

THE EFFECTS OF LABORATORY-BASED ACTIVITIES ON STUDENT
ATTITUDES TOWARD SCIENCE

by

Lizabeth Ann Townsend

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 2012

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.

Lizabeth Ann Townsend

July 2012

DEDICATION

"A teacher affects eternity; he can never tell where his influence stops."

Henry Adams

This project is dedicated to Mr. Gary Sullivan; Bozeman Senior High art teacher, life teacher, and shining example of humanity. Your dedication to your students and the craft of teaching has influenced so many people and continues to impact children today through the many students you had that are now teachers themselves.

I will never forget the day we were at the back of the school working on raku pottery. You stressed the importance of incorporating other subjects into art; that the effect of the fire on the raku pot was in fact a science concept. Or the day that we laughed at my teapot with its spout too low on the pot, which is now and will forever be a flower pot in my mother's home. You took the time to sit with us at our work tables in art class to see how we were doing, what we were planning, and sharing your knowledge about life through stories that were personal to you. Thank you for sharing, Mr. Sullivan.

On those days that I am having a difficult time, I think of your merry blue eyes, and how you treated all of us. On those days I question my choice of vocation and if I am making a difference, I think of you and your impact on the many students you had over the years. I think about how you made each of us feel important and valuable as people, not just as students. I try to pay that forward. Thank you for your example, your love, and your humanity. You will never be forgotten.

TABLE OF CONTENTS

INTRODUCTION AND BACKGROUND	1
CONCEPTUAL FRAMEWORK.....	2
METHODOLOGY	6
DATA AND ANALYSIS.....	9
INTERPRETATION AND CONCLUSION	16
VALUE.....	19
REFERENCES CITED.....	22
APPENDICES	24
APPENDIX A: Student Analysis Form.....	25
APPENDIX B: Student Interviews.....	27
APPENDIX C: Student Quarterly Evaluation	29
APPENDIX D: Student Science Survey.....	31
APPENDIX E: Teacher Survey Questions	33

LIST OF TABLES

1. Triangulation Matrix.....	8
2. Recall of Previous Labs	11
3. Student Quarterly Evaluation.....	15
4. Student Science Surveys Pre Treatment	16
5. Student Science Surveys Post Treatment.....	15

LIST OF FIGURES

1. Student Interviews-Favorite Subject Pretreatment9
2. Student Interviews-Favorite Subject Post treatment.....11
3. Student Interviews-Favorite Subject by Gender Pretreatment.....12
4. Student Interviews-Favorite Subject by Gender Post treatment13

ABSTRACT

The purpose of this action research was to study the effects of laboratory-based activities on student attitudes toward science. For the purpose of this study, fifth grade students were taught science over a five month period which included the regular science curriculum for the school district, labs from the science series, and additional labs corresponding to the topics in the curriculum that were developed by the teacher or other professionals. Students were given questionnaires and surveys at the beginning and end of the five month period. Surveys and questionnaires included questions about favorite subjects, what was best about science, and how the student understands science. Comments on what kind of lab/activity was most beneficial to increase understanding and what type of lab or activity was preferred were examined. Pre and post data were compared to determine whether or not student attitude toward science changed after the five month period. Although students entered this fifth grade classroom with a good attitude toward science, there was a noticeable increase in science attitude in regard to favorite subject and understanding of science at the end of the time period. The importance of using labs/activities to inspire and increase understanding of science in fifth grade was evident not only in survey results but from statements students made as well.

INTRODUCTION AND BACKGROUND

I teach fifth grade at Radley Elementary School in East Helena, Montana. I have taught for 20 years in this district and 24 years in total, 19 of those years in 5th grade. Our K-8th school district feeds into Helena High School in Helena, Montana. Our schools are organized by grade level rather than by neighborhood, with a pre-K to first grade, a second-fifth grade school, and a sixth-eighth grade middle school. There are 489 students enrolled in our 2nd-5th grade building and there are 1117 students registered in the entire district. All of the fifth grade teachers teach the four core subjects of reading, science, math and social studies. Specialists teach library science, music, and physical education on a rotating basis. Our district has over 21% of students in the free and reduced lunch program (Radley Office, 2011-12).

There are currently 26 students in my homeroom. One of those students is a special education child who is fully included in all regular education in the content areas. There are 13 boys and 13 girls in the classroom, 3 of whom are students of Native American descent. Students at our elementary have a 45 minute science block with their homeroom teachers.

