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ABSTRACT

Teacher action research is a powerful tool for change that begins with teachers conducting research in their own schools and classrooms in order to discover how to do something in a better way. This book contains a collection of action research reports written by seven elementary teachers (K-4) who were in their first year of implementation of Life Lab, an integrated garden-based science curriculum. In Part I, two teachers write about issues they faced surrounding students' motivation and persistence when learning mathematics and science. The reports in Part II explore how teachers and students ask questions when they are engaged in science investigations. In Part III, two teachers explore the relationship between learning about science and learning to read. By teaching a first grade curriculum that integrated science and language arts, each teacher investigates a specific dimension of what students gain. Contains 12 references. (MKR)

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Teacher *Action* Research

Learning with Life Lab:

Reports from the Field
1993-1994

Edited by
Kirsten R. Daehler

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Teacher Action Research

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Far West Laboratory for Educational Research and Development
San Francisco, California
1994

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The support of many people has made possible the publication of this collection of action research reports. Steve Schneider had the foresight to see a meaningful connection between the implementation efforts of Life Lab and teacher action research. He gave freely of his time and offered invaluable advise at crucial moments throughout this project. Donna Berlin and Arthur White ensured that this was a truly collaborative venture. With frequent flights to San Francisco, they readily shared their expertise and established an open dynamic of exchange among everyone involved. In addition, Donna and Art provided the means for every participating teacher researcher to feel fully supported in her research and treated with respect as professional educators.

The commitment of time and energy from all seven teachers whose reports are contained in these pages is commendable. Their personal achievements, openness with each other, and continued efforts to improve science and mathematics education are inspirational. The families, friends and school administrators of everyone involved were especially understanding of our investment of so much time, supportive of our endeavors, and flexible throughout our undertaking of this project of personal growth and professional contribution.

The preparation and printing of this book was only possible with the assistance of Don Klein and Far West Laboratory for Educational Research and Development. For each person mentioned, a special note of thanks is offered.

Introduction

Teacher action research is a powerful tool for change that begins with teachers conducting research in their own schools and classrooms in order to discover how to do something in a better way. This idea of internally driven change is not new and has sociopolitical roots in the nineteenth century. In 1945, John Collier, the Commissioner of the U.S. Bureau of Indian Affairs, suggested action research as a democratic means to improve the conditions of Native Americans. Rather than repeating failed attempts to mandate change from the top down, action research allowed those who were most familiar with a situation to identify the problems, gather information about the issues, and take responsibility for their own solutions.

During the 1960's and 70's, action research became commonly adopted in both Australia and the United Kingdom as a catalyst for educational change. One landmark project that identified teachers as the key to change was the *School's Council Humanities Curriculum Project* (1967) which helped teachers explore the effects of radical changes in pedagogy when addressing race relations in their classrooms. In 1974, when extensive curriculum reform efforts failed in England, the Ford Teaching Project was sponsored as an action research program to rescue a mandated, but doomed curriculum.

Currently, teachers throughout the world are engaged in action research projects of different types and dimensions. Some pre-service education programs have incorporated teacher action research into their curriculum, as have a variety of professional development programs. In addition, teacher-researchers' work is shared at annual conferences, and both national and international action research networks exist to link teacher research groups together.

More About this Teacher Action Research Project

This action research project was a collaborative venture among the seven participating teacher researchers, their students, Dr. Steven Schneider and Ms. Kirsten Daehler from Far West Laboratory for Educational Research and Development, and Drs. Arthur White and Donna Berlin from the National Center for Science Teaching and Learning at the Ohio State University.

The seven teachers who chose to participate in this year-long project came from four different schools and three separate districts in the greater San Francisco Bay area. Each brought a unique perspective due to her varied teaching background, level of experience, research interest, and degree of comfort with teaching science. However, there were many common threads that wove this fabric of teacher-investigators together into an open-minded, honest, collaborative research group. Each teacher taught an elementary level class (K-4) and each was in her first year of implementation of *Life Lab*, an integrated garden-based science curriculum. Most importantly all seven teachers wanted to take a critical look at their teaching of science in the context of a supportive, informative, and introspective environment.

During the winter and spring of 1994, all participating teacher-researchers and the collaborators came together for five full day "how-to" seminars. These sessions introduced the process of classroom research, assisted teachers in identifying meaningful research topics, and provided a forum for discussions about what had been learned, what questions remained, and what would be logical next steps. More specifically, the seminars addressed the issues of qualitative and quantitative data collection, instrument reliability and validity, triangulation, and methods for inferential and descriptive data analysis. The teacher-researchers took many of these ideas back to the classroom to learn more about their science teaching and their students. Daily reflection included video cameras, tape recorders, interviews with students, questionnaires, student attitude surveys, and written journal entries.

Throughout the year, Kirsten Daehler, the project manager, met with the teacher-researchers both individually and in small groups at their schools. These monthly conversations proved to be an effective way to build a supportive environment for sharing craft knowledge and furthering each teacher's research investigations. As relationships developed, conversations among teachers extended to regular phone calls and to a lesser degree e-mail messages. The teachers shared their experiences, asked each other for advice, helped interpret their data, commiserated, and worked together to solve each others' problems.

