al., 2004). Another drawback is the fact that the inquiry approach requires additional time on the part of the teacher. The conflict between sciences as inquiry versus teaching inquiry is factored into the design and development of the approach. Students' attitudes and beliefs towards learning are based primarily on the traditional learning that takes place in the majority of classrooms. Historically, students have learned to anticipate grades and traditional teaching methods as their guide to learning. These must be addressed if educators are going to move toward inquiry teaching (Newman, 2004).

The subjectivity component of science inquiry makes it difficult to establish an acceptable way to measure success. With this said, it appears that the data are continuing to be gathered to support inquiry learning. Instructors who teach this way require strong content knowledge as well as other, more specific, attributes in order to be successful in the implementation of inquiry-orientated instructional strategies (Smith, 2007).

Special training and professional development opportunities will provide much to enhance the overall success and effectiveness of inquiry learning in the science classroom. It is critical that special attention be directed to these teacher related issues in order to enhance the credibility and acceptance demanded to sustain the method. Otherwise, it is suggested that the introduction might be counterproductive (Smith, 2007).

Inquiry science allows students to learn concepts and have a better understanding of real world issues rather than simply responding with the “right” response. They can then construct their own understanding of scientific findings that expand the scope of their understanding as well as specific issue response (Morrison, 2007).

Implementing and designing inquiry instruction can be challenging, yet it is critical in developing a workable model with positive outcomes. According to Minner & Levy (2010), there are four levels of inquiry instruction that include confirmation, structured, guided and open inquiry. Confirmation inquiry is when students are provided with the question and method where the results are known in advance. Structured inquiry is when students are also given a question and method. The task is to generate an answer that is supported by the evidence gathered in the process. In guided inquiry, students are given only the research question and the task is to design the procedure and to test the question and the resulting explanations. The final of the four types of inquiry is open inquiry. In open inquiry, students ask questions, design procedures for carrying out inquiry and communicate their findings.

Students may have difficulty in designing and carrying out their investigation. This is particularly relevant to elementary age students. They need extensive practice to progress from the low level structured inquiry to the high level open inquiry. The many levels of inquiry the students have available allow many opportunities to develop their deeper scientific thinking (Banch & Bell, 2008).

The literature suggests that inquiry responds to a conglomeration of critical learning issues that are not taken into consideration in traditional teaching. Not only does inquiry provide a deeper understanding of scientific fact, it also allows students to understand real world application. Inquiry further takes into consideration the constant changing that takes place in our world which allows for a current teaching curriculum (Minner & Levy, 2010).

Science notebooks are an integral piece of the inquiry science instruction approach and can be used at the four levels of inquiry: confirmation, structured, guided, and open. According to *How Students Learn: Science in the Classroom* (Donovan & Bransford, 2005), science instruction should elicit and address students' prior conceptions of scientific phenomena, help students build deep understandings of science subject matter and of scientific inquiry, and help students monitor and take control of their own learning. Thoughtful use of interactive science notebooks can assist in meeting all three of these recommendations. By using science notebooks teachers can help students develop the reasoning skills that are essential for inquiry based learning. This includes the formulation of scientific explanations from evidence, analysis of various types of scientific data and the formulation of conclusions based upon relevant evidence. Science notebooks eventually become a thinking tool for students as well as an excellent ongoing assessment and feedback tool for teachers. This tool is used by students during their science experiences, investigations and in cooperative group learning with peers. It is used for reflections and for making their own meaning of the science content being studied. Science notebooks provide opportunities for students to develop a deeper conceptual understanding of science as well as the integration of language arts, reading, and mathematics which are the focus in many classrooms (Klentschy, 2008).

Researchers have found specific evidence of how interactive notebooks promote student learning and increase achievement. Science notebooks expose students' thinking, providing important insights about student understandings and serving as formative assessment tools as well as giving students many opportunities to develop and enhance students' writing skills (Hargrove & Nesbit, 2003; Gilbert & Kotelmand, 2005). Students thinking and making meaning from science instruction through science notebook use has resulted in elevated student achievement in science as well as in reading and writing. Carefully designed writing prompts in science instruction may enhance student science content understanding for standards based instructional units. Communication is a major component of the inquiry process. Student notebooks allow students to reflect on their own ideas and beliefs as well as to apply language skills. Decision-making and problem-solving skills are developed as students learn to collect and organize information as well as applying and testing new ideas (Klentschy, 2008). The use of student science notebooks in class discussions helps students construct meaning of science phenomena. Writing is an important tool for transforming claims and evidence into knowledge that is more coherent and structured and appears to enhance the retention of science learning over time (Rivard & Straw, 2000). Notebooks can also facilitate communication with parents and can be used to provide them with evidence of student growth (Hargrove & Nesbit, 2003; Young, 2003).