Since the implementation of the No Child Left Behind Act (NCLB), schools have been focusing on reading and mathematics. With the time constraints teachers have during the day and the curricular requirements of the other subjects, many teachers are forced to reduce time for art, extension activities, and labs for science. I feel very

strongly that an activity-based science program not only helps students learn but inspires them and improves their attitude toward science. Therefore, I chose to examine my classroom practice of including not only labs from the textbook series, but additional labs in science, and to determine how that affected student attitude. Both of the terms “activity-based” and “laboratory-based” refer to activities, visiting experts, group and individual projects, and actual labs. Labs or activities were conducted at least once per week. The purpose of this study was to examine the impact/effect of activity-based activities on student attitudes toward science. Interest in student attitude toward science in a class utilizing the inquiry model lead me to my primary focus question. Secondary questions will provide me with information on how students learn science best, what students like about science, and how their understanding of science has been affected by labs and experiments.

CONCEPTUAL FRAMEWORK

A positive attitude toward school is important in today’s environment. Inspiring and encouraging students to do well in school can be achieved through inquiry based science activities and labs. Young children are naturally curious and begin life as natural scientists (Louv, 2005). Llewellyn (2002) reported that inquiry is science, art and imagination combined, where students use critical, logical, and creative thinking to explore areas of personal interest, and that inquiry inspires students to be lifelong learners and to become independent thinkers. They observe, taste, listen, and touch to learn about their environments, much like how a scientist observes the world (Pearce, 1999). Using students’ natural curiosities improves their understanding and attitude toward science in

as little as ten hours (Cronin-James, 2000). Hands-on experiments, direct observation, and immersion into their environment increased students' knowledge of science (Sobel, 2004). Inquiry learning can take place in a schoolyard, a classroom, a school/community garden, or a local park. Outdoor learning environments have been utilized to help students care about their local environments, building stewardship for the area in which they live (Lakin, 2006). Positive attitudes and increased student engagement have been observed when inquiry learning is utilized (Elliott & Page, 2010; Lakin, 2006).

Maintaining student enthusiasm and a positive attitude through science inquiry would be beneficial for overall student achievement. Inquiry can be an important part of science and can motivate students to do well in other curricular areas (Pearce, 1999). Students come into school with an interest in bugs, dinosaurs, animals, etc, and they explore their environment with great enthusiasm. Particularly in grades four through six, students rate science as more important and more exciting than other subjects. They also report that science is an easier subject (Foley & McPhee, 2008; Neathery, 1997). A positive attitude toward science increases independent thinking, decision making, and an enjoyment of learning (Haury & Rillero, 1994). Sobel (2004) wrote that students not only gain skills in science through outside learning, but their knowledge and skills transfer to other subjects as well. Neathery (1997) also found that science achievement correlates with a positive attitude toward science.

Positive attitude and enthusiasm are not the only benefits of inquiry learning. Science skills are improved through inquiry learning as well. Pearce (1999) wrote that inquiry science for children taps into their instinctual behavior and through inquiry

children develop skills that are present at birth. Haury and Rillero (1994) reported increased skills in proficiency, development of logic skills, data interpretation, and finding more than one interpretation of data are benefits of inquiry learning. They also found that students developed critical thinking skills because inquiry requires students to interpret rather than just memorize data.

Students are able to develop their collaborative skills when working together on inquiry based science lessons and are better able to learn how scientists actually work (Song, Ahlswede, Clausen, & Herbig 2010). Llewellyn and Johnson (2008) wrote that working in groups can establish cooperation and interdependence.

Cronin-James (2000) states that for young students, hands-on science has a stronger effect on knowledge than on attitude. Students can conduct their own investigations and satisfy their curiosity which increases their engagement and supports their interest in science (Metz, 2008). This engagement and interest translates into increased learning. Students learn significantly more about ecological science, for example, in outside activities rather than in the classroom. Haury and Rillero (1994) found that outside inquiry, in particular, benefits physical and nutritional health as well as increases skills in communication, independent thinking and decision making. Inquiry needs to be done in such a way that it is not trivial to the student. In order for outdoor inquiry to be beneficial, the lessons need to have meaning for the students and be within the context of what they are currently studying (Elliott & Paige, 2010). Outdoor inquiry develops care and appreciation of the environment in students, giving students a fun and exciting place for understanding science concepts (Lakin, 2006). In taking students

outside for inquiry, the teacher increases academic understanding in students, as well as a love for the earth (Sobel, 2008). Classrooms can be conducted outside in many ways, from observing changes in trees to counting insects and recording data. In doing so, teachers and students can experience the benefits of being in nature (Louv, 2005). Activities should be designed that improve regard toward the local environment while improving scientific knowledge (Lakin, 2006). Cronin-James (2000) emphasized that teachers and students need not go far to learn outside since a schoolyard is a perfect setting for improved understanding in science. Louv (2005) found that outdoor learning promotes creativity, cognition, understanding of nature, and increased physical health.

Another benefit of inquiry learning is lessons that take a longer period of time to conduct. Students of today are used to high-speed, immediate feedback, and inquiry learning can help students learn to wait for information (Elliott & Paige, 2010).