By the end of the academic year, the teacher-researchers had moved toward finding answers to some of their original research questions. They also made some unexpected discoveries and generated a whole new list of questions. This provided rich fodder for continued conversations during the ensuing months. Each researcher tried to clarify the meaning their data and how to best summarize what they learned. In the 'quiet' of the summer months teachers participated in productive and stimulating writer's workshops. The reports collected in this book are the results of their research-based reflections.

What is in this book?

This book contains a collection of action research reports written by seven wonderfully committed elementary teachers who challenged themselves to better understand their individual classes and make changes in their teaching of mathematics or science. Each report speaks to the uniqueness of each teachers' classroom experience and is written in response to these questions:

- What did you choose to study?
- Why were you interested in this particular research?
- What did you do to find answers to some of your questions?
- How did you do the research?
- What does your data mean?
- What did you learn?
- What new questions came up as a result of your research?

The reports are organized into three sections according to the similarities in their research focus. In Part I, two teachers write about issues they faced surrounding students' motivation and persistence when learning mathematics and science. The reports in Part II explore how teachers and students ask questions when they are engaged in science investigations. Interestingly, each teacher takes a different angle when considering the issue of questioning as it pertains to science. For example, one teacher analyzes the types of questions students ask during science lessons, while another employs a variety of teaching strategies to increase the number of questions asked by her first graders. In Part III, two teachers explore the relationship between learning about science and learning to read. By teaching a first grade curriculum that integrated science and language arts, each teacher investigates a specific dimension of what students gain.

As you read these reports, you will find that they are specific to the individual events and context of each teacher and her class of students. It is important to recognize that any findings or conclusions reached by these teachers are not intended as universal truths or generalizeable to other settings. However, it is hoped that these narratives speak to some of the challenges, questions and accomplishments experienced by others who are either going through the process of teacher action research, implementing a new curriculum, using *Life Lab* curricular materials, or facing the day-to-day challenges of teaching elementary science and mathematics.

Helping Children Become Self-Motivated Learners By Making a Garden Grow

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Abstract

The aim of this study was to explore ways to encourage students in a second and third grade combination class to become self-motivated learners. In helping children to become self-motivated learners, the Life Lab Science program was used as a basis to develop student-led activities. The Life Lab Science program, developed by the University of California at Santa Cruz, is an integrated Life, Physical and Earth Science program that involves children in kindergarten through fifth grade in cooperative lessons that take place in the classroom and in a garden setting. This program is flexible and provides opportunities for both the teacher and students to expand the lessons to meet individual needs. This study used the Life Lab program to give students responsibility in planning, organizing and producing a garden festival.

For this classroom, it was found that in giving second and third grade children control of the planning and implementing of a highly interesting and motivating activity, the children became integrally involved in constructing their own learning. As the teacher stepped back and let the students take charge, the children developed successful organizational techniques that may lead to life-long learning patterns.

Introduction

As a teacher, I am concerned with helping children evolve into self-motivated, life-long learners. Each year I wonder what I can do to avoid having children slip away from the school community and become less and less excited about learning. My secret wish is to find the way to inspire every child and to continue to motivate them beyond my direct classroom influence. Recent research in motivation (Barr 1994, Kloosterman and Gorman 1990, and Kober 1993) indicates that children, in order to be self-motivated learners, must take responsibility for their own learning. The research also finds that the more involved children are in a learning activity, the more likely they will carry their knowledge beyond the classroom and make it part of their real life experiences. In this way, children can internalize the experience and build upon the rich knowledge at a later time. We have all heard children relating past classroom experiences to the current experiences we are sharing. For instance, I will pick up a book to share and find out from the children all the activities they did when they read the book in kindergarten or first grade. One child in particular used the phrase, "This project is like the time we ... in Mrs. ___ class." Unfortunately, there are also children who have been in the same previous classes and do not recall these experiences. Therefore, they can not build on them.

This school year provided me with the opportunity to look at motivation in children and try some alternative techniques that could potentially lead them to become more independent learners. Several factors made this task possible, including the composition of the class, the environment, the curriculum, the action research project, and peer relationships with other teachers in the action research project.

Background

To understand the specific motivational issues the children faced, it would be helpful to understand some background on the class and school setting. The school year began late for both the students and myself in my second and third grade combination class. Twenty-seven children arrived from four different classrooms six weeks after the school year began. I had been teaching Library Skills the day before. Our school became filled to capacity and a new class needed to be added. There had never been a combination class at this school. The students and their parents suffered from the change; children came with loyalties to other teachers and now faced a new schedule, a new classroom and a new teacher. Everyone had many adjustments to make.