METHODOLOGY

The treatment for my project was the implementation of science notebooks with an inquiry teaching approach in my second grade classroom. These notebooks were used to encourage reflections, to enhance learning on science content and to create positive attitudes toward science. Forty second grade students were involved in my research with a treatment/non-treatment design. The treatment group, (n = 20), were instructed with the incorporation of interactive science notebooks using an inquiry approach, while the non-treatment group, (n = 20), were taught without the use of science notebooks using a traditional lecture only format to deliver information. In terms of science content, the same units, matter and weather, were taught to both classrooms.

For comparison purposes within each class, I categorized students into performance groups based on academic performance in quarter two of the school year. In the treatment group, ten students were in the high performance group scoring an average of 86% - 100% in core subjects, six students fell into the average performance group with a 71% - 85% average in core subject and four students were placed in the low performance group scoring a 70% or lower in the core subject areas second quarter. The breakdown in the non-treatment group was as follows: twelve students had a high performance average, four students were average performing, and four students were listed as low performing.

The intervention for this study was implemented in two phases. In the first phase, I taught two science units on matter and weather in a traditional lecture format to the non-treatment group (n = 20). This non-treatment group was a second grade class in our school, and instruction had not included the use of science notebooks at any point in the study. Prior to the units instruction, a pre-test was administered to the whole group. At the completion of each unit, the non-treatment students were given a summative assessment testing content knowledge that was identical to the pre-test. I worked with this second grade class for science three times a week for 45 minutes and took 2 weeks to teach each unit of study. By doing this without the use of notebooks and inquiry, I was able to compare the effects these components had on content knowledge, and student attitudes.

The second phase of the study began by introducing science notebooks to the treatment group (n = 20). I did this by showing some examples of what science notebooks should look like and how they were used effectively. We then had a discussion around their purpose, and I explained why they were going to be important throughout our science study and how we would be using them on a daily basis.

Each student had his or her own science notebook with an understanding as to how it would be used. Special emphasis was on instructing students how to collect and organize data, how to record any questions they had, and how to complete the daily science prompt before instruction. Students were encouraged to discuss and share their notebook writing with each other to help foster ownership of their thoughts and opinion, as well as to provide me with their understanding and opinions of the process.

Once students had been given the introduction on using science notebooks, a simple task was presented that allowed them to practice the notebook entry technique. I started this task with a science prompt. The prompt was, “What kind of jobs do scientists do?” After discussing student’s responses to the prompt we elaborated more on this idea and came up with more answers. Students then were allowed to go back in their notebooks to expand their answers. I showed them additional notebooking procedures such as how to interact with me through the notebooks. This could be done by writing a question on the daily entry page. Each student was then required to write a question which I responded to in writing for them to see the next day. One student asked, “Are teachers’ scientists?” This task was associated with a previously learned science concept so learning actual science material did not interfere with the entry practice. I recorded informal observations in my teacher journal throughout the task. Notebooks were reviewed on a daily basis to check for understanding.

After I felt my students had an understanding of how these notebooks would be used, I taught the same two units on matter and weather that the other second grade class was taught using an inquiry approach. As with the non-treatment group, I began each unit with a pre-test and concluded with the identical post-test. I took two weeks to teach these units with the treatment group as well. Keeping the time frame consistent with both groups assured me that one class was not getting more instruction on the material then the other. Although two different groups of students were used in my research, I was able to see how using interactive notebooks with inquiry instruction during science affected students' learning and attitudes.

Research Methods

To find answers to my research questions, I came up with several measurement tools to guide me in understanding the impact science notebooks would have on content knowledge and attitude (Table 1). The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Table 1
Data Triangulation Matrix

Research Questions	Data Source 1	Data Source 2	Data Source 3
How do interactive science notebooks impact positive attitudes towards science?	Pre/post Student perception survey	Pre/post perception interviews	Teacher journal
How do interactive science notebooks increase mastery of content knowledge on selected units?	Pre/post unit tests	Teacher journal	Pre/post perception interviews

Student Attitude Surveys, modeled after student attitude surveys designed by Irene Grimberg within the SILC program (Science Inquiry Learning in the Classroom-MSP grant), were administrated before and after the treatment (Appendix A). This attitude survey was designed to gather information in regards to how students felt they were prepared for science class, what they felt their ability to be successful in science was, and their current level of interest. I compared the pre and post-test surveys from both groups individually as well as collectively to see if there were any shifts in students' opinions when science notebooks and inquiry were implemented. On this survey, students answered three questions by checking either *yes*, *sometimes*, or *no*. These questions were: I enjoy science, Science is useful in everyday life and I am good at science. A point value was given to each response. *Yes* answers were each worth 3 points, *sometimes* were worth 2 points and 1 point was given to *no* responses. The highest score each class could receive on the assessment was 60 points.