The student, however, is not the only player involved for success in science and other curricular areas. Elliott and Paige (2010) noted a teacher's positive attitude toward science, and a good relationship with students is critical for success. Teacher creativity and utilization of the community is important as well (Lakin, 2006). Teachers need to understand the importance of using schoolyards as well as classrooms to teach science (Cronin-James, 2000).

Inquiry based learning, whether in the classroom or outside, benefits students in multiple ways. Positive attitude, investment in the environment and community, and achievement not only in science but in other curricular areas has been noted through

inquiry based science (Cronin-Jones, 2000; Haury & Rillero, 1994; Neathery 1997; Yager, Choi, Yager, & Akcay 2009). Skills gained through inquiry are transferred into other curricular areas (Sobel, 2004). Inquiry engages and supports student interest in science (Cronin-James, 2000; Elliott & Rillero, 1994; Lakin, 2006; Metz, 2008). Utilizing a child's natural curiosity towards the world through inquiry enhances student learning and can maintain students' interest in their world (Cronin-James, 2000; Pearce, 1999).

METHODOLOGY

Research was conducted in my fifth grade classroom during the months of November to March during our 45 minute science period. Students were taught with a combination of our science curriculum work, which included guided inquiry lessons and full inquiry lessons both in and out of the classroom. During this treatment I refer to labs and activities interchangeably; the terms refer to hands-on activities, expert visitors, group and individual projects, and actual labs. 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.

Student reading and math scores on the state criterion referenced test (MontCas) and fluency rates in reading according to our reading diagnostic (DIBLELS) were used to ensure that all students with reading difficulties were not penalized in science content knowledge. During the year, science lab notebooks were collected and reviewed to evaluate student understanding of inquiry lessons that occurred. A student/teacher conference was also conducted to ensure requirements for lab write-ups were understood and to allow students to clarify misunderstandings on scores for the lab. Teacher

observations and the corresponding notes were used to evaluate student performance and understanding of the inquiry process. The Student Analysis Form was used so students could maintain records of scores on pretests and posttests to evaluate their own learning and to provide opportunity to comment on attitudes towards science (Appendix A).

The Student Interview was conducted to determine general school attitude (Appendix B). All interviews were conducted in the classroom in a quiet corner while other students were finishing assignments. All of the students in the classroom were interviewed. The Student Interview was given again in March so that I could evaluate whether or not a change in attitude had occurred with the students. I examined trends in choice of favorite subject, student lab preference, and how students liked to receive instruction in science, and then compared pre and post treatment results. The Student Quarterly Evaluation was given to students to determine their attitude towards science and to compare any changes in trends from term to term (Appendix C). The Science Survey was given as a pre and post survey to gather information about science (Appendix D). Pre and post treatment data was compared by themes to evaluate whether or not a change in attitude toward science had occurred during treatment. All treatments listed are in the triangulation matrix (Table1).

Students in the classroom engaged in at least two outdoor inquiry labs during the five months. Labs from the science series were conducted as usual. Additionally, lab activities developed by the teacher were used. Students also engaged in labs/experiments of their own design. Pre and post chapter tests were given to evaluate students. Each chapter was evaluated by the students themselves following chapter tests.

Fourth grade teachers were given the Teacher Survey Questions in the fall previous to the students entering 5th grade to determine the frequency and type of labs or experiments conducted during science class (Appendix E). Teachers surveys were anonymous and included 80% of the fourth grade staff ($N=5$). Data from the teacher survey was compared to student interviews to discover whether or not student perception about the frequency and effectiveness of labs coincided with the teacher's reports on frequency of labs in the classroom. During this treatment I refer to labs and activities interchangeably; the terms refer to hands-on activities, expert visitors, group and individual projects, and actual labs.

Table 1
Triangulation Matrix

Research Questions	Source 1	Source 2	Source 3
What is the best way for you to learn science?	surveys	Interviews	pre/post test Scott Foresman Science, 5 th grade, 2010 ed.
What do you like best about science?	lab notebooks	Interview	observations
Has your attitude or your feelings about science changed this year?	interviews	Lab notebooks	observations
Please discuss specific things that you have learned from your labs.	interviews	Lab grades	Student notebooks

DATA AND ANALYSIS

At the beginning of the year, students were given the Student Interview to determine their general attitude about school, their favorite subject, and what they liked best about science (Appendix B). Forty-four percent of the students reported science to be their favorite subject ($N=26$). Twenty-eight percent of the students chose math as a favorite subject (Figure 1). When questioned further about why science was a favorite, one student reported that “You are able to do experiments in science” Another said, “It feels like you are having fun.”