Several children lived in surrounding cities and were enrolled based on needs of neighborhood child care and after school baby-sitters. Selection for the class was not based on ability grouping, but was considered so that a range of behaviors and skill levels were included. This class was in no way elite, but mirrored the structure of most classes in the school. The number of students through out the year averaged twenty-seven. The second graders averaged thirteen students -- seven boys and six girls. Four of these children were bilingual and three were resource specialist monitored. The resource specialist worked mainly with low ability readers in a "pull-out" program of twenty minutes, four days a week. The third grade averaged fourteen students -- eight boys and six girls. Five of these children were bilingual and two were monitored by the resource specialist. Four children in the third grade were speech impaired. Three third graders were in group counseling with the school psychologist intern; one child was severely emotionally disabled and the other two children made great progress through the year in dealing with anger and peer socialization. Throughout the year we had a fairly normal classroom content (for our school) with a few children leaving to be replaced with new enrollees. There happens to be a large degree of family migration in this area of the city.

Our classroom environment is unique. We are housed in a portable that is much longer than it is wide. The portable was used as a storeroom for old furniture and discarded books, and not as a classroom for the past couple of years. There is an office at one end for the school psychologist, who is there one day a week. There are very few bookcases or outside storage areas in the room. On one long wall facing the street, there are three windows that let in the sun that blinds the children if the shades are not closed. The lighting is fluorescent and must be on all the time. There are doors at either end of the room that creates a wind tunnel effect if both doors are open. We do have an air conditioner, carpeting, and a telephone. Children sit in groups of four, at round tables, throughout the room. Their tables are identified by numbers posted on mobiles hung above the tables that are changed with the seasons. We have three other work tables for center activities around the room and there is a single Mac Plus computer for word processing that includes a printer. We also have an overhead projector and two chalkboards (one moveable). The walls are sponge painted blue. The bulletin boards are four feet above the floor and hard to reach. Nevertheless, the walls are filled with children's work. Their art, science, math and literature projects are displayed and changed as the children produce more to share.

This year the noise level in the room fluctuated according to activity and enthusiasm throughout the day. The children loved to help each other, socialize, and were for the most part, friendly and happy. The children worked cooperatively with a partner and in groups of four depending on assignments. Sometimes they were pulled aside for grade level or individualized direct instruction. There was a wide range of flexibility in the grouping. As the children worked together there were a few disagreements and clashing of wills from time to time. Our Principal, upon observing the class commented that the children had separate strong personalities and yet showed a strong group personality as well.

Interestingly, the third graders did not take a nurturing role with the second graders at anytime during the year, nor did the second graders act in a way that would put them in a secondary role to the older children. All children who needed help, received help sometimes from adults or from student "experts" in the subject matter. All children who could help were more than willing to help. Each grade level had their own work to do as well as cooperative work. By the end of the year the individuals in the class completed their individual second and third grade phases and were ready for the next year's grade level. One child completed both second and third grade material and skipped a grade level.

The Problem

The first days of school did not indicate that the year would end as well as it did. I had taught combination classes before and was fully aware of the drawbacks. In the past, I had plenty of help from instructional aides and parents. This year there was going to be very little outside help. I had an immediate and critical need for these children be independent and self-sufficient learners. They needed to be self motivated and able to sustain this motivation over time. My role could not be lecturer, guide and nurturer, for we had much work to do and were starting six weeks late.

Fortunately, two things proved to be in my favor. First, our school adopted the Life Lab Science program and second, I became involved in the Far West Laboratory Action Research project. Life Lab is a garden-based science program that integrates multiple curriculum areas around grade specific science concepts. The lessons are motivational in themselves and are flexible and open-ended, such that the class can expand on areas of interest or on topics where there is a lack of understanding.

The children enjoyed the Life Lab lessons and working in the garden from the start. They seemed interested and enthusiastic when asked to do a short term task like planting a seed, but lacked interest in following through after the immediate lesson was completed. I wondered why. Furthermore, I began noticing this lack of follow through in other areas. By observing the children as they worked on Life Lab activities, I noticed how they asked questions and developed ways to look at problems. For example, one activity had the children examine what a plant needed to grow and then had pairs of children design an experiment that gave one plant the life sustaining necessities (light, water or soil), but withheld one necessity from another plant. The children felt they already "knew" the answer to the experiment and didn't feel it was important to show the result by following through with the experiment. Consequently, they were not involved enough to follow through on questions that came up during the activity, no matter how interesting the questions seemed. I was faced with a class that asked great science questions, but were not motivated to find answers. Designing questions was enough for them. I suspected that the children may not have had successful experiences researching answers to questions they had posed, so they didn't really know how to go about researching and sustaining an interest throughout a project. I was curious to know whether they had previous experience making choices, and if it was hard for them to make decisions. On the basis of observations, such as those described, my research question developed into the following: **"How could I use the Life Lab science program to help my students evolve into self-motivated learners who would be able to internalize and sustain their interest, and develop learning patterns that would continue beyond the duration of a specific lesson?"**

Action

I used three methods to gather information about the students. First, I kept weekly notes on observations that I made of the children during Life Lab lessons. Sometimes I was able to note behaviors and write them in a journal when I felt the observations were significant or interesting to the study. Some of these observations were during science related art lessons. One project was a construction paper collage in which the children were instructed to include parts of an ecosystem of their choice, including herbivores, carnivores, decomposers, plants, and the physical elements that all living things need (sun, air, soil, and water). Second, I was also able to video tape a few of the lessons, so that I could examine more closely those behaviors that illustrated motivated learners. From a study of the tape, my notes and reading literature in the field of motivation, I was able to determine several components that are essential to motivating the students in my class. Third, I relied on surveys and interviews taken before and after the project, which explored students' feelings about science, cooperative learning behaviors and their attitude toward the Life Lab experience. In making these observations, I saw that teaching (or leading) children to become self-motivated learners, would require some special method or activity. What I determined I needed was a highly motivational activity that incorporated many of the Life Lab lessons into an activity in which everyone could participate as individuals, with partners and/or in groups. I decided to introduce the idea of a garden festival produced by the class. This would serve as an umbrella activity for our fact finding lessons, and inform others about what we had learned in the garden. The festival would enable the children to develop activities that would entertain and would involve everyone as presenter, participant and observer.