I used Student Perception Interviews formulated by me based on information I wanted to know about the students (Appendix B). These interviews took place before and after the research. Students from both the treatment and non-treatment group were selected to be interviewed. I chose six students from each class to partake in the pre and post-interviews. Two students were selected from the low performance group, two students were selected from the average performance group, and two students were selected from the high performance group. This allowed for a mixture of ability levels to parttake in the interviews. Some of the questions had a correlation to the Student Attitude Survey (Appendix B). These interviews helped me gather information on the students' perceptions about their own personal ability to succeed in science. It also revealed what their interest in science was and how they felt about the organization of the science class. The interviews were videotaped and later transcribed to help identify common themes that occurred. Six index cards per student were used to record key words given during the interview for every question. Responses were then placed into groups to reveal common themes. I also recorded outlying responses that were given. When analyzing the pre and post-interviews, I compared the responses to see if there were any changes in student perceptions regarding science.

Types of Matter and Weather Wise (Appendix C & D) were the pre- and post-test assessments students took on the two units studied. These assessments included vocabulary and other unit related data to determine each student's level of understanding pre and post instruction on matter and weather. Students were allowed to use their science notebooks to review for preparing for the tests. In the non-treatment group, students were allowed to use the text book for review in preparation for the tests. The student assessments were important tools because it allowed me to document student growth. The tests were analyzed to see differences between the treatment and non-treatment groups.

One of the tools that I found to be most beneficial was the teacher journal I kept. Throughout the research period, entries were made three times per week. The purpose of this journal was to record observations, reflections, ideas, questions and goals that may have come up during that day's lesson. Regular review of this recorded information allowed me to make adjustments, modifications and reflections based on my interpretation of the entries. This also helped allow me to better understand student behaviors and performance. It assisted me in making a final assessment of the overall effectiveness of science notebooks and inquiry in a more global manner.

I applied data triangulation to increase the overall reliability and validity of these measurement tools. Each of these tools helped me determine the overall effectiveness student notebooks and inquiry had on student learning and attitudes. In Table 1, a description of the three sources for the triangulation is displayed.

DATA AND ANALYSIS

Data analysis took place over a several week period. During this time, I examined the data from the treatment group and non-treatment group independently and collectively. The treatment group revealed an average score increase from 66% to 89%

on the matter unit assessment. The non-treatmentgroup tests revealed a beginning pre-test score of 66% to a post-test score of 71% (Figure 1).

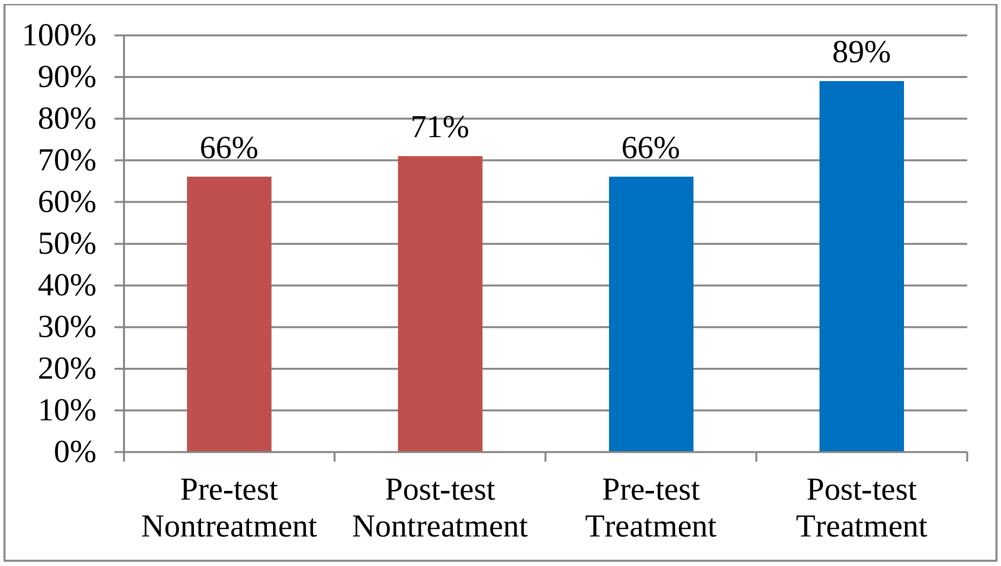


Figure 1. Test averages, matter, (*n* = 40).

Looking at data collected on the weather assessment, the treatment group showed a greater increase in scores then the non-treatment group. The non-treatment group scored 72% on the pre-test and improved to an 84% on the post-test showing a 12% improvement. The treatment group scored an average of 76% on the pre-test and a 91% on the post-test improving by 15% (Figure 2).