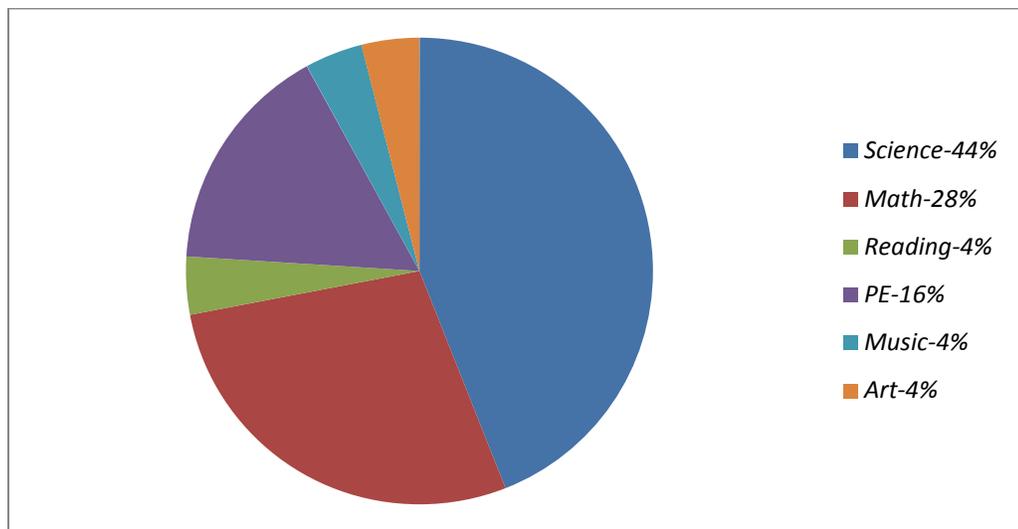


Figure 1. Student Interviews-Favorite Subject, Pre Treatment, ($N=25$).

Fifty-six percent of the students reported that they liked labs or experiments best. One student stated, “Labs, because I don’t like textbooks.” Another said, “I like the labs because they are very cool.” Sixteen percent of the students reported that they liked “getting new knowledge” and 12% reported “having fun” was best about science. One student elaborated by stating, “I like all experiments; they’re all so much fun.”

Results at the end of the treatment indicated that 77% liked science best, 19% liked math best, and 4% liked social studies best. No other subjects were chosen as a favorite at the end of the treatment (Figure 2). When asked what they liked about science, one student reported that “most of the time we get to do experiments-fun to learn about everyday things,” Another student said, “It is easy to understand because of the labs,” Another student reported that, “It was so much fun to do projects, I haven’t done in my entire life...It’s fun to do projects I understand,” While yet another stated, “It’s fun because I like doing experiments and exploring things.” Students also reported more confidence in their abilities in science. One student reported that she was able to help her older sister with a science assignment, saying, “I think science is going really well this year. I have learned about Newton’s Three Laws of Motion. Knowing about Newton’s Laws of Motion I was able to help my sister who is in eighth grade on her paper about Newton’s Three Laws.” Another student reported that science was “something that I used to not be good at...I’m working hard at it and getting better, so I really like it.” When asked why, the student stated that science was “more fun than...in the past...you do a lot more labs and we do science more often.” Overall, 88% of the students said that what they liked best about science was the labs.

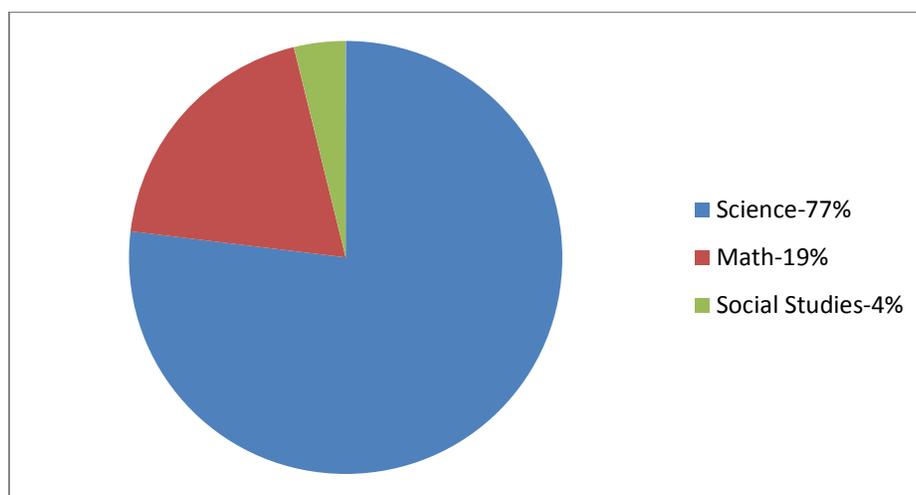


Figure 2. Student Interviews-Favorite Subject, Post Treatment, (N=26).