My research in the literature informed me that children need to have authorship and credit to build confidence in their learning. Therefore they, not I, should be in charge. I handed the festival planning over to the class to see what they would do. For the first step, they decided to plan what they wanted for the festival. They decided to have games, food, and present information about what they had learned about the garden this year. The activities they decided upon included pizza and salad making, face painting, prize making, giving information about using natural resources and nutrition, and games such as, "Find the Flower in the Trash", "Pin a Petal on the Flower," and "Fishing for Flowers." They listed the activities and assigned the work to partners by drawing names. The partners were to organize the work for their assigned activity. Once this was done, they decided everybody wanted to participate in every part of the festival. The partners were to make material lists and make assignments for the rest of the class in order to put activities, games, prizes or garden food together. The whole class learned how to do each part of the festival, and were able to explain to their parents on Open House Night, in May, what they had done and why they were doing it. The activities continued to be handled this way and as this cycle evolved, I became less and less involved and only stepped in occasionally to make a suggestion, not always accepted, and once to solve a problem that was beyond anyone's control. This problem occurred when one group of children designed the game called, "Find the Flower in the Trash." The entire class had been saving trash in a wheelbarrow for weeks. The night before the festival our custodian thought that the wheelbarrow was full of "real" trash and disposed of it. The next day we discovered the tragedy. I found packing peanuts, the group put them in the wheelbarrow and the game went on as planned.

The children ran all the activities on festival day and even supervised the few parent volunteers. All the activities went smoothly. At the end of the day, there had been absolutely no behavior problems. Not one child complained or was cranky. Our principal, whose office overlooked our staging area, commented on how amazing it was that all the children sustained interest and shared rotations at booths and as spectators throughout the day, without being told by adults. As I interviewed the children at the end of the day, not one child voiced disapproval of any activity. They were exhausted and happy. The entire class unanimously said that it was, "The best day ever!"

Analysis, Findings and Implications

I found out from my research that my students, as bright and capable as they were, did not know how to own their own learning. From a sample of the students' academic work, such as spelling tests, prior knowledge, and brainstorming mind maps, seventy-five percent of the students were good receivers of information and twenty-five percent of those had good memories as well. In a class of twenty-seven, it turns out that only five children retain knowledge through the years. Unfortunately, my observations confirmed this. These children were not used to interacting with their learning activities. They waited for the answers to be given to them and they had developed a pattern of waiting around until somebody, teacher or student, came up with the right answer. At times during lessons earlier in the year, the tension of waiting for an answer was so high, that when the answer was given a sigh of relief was audible.

When we began using the open-ended questioning lessons, that the Life Lab curriculum encourages, it was difficult for the children. As time went on, a pattern emerged in which an increasing number of children were taking risks with their answers and predictions. One lesson I video taped shows a child explaining why taking water away from a plant is like the plant having cancer and wasting away.

What really involved the children, even the most shy ones, and made them buy into the learning experience, was the garden festival. This activity pushed everyone's button. I can't express completely the enthusiasm it generated in my classroom. I still haven't figured out why all the skills needed at the time were suddenly available for all the children, and why they were able to take the reins and charge ahead. Whatever the cause, it happened. I have never witnessed anything like it before in a classroom. However, there is one draw back for the teacher. Once you give the class the responsibility for their own learning, you have to hold on for dear life, because their progress is so rapid and expansive.

There were obvious, observable changes in the behavior of the children throughout the course of the garden festival activity. I had wanted the children to be able to sustain their interest over the entire length of the project and to develop confidence, a "can do" attitude, flexibility, a cooperative spirit, and a willingness to do more. The garden festival project gave the children the opportunity to do all these things. They worked well together and when they realized that I wasn't going to be involved in trivial problems, they didn't bring them to me. The children found few areas of dispute, as they were more interested in making the festival the best it could be.

Before the possibility of a garden festival was introduced, I took a survey of the children's attitudes toward science to see how interested they were in the subject. It asked them to rate their attitudes on a five point scale. For example, they had to decide whether science was easy or hard, and place an X on one of five blank lines. A child who thought that science was easy would place an X on the line closest to the word easy. A child who thought that science was hard would place an X next to the word hard. If a child thought that science was both hard and easy he would place his mark in the blank line in between the two words. The two other choices were for somewhat easy and somewhat hard. (See the Appendix A for an example of the survey and a summary of the results.) Orally, I went over the survey item by item and line by line as the children responded. On the back of the survey sheet, I gave the children a sentence to complete about the garden, that stated, "I liked/did not like the garden activities this year because... " After they marked the survey, several children commented on their answers.