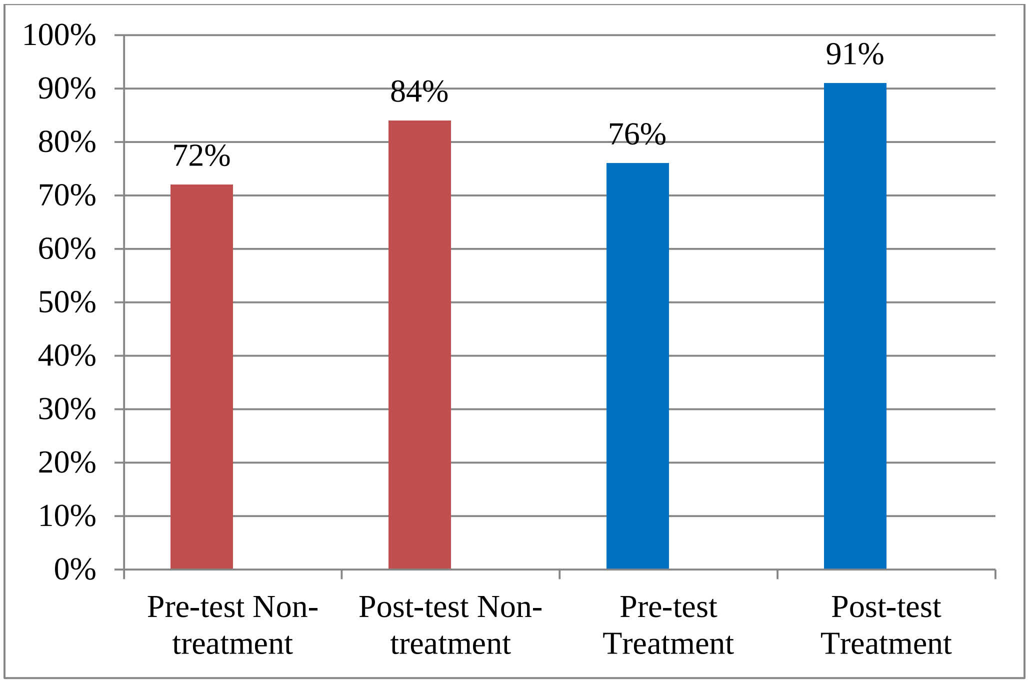


Figure 2. Test averages, weather, (*n* = 40).

All students showed gains in their academic achievements. However, a greater increase was seen in the treatment group. Further, when reviewing the data in regards to the treatment group, the lower performing students made the greatest gains. On the weather assessment a 21% improvement was made from the pre- to post- test and on the matter assessment there was a 26% improvement. The average performance group showed a 6% increase in the weather pre to post test and a 12% gain in the matter pre- to post -test. The high performance group had a 12% gain in the first pre- and post -test and a 16% gain in the second test taken (Figure 3).

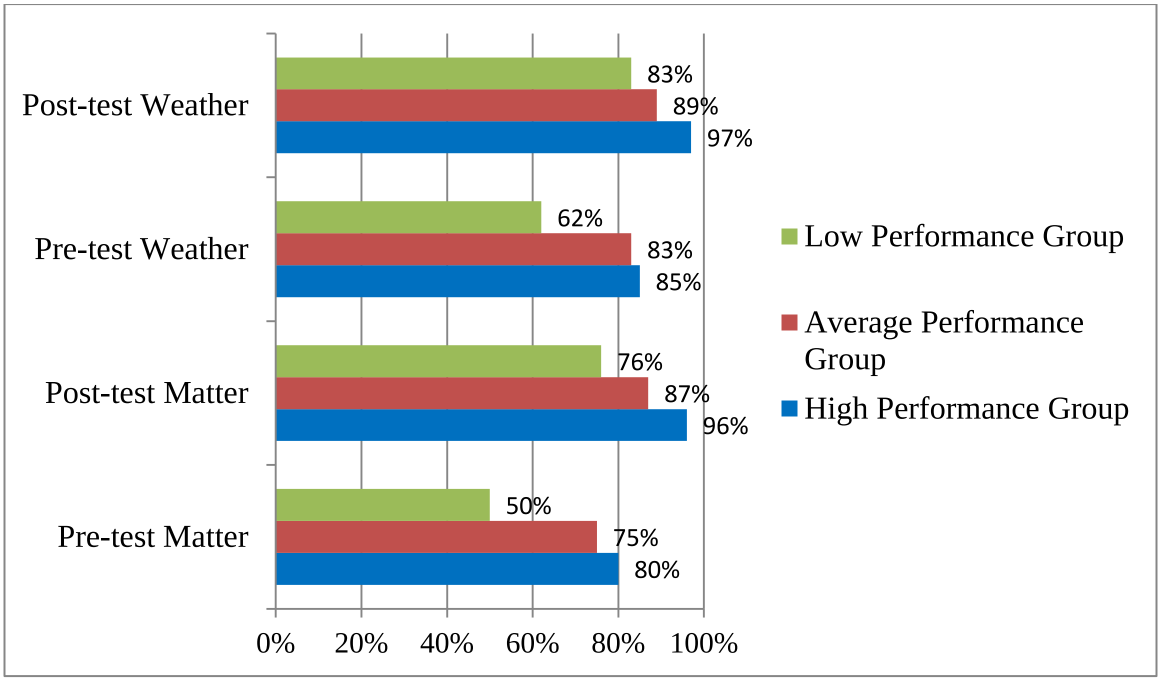


Figure 3. Performance group test averages, treatment group, (n = 20).