Although students reported that they enjoyed science, and especially labs, they did not recall the number of labs they had done in the previous year. When students reported on the kinds of labs that they had done, only 4% could remember doing four or more labs. One student stated, “We didn’t do, oh scratch that, because I remember a lab about density.” Sixty percent of the students remembered one lab while only one student could remember doing five labs (Table 2). However, a total of 13 different labs were mentioned by the students in class.

Table 2
Recall of Labs in Previous Years

1 lab	2 labs	3 labs	4 labs	5 labs
60%	24%	12%	0%	4%

Upon breaking up the analysis by gender, I found that 92% of the girls surveyed chose math or science as their favorite subject and only 54% of the boys reported the same. Fifty percent of the girls chose science as their favorite, and 42% chose math.

Thirty-eight percent of the boys chose science as their favorite, while the other subjects had a fairly even spread other than physical education at 31% (Figure 3).

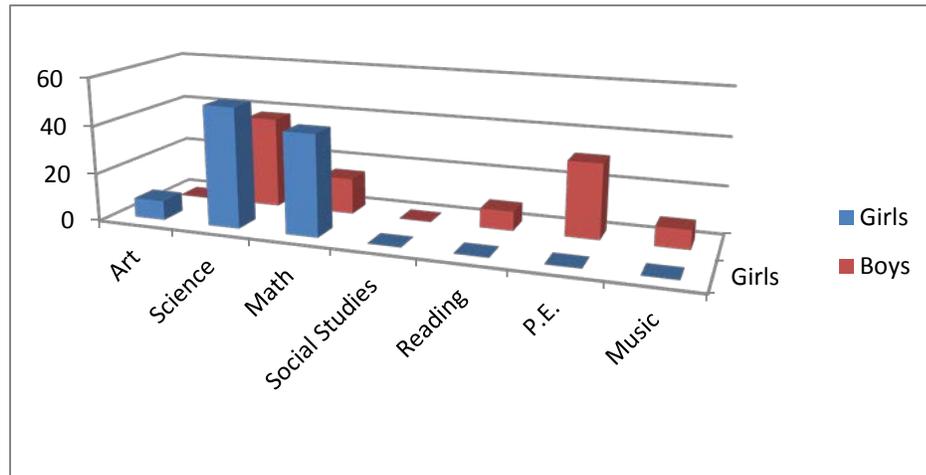


Figure 3. Student Interviews-Favorite Subject by Gender, Pre Treatment, (N=25).

At the end of treatment, however, some students had changed their minds about favorite subjects. When analyzed by gender, 85% of the female students and 69% of the males chose science as a favorite subject. Fifteen percent of the girls and 23% of the boys chose math and 8% of the boys chose social studies as a favorite (Figure 4).

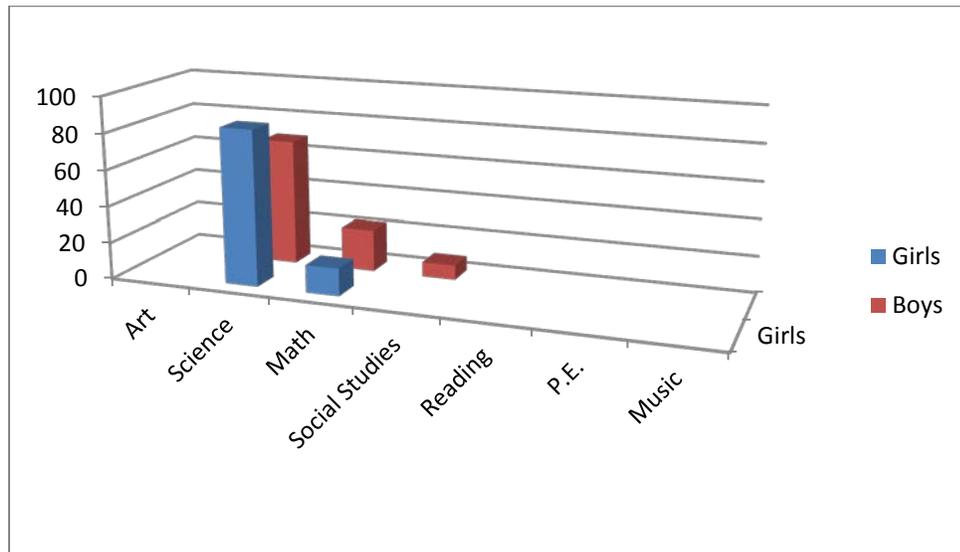


Figure 4. Student Interviews-Favorite Subject by Gender, Post Treatment, (N=26).

At the end of the first quarter of this year, students were given the Student Quarterly Evaluation (Appendix C). Ninety-six percent of the students reported that science was going *very well* or *great* with one student stating that “All the labs we’re doing is helpful.” This trend continued each quarter, with 100% of the students reporting a positive comment about science. Nine different labs were mentioned by the students when they were asked what they had learned during the first quarter. One student commented that “if you use a different temperature of water, it can change your outcome” Another stated, “I learned that things can be like liquid and solid at the same time.”