Results from the survey showed that 88% of the children marked that science has positive meaning and that they enjoyed doing science activities. One child remarked that science could be both good and bad at the same time, because it has been used to help people and to hurt them. As expected, not all children like to jump into science activities. Some children are naturally more reticent and others like to watch more experienced children before they become involved. The class was split on whether science was easy or hard. In the discussion afterwards they explained that science could be hard, but that hard work is challenging and fun to do. The final item asked whether they would like more or less science. Most of the children responded that they thought they were given the right amount, with a few students feeling that more science would be ideal. (See Appendix A for a summary of these results.)

When the children responded to the sentence completion, "I liked/did not like the garden activities this year because... " they were expansive in their praise. One child wrote, "I love working on our garden activities because it is fun discovering things that I never knew." Another child wrote, "I have liked working on the garden this year because it's like science. It's fun because you'll get to know more things about plants, gardens and other stuff!" The students that had been in the classroom from the beginning of the year associated science with the garden laboratory and were more inclined to feel that even if activities were hard they could be fun too. Six children who came into the class later in the year didn't make the same connection to the garden; science was less meaningful to them in the garden context. These children found the garden an exciting place, but didn't consider science an exciting subject. One hundred percent of the class enjoyed working in the garden! Only one child during the year expressed disapproval; she did not like the worms we uncovered when we were planting. Nevertheless, this dislike of worms did not stop her from "digging in" to the activities. I was pleased that not one child cited getting dirty as a reason that they didn't like the garden, because they really did get dirty!

After the garden festival, I gave the children a second survey. This survey asked about students' attitudes toward organizing the garden festival and how successful it was for each child. I asked some behavioral questions on this survey to see what attitudes they had toward working with one another. This five item survey considered students' values ranging from very happy to happy, neutral, sad, and mad. The responses were made by circling the picture of Snoopy that illustrated the child's feeling about the subject of the question. (See Appendix B for an example of this survey and a summary of the results.) The children indicated that they enjoyed designing science activities, even when they were not pleased when someone had an idea different from their own. This attitude correlates with my observations and interviews with the children. All the children enjoyed the festival completely and responded that they were either happy or extremely happy about this event. They also talked about the festival for days and days, and I heard good feedback from the families about what the children learned. Most of the children liked being in charge of an activity. A couple of children, who were shy and less mature, were not happy with this responsibility, but loved the festival and would like to do it again. When asked to be in charge of an activity, some children found it difficult or unpleasant to be the one responsible. However, no one turned down their assignment or asked for a change. Based on these results, it seems when children are given the responsibility to achieve a highly motivating common goal, this allows them to overcome their personal fear of failure in taking responsibility. This supposition would be interesting to look into further.

Conclusion

The most compelling conclusion I drew from this experience is that when children are made responsible for their own learning, in a highly motivational climate, they will be eager to learn how to plan, organize and follow through on activities. When engaged in this type of activity, the children in my class could work with any combination of individuals in a group situation. They developed ways to get along with difficult people and the ability to get things done no matter what the obstacle. The greater the expectation, for these children to fulfill their self-developed obligations, the more independent and self-motivated they became. They developed respect for each other's ideas, time and material management skills, and organizational skills. In addition, they gained knowledge in science concepts and learned how these concepts applied to the garden. Because children do best when they are interested and value their project, they worked hard day after day to achieve their goals. As a result of the ongoing Life Lab cooperative learning experiences, the children learned how to sustain themselves with enthusiasm through the preparation, set-up and running the festival day itself. Not one child reported disappointment or being let down by false expectations. The festival met everyone's needs. I am convinced from the results of my study and the confidence these children displayed, that they will be able to replicate the same activity later and in a different situation.

As I look forward to next year and a new class, I realize that I have changed a great deal in my teaching philosophy. I will be more inclined to listen to what children want in their learning activities and pay attention to how they think the curriculum objectives can be met. I will use the information I learned from the children to look for clues that will motivate them to be more involved in their learning. I have learned to let go of the controlling and directing of lessons and allow students to construct meaning from experiences. Sometimes the results are surprising. I realize that in my doing so, the children can take their own steps toward becoming life-long learners. It was fun for the children to make the garden grow this year. It was even more satisfying to see that the garden was not the only thing that was growing!

References

Barr, B.B. *Research on problem solving: elementary school..* in D.L. Gabel, (Ed.) Handbook of Research on Science Teaching and learning: A Project of the National Science Teachers Association. New York: McMillan Publishing Company. 1994. 237-245.

Foster, G.C. *"Oh no! a science project!"* Science and Children. November December, 1983. 20-22.

Gabel, D.L. (Ed.) Handbook of Research on Science Teaching and learning: A Project of the National Science Teachers Association. New York: MacMillan Publishing Company, 1994. 223-233.

James, T. *Teacher of teachers, a companion of children: an interview with David Hawkins* Phi Delta Kappan. January, 1983. 362-365.