The lower performance group showed an overall increase of 33% with their initial low being 50% and the high being 83%. A comparison of the non-treatment group showed that although they increased their scores, it was not as dramatic (Figure 4).

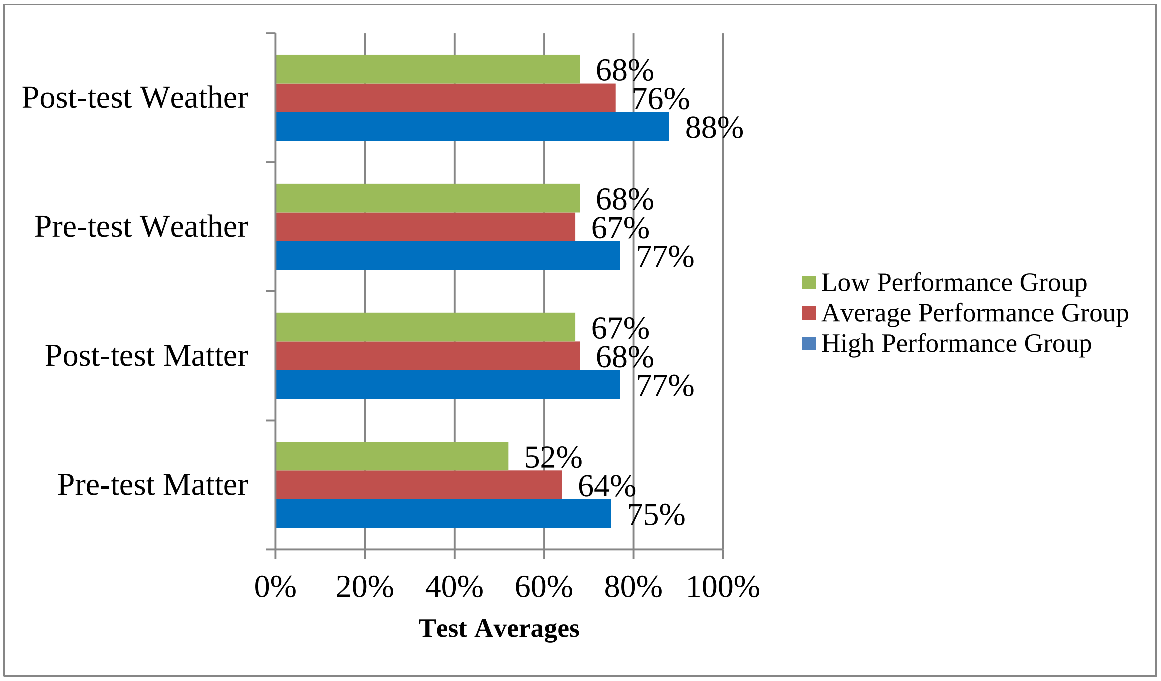


Figure 4. Performance group test averages, non-treatment group, (*n* = 20).

In addition to the quantitative data collected via the surveys and pre- and post-content tests, several qualitative data sources were also collected. Interviews with students in both groups revealed that the students keeping the notebooks seemed to understand the information covered more clearly because there was more depth to the topic covered. Students were encouraged to look up troublesome spelling words. While doing so, they found pictures or other information that appeared to add to their understanding of the topic. One student reported, “Science seems to make more sense when you have to write it down than when you just tell us.” One of the students in the lower ability groups stated, “I like using the journal because it makes me feel smart, like my big brother.” Another shared, “Writing things down seems to lock information in my brain.”

The students in the treatment group all reported it helped them to remember science concepts and vocabulary by writing them down, and they could look at their notebooks when they forgot information. A student stated, “I wish we could use notebooks in all subjects, I think I would understand better.” A girl in class said, “I feel less frustrated when I am able to look into my notebook to remember things I have forgotten.”

Another finding for the notebook analysis was that the treatment group seemed to improve the quality of what they put into their science notebooks during the study. Their sentences were becoming more complete and meaningful. “The 3 types of matter we learned about in this unit are solids, liquids and gasses.” This was a sentence one of my students in the low performance group wrote in his science notebook. Only a couple of weeks earlier he wrote, “A ball is hard.” when asked to describe a solid. “Matter can be changed into different forms by applying heat or pressure.” This sentence was recorded in a high performance student’s notebook. I saw improvements in their writing skills and they began to show ownership and pride in their notebooks.

To determine student’s attitudes about science, I asked both groups to complete an attitude survey before and after the project. One question asked was if students enjoyed science. When the treatment group was asked if they enjoyed science in the pre-survey, they responded with 70% of students saying yes, 30% said sometimes, and 0% said no. After the project, in the treatment group, 75% said yes, 25% said sometimes, and 0% responded no. The non-treatment group did not show a shift of attitude towards science from the start of the research to the completion.