In the first quarter, four labs were reported by students as being the most beneficial in understanding science. A lab was conducted exploring the densities of different types of canned soda. Eight students found this lab the most helpful, reporting that “I have learned that pop can have different densities” and “the soda experiment, very

helpful with understanding grams and density.” Students constructed a homemade thermometer for another lab, which aided in “understanding heat and temperature.” In the second quarter ten different labs were cited as helpful, and in the third quarter nine were reported to be helpful.

Twenty-three students responded to the question regarding how they felt about science at this point in the year reported that they *felt good*, and many reported that they were *getting good grades*. Student comments were very enthusiastic with explanations; for example, one student reported, “I feel really good about science because I have improved at it.” Another student stated, “I feel like I am a part of something that is really fun,” Another student said, “I like how we don’t just read in the book because that does not help me learn,” While yet another reported, “You persuade me to like science more and more every day.” Many students suggested doing more labs and activities, stating *labs help me learn*. A student said, “I would like more experiments or labs.” More labs were reported as beneficial each quarter, however since two of the types of labs that were conducted carried over from second to third quarter I recorded the data for the doubled labs in the second quarter. Nine labs or activities were conducted each quarter (Table 3).

Table 3
Student Quarterly Evaluation

	First Quarter	Second Quarter	Third Quarter
How is science so far this year?	96% positive	100% positive	100% positive
What have you learned so far? (concepts reported)	100%	89%	89%
Which lab/activity was most beneficial? (different labs)	44%	100%	100%

Students had similar responses to the Student Science Survey (Appendix D). Eight percent of the students *strongly agreed* or *agreed* that they did not like science whereas 85% *strongly disagreed* or *disagreed* with that statement. Seventy percent of the students *strongly agreed* or *agreed* that they liked science best. After treatment, results indicated that students liked science best than at the beginning of the treatment.

Before treatment 34% of the students chose *strongly agree* or *agree* for learning science best from labs or activities, but after treatment, 93% chose that category. Conversely, 23% of the students chose *strongly disagree* or *disagree* pretreatment, but post treatment only 4% reported the same (Table 4).

Table 4
Student Science Survey, Pre and Post Treatment

	Pre treatment		Post Treatment	
don't like science	strongly agree and agree	strongly disagree and disagree	strongly agree and agree	strongly disagree and disagree
	8%	85%	0%	93%
like science best	strongly agree and agree	strongly disagree and disagree	strongly agree and agree	strongly disagree and disagree
	70%	16%	85%	12%
learn best/labs	strongly agree and agree	strongly disagree and disagree	strongly agree and agree	strongly disagree and disagree
	34%	23%	93%	4%

INTERPRETATION AND CONCLUSION

Although students initially had positive comments about science, there was a noticeable increase in self-reported attitude toward science at the conclusion of the five month period in which this action research based classroom project was conducted. By the end of the year on the student survey, all students reported that they had positive feelings toward science, even if they did not choose it as their favorite subject. Many students reported that science was more enjoyable when activities and labs were part of the learning experience, but what was more encouraging was that the students reported that they learned better when they were able to be active in their science learning. A student stated, "I have learned so much that I don't think I can put it on this paper." Another said, "All the labs we're doing are helpful." Yet another commented, "Labs help me learn." One student commented that "I liked motion and Newton's Laws. We could

understand inertia, an object at rest stays at rests or an object in motions stays in motion unless and outside force acts on it. The labs helped me understand what that law meant.”

Change in attitude was evident in student comments. One student said, “You persuade me to like science more and more every day.” Another student stated, “I like how we don’t just read in the book because that does not help me learn,” Another said, “I feel like I am part of something really fun.”

An increase in confidence was mentioned by some students; one student stated that “I feel really good about science because I have improved at it.” While another said, “I like the types of labs where you build something. I am creative, I like testing what I build.” Another student said, “I think it’s going better than last year because I understand it better.” One student reported, “I think science is going pretty good this year. Both the books and labs help me understand science better.” Another student said, “I think science is going wonderful this year because we do labs and papers and it helps me to read and see things better and that’s exactly what we’re doing this year.”

Being able to do an activity or lab rather than just watch a demonstration is important to students. One student expressed the importance of activities in science with this remark, “The best thing about science is all of the experiments and getting to do experiments ourselves rather than the teacher showing us,” Another student reported, “It is a lot different than what we usually did. Last year we just read out of a book. This year we did tons of labs and read out of a book.” One young man said that “Science is my favorite thing, and the labs are the funnest [sic] and we’ve done 20 labs this year already!” It is important to do as many labs as possible when they are appropriate, to help students understand and to maintain their natural enthusiasm for science. A young man

told me, “It is fun and very easy unlike the rest of science classes I took. We did two labs last year, and I was absent both days.”