Kloosterman, P. and Gorman, J. *Building motivation in the elementary mathematics classroom* School Science and Mathematics. Vol. 90(5) May/June, 1990. 375-382.

Kober, N. *EDTALK: What we know about science teaching and learning.* Washington, D.C.: Council for Educational Development and Research, 1993. 65-66.

Appendix A: Attitudes About Science Survey and an Analysis of the Results

Name ______________________

ATTITUDES ABOUT SCIENCE

For each pair of words below place an X on the blank that best tells how you feel about –

SCIENCE

bad	____:____:____:____:____	good
sad	____:____:____:____:____	happy
boring	____:____:____:____:____	exciting
jump in	____:____:____:____:____	hold back
hard	____:____:____:____:____	easy
more	____:____:____:____:____	less

Using the statistical program Data Desk™ to analyze results from the *Attitudes About Science Survey*, the following table of results was derived.

Survey Analysis of Science

Summary statistics for Item 1
Mean 4.5000000
Median 5
StdDev 0.81240384
Range 2
Variance 0.66000000

Summary statistics for Item 2
Mean 4.4230769
Median 5
StdDev 0.85664821
Range 2
Variance 0.73384815

Summary statistics for Item 3
Mean 4.3076923
Median 5
StdDev 1.0495420
Range 4
Variance 1.1015385

Summary statistics for Item 4
Mean 3.6153846
Median 4
StdDev 1.6267003
Range 4
Variance 2.6461538

Summary statistics for Item 5
Mean 3.0769231
Median 3
StdDev 1.2303846
Range 4
Variance 1.5138462

Summary statistics for Item 6
Mean 3.8076923
Median 4.5000000
StdDev 1.4971768
Range 4
Variance 2.2415385

From the table, you can read that as a whole the class felt quite "good," "happy," and "excited" about science, as reflected by the mean scores of 4.5, 4.4, and 4.3, respectively.

It was not surprising that there was more diversity of attitude in how the children felt about involving themselves by "jumping in" or "holding back." In examining individual responses, the shier children responded more toward "holding back," until they were more comfortable with the activity.

The responses to whether science was "easy" or "hard" was interesting to examine after our post survey discussion. Many children found that science can be fun even if the work is challenging or "hard." Therefore, it was found that the word "hard" did not have a negative connotation for these children.

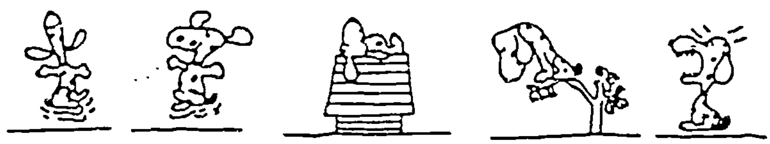
In comparing the sum score of questions one and six, science was "good" and the children would like to have "more" of it. The mean score was 23.7, meaning that among the twenty-six students responding, twenty-four found that science was both good and that they would like to do more. Two students who responded that science was neither "good" or "bad" stated that they liked science but that it could be used by bad people for bad reasons.

Appendix B: Attitude Survey About the Garden Festival and an Analysis of the Results

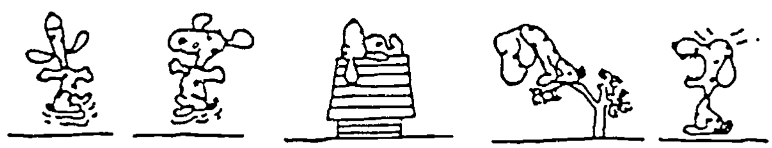
NAME ______________________

ATTITUDE SURVEY ABOUT THE GARDEN FESTIVAL

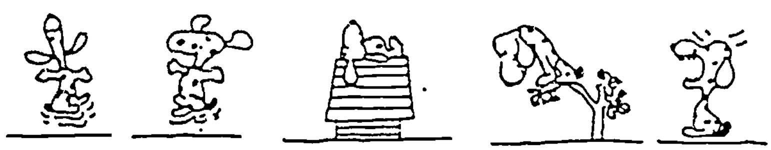
1. How do you feel when you work on planning science experience.



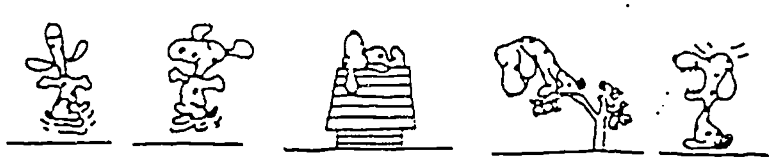
2. How do you feel when someone has a different idea then you do.