Within the Student Attitude Survey, a point value was assigned to each response. *Yes* responses received three points, *sometimes* responses received two points, and *no* responses received no points. When reviewing over the scores from the pre-surveys, both groups displayed a mode of 2. This showed the majority of responses given were *sometimes.* The post-test survey revealed there was no shift in attitude in the non-treatment group. However, in the treatment group the mode shifted to 3 revealing the majority of answers were *yes.*

Data showed that the treatment groups overall attitude towards learning science increased greater than that of the non-treatment group. I asked a student from the treatment group why he marked *yes* when asked if he liked science and he stated, "I like learning a lot in science because it makes me feel like a scientist and that's what I want to be when I grow up." Another comment from this group was, "Science is interesting because it is everywhere around us."

INTERPRETATION AND CONCLUSIONS

The data resulting from the project were all quite positive and reinforced my belief that I am able to be more efficient in positively influencing my students in the area of academics. Using an interactive notebook with an inquiry teaching style allows a student to think, record data and observations, and reflect just as professional scientists do (Young, 2003). Additionally, it gave me data to support the desire to make adjustments in the manner in which I perform my teaching. Although a t-test was not used for statistical analysis in this investigation, future research might include this technique in order to determine if the observed results can be considered statistically significant.

An examination of the data from the project demonstrated that notebook use and inquiry in this class did support science concept learning. Pre and post-testing revealed that the treatment class scores did show a greater increase in science content knowledge than in the non-treatment group. I found that my predicted outcomes of the project were pretty well met in a general sense. I was somewhat surprised at the ease in which the treatment group acclimated to the science notebook method. This was most likely due to the fact that it was not a "new" experience to them in that we have used journals in writing throughout the year.

I did discover that it is really quite difficult for students to transpose thought to well-organized and meaningful statements on paper. This improved throughout the duration of the project, and I feel that it will become a skill that improves throughout their educational future. According to Gilbert and Kotelman (2005), notebooks offer numerous opportunities to develop and enhance students' writing skills. Probably the most exciting discovery was the closing of the gap between the low performance students and those students who were performing at a higher level. Notebooks provide a structure and support for differentiated learning, helping all students to achieve (Amaral, Garrison, & Klentschy, 2002). This supported my suspicion that students can learn from each other almost as much as they learn from teachers. Finally, I was surprised to discover that several students, who displayed a rather negative attitude toward school, had a positive demeanor in notebook writing. I guess we think we pretty well know and understand our students, but sometimes they are camouflaging their true attitudes.

The higher performing students did well with or without the use of science notebooks. However, they seemed to feel that the process helped them learn. It did seem to accelerate the low and average performance groups to a point that they were able to better interact with the high performing group on science content. My teacher journal entry on April 1 noted that the students seemed to be more excited and interested in learning than they had been in previous units. Notebooks encourage active learning and provide opportunities for students to pursue their own interests and tackle authentic problems (Gilbert & Kotelman, 2005). This was more evident in the treatment group.

Student notebook use demonstrated to me that with assistance second grade students were able to formalize thought concepts in the form of written response. The project demonstrated students were able to take information from the two project subjects, matter and weather, and transpose to writing their observations. Writing enables students to express their current ideas about science content in a form that they can examine and think about. Achievement in science is directly proportional to the student’s ability to use language (Fellows, 1994). Data suggested the process enhanced the students’ ability to understand, comprehend, and remember information better than they did without the science notebooks. Regular review of these notebooks revealed that the students were becoming more proficient in accurately describing with their scientific notes. I cannot attribute this completely to the project because other classroom instruction dealt with writing and concept understanding, but it was pretty obvious through data examination and interviewing the improvement was accelerated by the science notebook process.

I view science as a "mental excitement" subject that, if presented in a proper manner, can stimulate students in a very positive and learning manner. Accomplishing this can have dramatic effect on the student's ability to learn and excel throughout their school career. The data collected from this project revealed the attitudes of the treatment group were more positive than the non-treatment group. Based on these data, I can conclude that the science notebook use and inquiry learning contributed to this consequence. The initial attitude, that the notebooks seemed to be an additional task and not met with real enthusiasm, seemed to dissipate as the project proceeded. This was reflected in the collected data. I believe that continual encouragement and reinforcement of the positive aspects of their notebook entries influenced the attitudinal shift. The students were actually becoming proud of their notebooks and anxious to show them off to each other and me.

Writing skills are extremely important in the world we live in and writing proficiency will continue to be critical in each student's quest for success. The project played an important part in developing skills in the area of conventional writing. The noted enhancement between the early project and late entries clearly shows that most students gained considerably in this area. Science notebooks seemed to allow the peer influence effect to become more important. I have determined that these students can often times learn more from each other than the teacher, and the notebooking result seemed to narrow the separation between the performance groups allowing for more meaningful interactions.

VALUE

As an elementary science teacher, I intend to continue notebooks as a standard tool. The data collected prove to me that notebook use does improve the student's ability to comprehend, understand, and enjoy the subject. Due to complexity, science is a difficult class to teach and the notebook inclusion will assist in helping young minds understand some often times difficult scientific topics.