Students wrote comments in their science lab notebooks at the conclusion of some of the labs. In their own words they were able to describe their understanding of science concepts. A Title One student wrote the following statement:

At first I thought that Newton’s Laws were non-important. But now I know that if something is in motion it tends to stay in motion. For the Newton’s First Law of inertia it helps me because I didn’t really get it. The lab helped me by when a car stops and an egg is not wearing a seat belt it keeps moving forward and out of the car.

Not only did student attitude toward science improve, but confidence and understanding of science confidence increased as well. One student told me that, “I feel good. I love science. Science was my worst subject and now it is my favorite.” Pre and post test scores on chapter tests improved as well, averaging a 26% improvement in scores on tests taken during the five months. Evidence supports that student attitude improved from pre to post treatment even though the students entered the year with an enthusiastic attitude toward science.

On all of the instruments I used to evaluate student attitude toward science I noted a change toward the positive, even though many students had chosen science as a favorite subject. Student confidence increased in their science ability as well. Some of the students recommended that I conduct more labs and activities next year.

VALUE

I began this process with a conviction that students love science, and given the opportunity to experience science through activity reinforced by reading, they would maintain a positive attitude, if not increase their enthusiasm for science when in a classroom with science activities and labs that support their learning. The readings that I engaged in supported this conviction. At the beginning of the year I interviewed students to ascertain their attitude toward science. I found that they were already quite enthusiastic and that most of them chose science as a favorite subject. I began to get worried that I would not see measureable results in my study. However, I did see positive results that supported my conviction. One young man told me, "I feel really great about science this year. It's fun, I'm learning a lot. All I can say is I love science this year. I liked it in fourth grade, it was fun, but this year I love science." I received positive feedback from students not only supporting that their attitude toward science became more positive as the year progressed, but their confidence increased and they understood science better due to the activities and labs that were conducted during the year. One student said, "I have learned a lot; at the beginning of the year I hated science now it's really fun." Even a simple lab using flashlights and Styrofoam balls to demonstrate phases of the moon were helpful for students, as one child stated, "I liked how we did the Moon lab where we looked at phases because I liked how you could see how the phases were formed instead of just reading about it." Another student said, "When I was younger I had trouble understanding why the moon changed. Now I get it."

Students enjoyed designing and testing their boats and rockets. A young man reported that “I like the ones where you have to think about a design and then figure out how to make and build it. I like testing the design.” A female student described which labs she preferred, she said, “When we are building something because everyone in my family likes to build so it’s rubbed off on me. I understand that kind of lab.”

Several students reported that they liked the lab where we conducted motion and forces experiments with our second grade readings buddies. A student said, “I think teaching the second graders was the most beneficial because we got to teach the second graders how Miss Townsend taught us.” Another student stated “The light lab was the most beneficial way for me. It showed me that light is different than paint.”

The importance of doing activities and labs in science has become even more evident since I conducted this action research. Improving understanding, enthusiasm, and confidence in science is a benefit gained from engaging in an activity-based science classroom. Maintaining the natural scientist in the child is important in the elementary classroom to ensure that students continue to pursue science; it is a responsibility I feel even stronger. Reaching the child in ways that have meaning is important and possible in the science classroom. A student who doesn’t like to read said, “I like labs because they help me understand. I don’t like to read that much but I like to do labs.”

As a result of the knowledge I have gained about activity-based science classes, I am even more convinced of the importance of conducting science learning in this way. I will encourage administration to provide professional development opportunities so that staff can learn more about activity-based science, and thus gain confidence in teaching in such a classroom.

This action-based classroom project has provided me with evidence directly from the students as to the value of an active classroom. Not only is it important for their attitude toward a subject, I found it was important for their self-confidence and comprehension. Next year I want to incorporate more activity-based learning into social studies and increase the activities in math that already exist. I have learned to value input from the students that I teach, whether it is for a single lesson, a chapter, or a unit, their opinions and ideas can guide me in changes in instruction.

An activity-based science classroom can engage all students. All students, regardless of reading ability, mathematical ability, or learning difficulties can experience success and gain confidence in an activity-based classroom. Over and over again as I reread interviews and surveys, I noted that my students were enthusiastic, changed their minds about science, and gained confidence in their abilities regarding science. One of my students, who tested at 3rd grade level in math and science at the beginning of the year, stated her feelings about activity-based science clearly; "I like the engineering labs because I can experience...write my ideas and then build it, like the rockets. I said to myself-this is my moment."