3. How do you feel about having the garden festival.



4. How do you feel when you are asked to decide on what we should have at the festival.



5. How do you feel when you are asked to be in charge of one of the activities.

Using the Data Desk™ statistical program to analyze students' attitudes about the Harvest Festival, the following results were noted:

Survey Analysis of Garden Festival
Using Data Desk

Summary statistics for Item 1
Mean 1.9615385
Median 2
StdDev 1.0763185
Range 4
Variance 1.1584615

Summary statistics for Item 2
Mean 3.7307692
Median 4
StdDev 1.3728129
Range 4
Variance 1.8846154

Summary statistics for Item 3
Mean 1.0384615
Median 1
StdDev 0.19611614
Range 1
Variance 0.03846154

Summary statistics for Item 4
Mean 1.8076923
Median 2
StdDev 0.93890280
Range 4
Variance 0.88153846

Summary statistics for Item 5
Mean 1.4230769
Median 1
StdDev 0.90213422
Range 4
Variance 0.81384615

On Item One, most children responding felt "very excited" and "happy" about planning science experiments. The mean score of 1.9 showed that the children were "very excited" and "happy" when working on science experiments.

On Item Two, however, many children in the class were "not happy" about sharing with others their ideas and didn't like it when someone else didn't agree with him or her. This was interesting to note since there were no arguments and everyone got on well throughout the festival planning and implementation.

Item Three showed that the children were "very excited" and "happy" about the festival. The mean score of 1.03 showed that most all of the children circled the "very excited" Snoopy.

Considering the response to Item Two, it was interesting to see that the mean score was high in Item Four. The children had many diverse ideas about what should occur at the festival. It would seem by the response that being given the decision making power over the festival planning made up for having to deal with diverse opinions.

Finally on Item Five, it was interesting that most children and even the shier children liked being in charge and having responsibility for the activities. The survey did show that the children enjoyed being empowered and given the responsibility of the festival work. The survey also shows there were strong attitudes developed about the festival itself.

Increasing Student Persistence Through Open-ended Math Problems (Fourth Grade)

Catherine Garton
Garfield School
San Leandro, CA

Why I Chose to Study Students' Persistence

I chose persistence as the focus of my action research project because I believe that persistence is a basic trait of academically successful students. So much in life depends on this one trait. However, I have witnessed an ever growing lack of persistence in the students I teach when they are solving both academic and social problems. The causes of this lack of persistence was not the focus of my study, but I suspected that the ease of doing things with computers and microwaves, plus too much cooperative learning and role models with defeating attitudes has contributed to students' lack of persistence. Many of my students do not have good parent/adult role models in their lives. Consequently, I wanted to encourage a trait in them that would see them through the tough places in life and lead them to greater success.

In my study, I tied persistence specifically to solving math problems. I did this because my students' needed to be prepared for the CLAS testing, which required them to solve open-ended math problems. Much of a students' success on this type of math problem is related to an ability to persist. The pattern that I observed, before trying to develop their persistence, was how easily they gave up when solving even the simplest word problems. They always asked if they could do the problem with a partner or take it home for homework, where I suspected they would have someone else solve the problem for them.

Background Information

In order to have a more complete understanding of this particular class and how it came to learn about persistence, I have provided some background information about the school, the students and myself.

The School Setting: Garfield Elementary School is 48 years old and is housed in a single story ranch style building. The outside of the building is decorated with large tile mosaics made by seventh grade students in the 1970's. Often the school is vandalized with graffiti, but it is interesting to note that the mosaics are never damaged. The school has been newly painted and new cupboards have been installed in some rooms. There is a large, well-lit, and well-stocked library, a computer room, and a garden area. The separate complex that houses the fourth and fifth grades is about three years old.

There are children on the school grounds before and after school as the Parks and Recreation Department conducts an after school program for the children. There is also a child care facility on the campus. Many children are on the grounds before some of the teachers and leave much later.

My Classroom: My class is housed in a separate complex from the school in a "permanent portable" prefabricated structure. The room is fairly crowded with old-fashioned, universal desks, where the seat comes attached. The room has two large library/conference type tables in the back of the room. There is only one door which opens onto a hallway and one large tinted window that faces northwest. It does not allow much natural light into the room, nor does it provide much ventilation. There is also an air-conditioner that does not work very efficiently. The room goes between feeling stuffy and too warm to being too cold. The two chalkboards take up the majority of the west and east walls. We have an overhead projector, pull-down maps, one early-model Apple computer, and several bookshelves. The seating arrangements vary with need. Usually desks are placed in groups of four, for team work. However, during lesson presentation they face the front and then are moved into a team configuration for group work.

Geographic, Socioeconomic and Ethnicity Background: San Leandro is a bay side community of about 65,000 people that is becoming ever more multi-ethnic. It is located next to Oakland and the last few years has experienced an increase in gang problems and racial problems. The school is within walking distance of the marina where parks and a golf course are located.

A large percentage of the families whose children attend Garfield school are receiving welfare. Many of the children are from non-traditional family backgrounds (i.e. live with grandparents, single parent, or other arrangements). There are many industries and businesses located in the area. Many parents work in the surrounding area and are unskilled and skilled workers, rather than professionals. Garfield is a Chapter I school.

The Teacher: I have a Bachelor of Arts degree in Liberal Studies with an English option, which I received from California State, Hayward. My Multiple Subject Credential was also earned at California State Hayward in 1987. Before taking up this teaching career, I was a licensed vocational nurse and raised two children. Much of my experience and staff development has been in whole language techniques and cooperative learning. In addition, I have started and continued several school-wide enriching programs. One program is an Environmental Living Program, where children experience history by dressing and doing things from a particular era. At the most recent enrichment program, we experienced what it might have been like living during the late 1800's to the early 1900's, at the John Muir House in Martinez, California. In the last four years, I also started and maintained a Science Fair and a positive reinforcement discipline program called Gator Gotcha. I have been working at Garfield throughout my entire seven year teaching career.