Becoming a better educator is a continual goal that all teachers should own, and it certainly is a constant objective of mine. Not only does it make my job more rewarding in a professional sense, but it provides the students with academic guidance that can have a positive effect on their educational future. The incorporation of science notebooks and inquiry has made me a better teacher and my students more successful. Complementing this is the feeling that my connection and understanding of individual students were enhanced through the project. I was able to recognize many individual aspects I would not have recognized without the influence of this project.

I believe educators come to a premature conclusion that second grade students are not academically developed enough to be able to significantly gain from thought and concept transference by writing. This project not only showed this is false but also showed that students can accelerate their learning by using notebooks as an added tool.

The value of using science notebooks and inquiry not only assists in their gaining additional assistance in learning science, but it also provided students with a process that can be used in many other settings. This is a valuable practice that will assist them throughout their academic careers.

When I began the project, I had already reached the conclusion student notebooks and inquiry teaching had a positive effect. The research project established a means of confirming through the collection of data a belief that I already owned. The value of something I "think" certainly doesn't carry as much weight or credibility as a research project can provide.

Findings from this study indicate to me science notebooks and inquiry teaching are worthwhile aspects of teaching science to elementary students. I intentionally kept my first research project simple so I could have a clear understanding of basic issues. Adding additional components to the study may have allowed me to have an even better understanding of the affects notebooks had on students. The answer to a few questions opens the door to implications for further research. I wonder about the effect on social issues, parent school involvement, self-esteem, peer relationships, and other peripheral issues would be interesting to examine in the research project. Obviously, one has to factor in the associated time demand and weigh the value with the impact on other teaching activities. The research project has made me a better teacher as well as assisted students in becoming more knowledgeable about the area of science. They became more able to transpose thought to writing. The results I saw throughout this project encouraged me to continue the notebook practice in science and may consider adding it to other subject areas.

REFERENCES CITED

Amaral, O.M., Garrison, L., & Klentschy, M. (2002). Helping English learners Increase achievement through inquiry-based science instruction. *Bilingual Research Journal*, 26, 213-239.

Banchi, H., Bell, R., (2008). The Many Levels of Inquiry: Inquiry Comes in Various Forms. The Learning Center of the NSTA. Retrieved October 2012

Bureau, U.S. (2011). *State & County QuickFacts.* Retrieved November 2011, from http://quickfacts.census.gov/qfd/states/30/3035600.html.

Carter-Scanlon, L. (2012). *Jefferson Report to the Community.* Retrieved August 2012, from http://www.helena.k12.mt.us/schools/elementa/jefferso/index.dhtm.

Donovan, M.S., & Bransford, J.D. (2005). *How students learn science in the classroom.* Washington, DC: National Academy Press.

Dow, P., Duschl, R., Dyasi, H., Kuerbis, P., Lowery, L., McDermott, L., et al. (2000). *Inquiry and the National Science Education Standards a Guide for Teaching and Learning*. Washington, D.C.: National Academy Press.

Fellows, N. 1994. A window into thinking: Using student writing to understand Conceptual change in science learning. *Journal of Research in Science Teaching, 31,* 985-1001.

Hargrove, T., & Nesbit, C. (2003). *Science notebooks: Tools for increasing achievement Across the curriculum.* (ERIC Document Reproduction Service No. Ed 482720). Retrieved January 10, 2010, from http://www.ericdigests.org/2004-4/notebooks.htm.

King, R., Erickson, C., & Sebranek, J. *Inquire A Student Handbook for 21st Century Learning.* Burlington, WS.: Thoughtful Learning.

Klentschy, M.P. (2008). *Using Science Notebooks in Elementary Classrooms. N*ational Science Teachers Association Press (NSTA).

Morrison, J.A., (2007). Individual Inquiry Investigations in an Elementary Science Methods Course. *Journal of Science Teacher Education, 19,* 117 – 134.

Minner, D.D., & Levy, A.J., (2010) Inquiry-Based Science Instruction-What Is It and Does It Matter? *Journal of Research in Science Teaching, 47,* 474-496.

Newman, W.J., Abell, S.K., Hubbard, P.D., McDonald, J., Otaala, J., & Martini, M., (2004). Dilemma's of Teaching Inquiry in Elementary Science. *Journal of Science Teacher Education, 15,* 257-279.

Rivard, L., & Straw, S., (2000). The effect of talk and writing on learning science: An exploratory study. *Science Education, 84,* 566-593.

Smith, A.C., (2007). Inquiry-Oriented Instruction in Science: Who Teaches That Way. *Journal of Educational Evaluation and Police Analysis, 29,* 169-199.

APPENDICES

APPENDIX A

STUDENT ATTITUDE SURVEY PRE/POST

What do you think about science?