REFERENCES CITED

- Cronin-Jones, L. L. (2000). The Effectiveness of Schoolyards as Sites for Elementary Science Instruction. *School Science & Mathematics, 100*(4), 203.
- Elliott, K., & Paige, K. (2010). Middle year students talk: Science sucks or science rocks!. *Teaching Science - the Journal of the Australian Science Teachers Association, 56*(1), 13-16.
- Foley, B. J., & McPhee, C. (2008). Students 'Attitudes towards Science in Classes Using Hands-On or Textbook Based Curriculum. *AERA*,
- Haury, D.L. & Rillero, P. (1994). Perspectives of Hands-On Science Teaching. *ERIC Clearinghouse for Science, Mathematics, and Environmental Education. Mar 1994*.
- Lakin, L. (2006). Science beyond the Classroom. *Journal of Biological Education, 40*(2), 89-90.
- Llewellyn, Douglas. (2002). *Inquire Within Implementing Inquiry-based science Standards*. Thousand Oaks, CA: Corwin Press, Inc.
- Llewellyn, D., & Johnson, S. (2008). Teaching Science through a systems approach. *Science Scope, 31*(9), 21.
- Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel Hill, NC: Algonquin Books of Chapel Hill.
- Metz, K. E. (2008). Narrowing the Gulf between the Practices of Science and the Elementary School Science Classroom. *Elementary School Journal, 109*(2), 138-161.
- Neathery, M. F. (1997). Elementary and Secondary Students' Perceptions Toward Science:. *Electronic Journal of Science Education, 2*(1), Retrieved from <http://wolfweb.unr.edu/homepage>
- Pearce, C.R. (1999). *Nurturing Inquiry: Real Science for the Elementary Classroom*. Portsmouth, NH: Heinemann.
- Scott Foresman. (2010). *Scott Foresman Science: Grade 5*. Pearson Education, Inc.
- Sobel, D. (2008). *Childhood and Nature: Design Principles for Educators*. Portland, ME: Stenhouse Publishers.

Sobel, D. (2004). *Place-based Education: Connecting Classrooms and Communities*. Great Barrington, MA: The Orion Society

Song, Y., Ahlswede, D., Clausen, C., & Herbig, L. (2010, March). Community -Based Inquiry Lessons: Building a scientific community in the high school science classroom. *The Science Teacher*, 61-65.

Yager, R. E., Choi, A., Yager, S. O., & Akcay, H. (2009, Spring). Comparing Science Learning Among 4th-, 5th-, and 6th-Grade Students: STS Versus Textbook-Based Instruction. *Journal of Elementary Science Education*, 21(2), 15-24.

APPENDICES

APPENDIX A

STUDENT ANALYSIS FORM

APPENDIX B

STUDENT INTERVIEWS

APPENDIX C

STUDENT QUARTERLY EVALUATION



- 1) How do you think science is going so far this year? Explain.

- 2) What have you learned so far this year? Explain.

- 3) Which lab/activity was the most beneficial in helping you to understand science this quarter? Explain.

- 4) How do you feel about science at this point in the year? Explain.

- 5) Can you think of anything else that you would like to add?

This survey is optional. Please do not write your name, just your student number and your gender.

APPENDIX D

STUDENT SCIENCE SURVEY

Participation in the survey is optional.

Please circle the response that is closest to how you think or feel.

SA=Strongly Agree, A=Agree, N=Not Sure, D=Disagree, SD=Strongly Disagree

- 1) I learn science **best** from reading and doing worksheets.
SA A N D SD
- 2) I learn science **best** when I can do labs or activities.
SA A N D SD
- 3) I learn science **best** with a combination of textbook work and activities.
SA A N D SD
- 4) Reading about science and doing worksheets is exciting.
SA A N D SD
- 5) Sometimes we do science outside.
SA A N D SD
- 6) I don't like science much.
SA A N D SD
- 7) I like science best of all the subjects this year.
SA A N D SD
- 8) We often do labs and activities for science in this class.
SA A N D SD
- 9) In the past, I have often done labs and activities in science class.
SA A N D SD
- 10) I like being able to investigate something I am curious about.
SA A N D SD

APPENDIX E

TEACHER SURVEY QUESTIONS

Teacher Survey Questions

- 1) What subject do you think most of your students like best? (Poll the class if you need to.)

- 2) How often (per week or per month) are you able to teach science? Please include any information that may be pertinent here.

- 3) How many labs do you do? Include all labs, for example, labs from the series, labs you have developed, etc. (per week or month, please indicate which)

- 4) How are your labs set up? For example, is the lab a teacher demonstration or a group lab conducted by students? Please explain how you do this.

- 5) Do you conduct any outdoor labs? How often?

*You do not have to do this survey...just put your grade level on the empty sheet and put it in my mailbox if you chose not to do this. This is anonymous, and no one from the district will see any part of the completed surveys or the information gathered. Thank you for your time.