Please read each statement carefully, and make a mark in the cell of the number that best matches **what you think**. There are no “right” or “wrong” answers. You may stop your participation in this research survey at any time.

(1) No (2) Sometimes (3) Yes

	1	2	3		
I enjoy science					
Science is useful in everyday life					
I am good at science					

APPENDIX B

STUDENT PRE/POST INTERVIEW

Interview Questions

1. Describe how you feel about learning science. What would help you understand concepts better?
2. What helps you to learn science the best? Experiments? Reading in the text book? Explain your reasoning.
3. What is your favorite thing about science?
4. Have you ever used a notebook to record information in science or any other subject? If so explain.
5. Do you feel like a scientist when you are learning science? Why or Why not?
6. Is there anything else you would like to tell me about your experiences with science?

APPENDIX C

PRE/POST ASSESSMENT ON WEATHER

Assessment on Weather

Name:

Date:

SECOND GRADE WEATHER ASSESSMENT

1. What is the name of a scientist who studies weather?

2. What are long periods of time with no precipitation called?

Use the pictures to answer questions 3, 4, and 5.

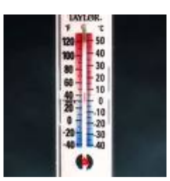
a.  **b.**  **c.** 

3. **Which picture is of cumulus clouds?**
a. Picture a   b. Picture b   c. Picture c   d. Pics. a& b   e. Pics. b& c

4. **Which picture is of cirrus clouds?**
f. Picture a   g. Picture b   h. Picture c   j. Pics. a& b   k. Pics. b& c

5. **Which picture is of stratus clouds?**
a. Picture a   b. Picture b   c. Picture c   d. Pics. a& b   e. Pics. b& c

Use the pictures to answer questions 6, 7, and 8.

a. 
b. 

c. 

6. **Which would you use to measure the amount of rain and its name?**
f. Picture a
g. Picture b
h. Picture c

j. Pictures a & b
k. Pictures b & c

7. Which would you use to measure the temperature and its name?

a. Picture a
b. Picture b
c. Picture c
d. Pictures a & b
e. Pictures b & c

8. Which would you use to measure the air pressure and its name?

f. Picture a
g. Picture b
h. Picture c
j. Pictures a & b
k. Pictures b & c

MATCHING

1. Blizzard	**a. A snowstorm that occurs when heavy Snow is joined by high winds.**
2. Weather	**b. A storm with high clouds, heavy rain, Strong winds, thunder and lightning.**
3. Thunderstorm	**c. The state of the air at a certain time and place.**
4. Hail	**d. Ice pellets or chunks of ice that are usually formed in thunderstorms.**

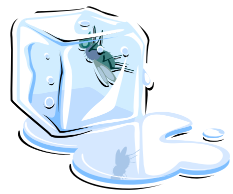
TRUE OR FALSE

1. There are two different seasons? T or F
2. Water cycle – The way water keeps using itself over and over. T or F
3. Precipitation – Water that falls from clouds in solid or liquid form. T or F
4. Forecast – A prediction of the weather in the future. T or F

APPENDIX D

PRE/POST ASSESSMENT ON MATTER

Name: ______________________________



What's the Matter?

solids	Volume	Container	matter	ice	juice
gasses	Mass	Atoms	chair	air	melting
liquids	Shape	Space	milk	clouds	

Choose a word from the box to complete each sentence.

1. The three basic properties of matter are ______________, _______________, and _______________.

2. All matter is made up of tiny particles called _________________.

3. Volume is the amount of _________________that matter takes up.

4. Mass is the amount of _______________________ an object has.

5. Liquids take the shape of their __________________________.

6. _____________________do not have a definite shape or volume.

7. _______________ do not have a definite shape, but they do have a definite volume.

8. ______________________have a definite shape and volume.

9. A _______________and ______________are examples of solids.

10. _________________and ______________are examples of liquids.

11. ________________ and _________________are examples of gas.

12. Solid ice is ___________________when it is changing into a liquid.

APPENDIX E

FORMATIVE ASSESSMENT

Teacher Journal Guiding Questions

How will using science notebooks impact my daily teaching?

How do science notebooks affect the attitudes my students have towards learning?

What components of using the science notebooks seem to be the most beneficial for the students?

What is the impact science notebooks have on students' science concept understanding?

Do students seem to enjoy using their notebooks during the lesson?

- **Each day after a lesson I will try and find time to reflect on the notebook process. What things seem to be working well? What are things I can change the next time I conduct that lesson? I will review my daily journaling to help me conclude whether or not science notebooks had a positive impact on student learning.**

APPENDIX F

IRB APPROVAL

MONTANA STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects
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MEMORANDUM

TO: Heather Lieberg and John Graves

FROM: Mark Quinn, Chair *Mark Quinn CJ*

DATE: December 5, 2012

RE: *Using Interactive Science Journals in Daily Science Instruction [HL120512-EX]*

The above research, described in your submission of December 5, 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:

_X_ (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.

_X_ (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.