As a teacher, I am concerned with helping children become independent learners, so that they will independently seek knowledge outside direct classroom influence. With this in mind, I felt that persistence was a lifelong, transferable key to being a successful life-long learner. I teach most subjects with confidence, but feel that my weakest area is math. Therefore, I choose to develop some better teaching techniques in math.

Methodology

In order to develop persistence in my students, I started out by simply telling them how important it was. I told them that I would encourage them to persist by observing, timing and grading their persistence. Their improvements would be rewarded. I told the class that I would be looking for ways to help them develop persistence and that it was the subject of my research project.

I was amazed that through my openness with students and including persistence in a grade, the students became more persistent, right from the start. Unfortunately, I did not document, in any formal way, students' levels of persistence at the beginning of this study. This would have made for an interesting comparison. Sharing the concept behind a grade had amazing effects on the students. I think we often hide ou reasons and purposes for doing activities from students, and they do work just because it is a "school" thing. After I learned how easy it was to motivate my students by explaining what was important, I began to show them grading rubrics and grading criteria for other subjects as well. (See appendix A for sample scoring rubrics.) I gave both parents and students copies of scoring rubrics and explained to them how I would be grading their work. With rubrics in their binders, students were often expected to grade their own papers before turning them into me. As a result of this method, more than once students asked if they could have more time to improve their work (i.e. persist). In addition, I hung a poster in my room with helpful hints for problem solving. I constantly referred the students to these problem solving strategies.

Although the entire class worked to increase their persistence, I chose to follow four students more closely and write case studies about them. Based on these cases, I believe that the outcome are reflective of the entire class. A more in depth study of these four students began with individual interviews. I taped these interviews. (See appendix B for a copy of these interview questions.) From these interviews I wanted to see if there was a pattern between the family relations or home activities and the children who persisted.

In addition, I video taped several lessons in order to observe my teaching and the children's work on particular lessons. One lesson I video taped came near the end of the study. The lesson involved a completely new concept, where students had to tell a partner how to draw a particular shape on a grid, without looking at each other. First, they had to write down directions for how to draw their particular shape. Then they gave the directions to their partner to try to draw. Each student had a different shape. My purpose in introducing this new concept was to see if students would persist in solving a problem that had a high frustration level. The video tape shows varying amounts of success and even though the students had great difficulty and frustration with this activity, that they indeed did persist.

There are several other lessons that I used to have students practice persistence. One problem that I included in this study, and that I refer to often, is the *Vending Machine*. (See appendix C for a sample of the Vending *Machine* problem.) In this problem, students were asked to show all of the different ways they could pay for a snack that they purchased from a vending machine. The machine only takes nickels, dimes, and quarters. After working on this problem, students completed a questionnaire titled, *Student Checklist About Problem Solving,* which asked them to rate how they felt about their problem solving skills after working on the *Vending Machine* task. Near the end of the study, students also filled out an attitude survey title, *Problem Solving Inventory.* This survey asked them whether they agreed or disagreed with a series of statements about their own problem solving. (See appendix D for copies of the attitude survey and the student questionnaire.)

Analysis

The *Problem Solving Inventory* was analyzed first by adding up students' responses for all 26 questions. This score gave me a way to see students' attitudes about whether or not they were successful problem solvers. Then, I compared my case studies to the average score for the class.

Next, I noticed that the attitude survey contained questions which could be subdivided into different categories. The different categories I came up with were students' attitudes about problem solving, their efficacy, persistence, lack of strategies, and use of multiple problem solving strategies. Then, I analyzed each student's scores for each of these categories and compared the students chosen for the case studies to the class average. (See appendix C for a summary of these results.)

The Students

Alicia:

It was important to choose students to follow as case studies who had varying academic abilities. This would allow me to see if my teaching methods could work for most students. The first student I choose was Alicia. She had average skills in all areas and since the beginning of the school year displayed some degree of persistence. I felt that she would be very open to developing even more in this area. This sense that she persisted and was capable in problem solving was also confirmed by her score on the *Problem Solving Inventory* . This showed that her **attitude** about problem solving and persistence was the highest in the class with a score of 27, compared to the class average of 22.9. Alicia is a very polite, honest nine year old, whose family came from Romania in 1986. She was the fourth daughter in a family of five children.

During the initial teacher-student interview Alicia seemed relaxed and responsive to the questions. Her family did many things together and most of their outside activities centered around church and family happenings such as attending recitals. Her family also played some games together. At home her favorite thing to do was to ride her bike and to play pretend games. Her mother worked part-time outside the home and the father was regularly employed. Alicia felt comfortable asking her family to help her with her homework, but she mostly asked an older sister for help.

Alicia feels she has persistence, but will eventually give up if, "I try a lot and it still doesn't work." She feels she gives up in math, because it's sometimes too hard. Math is her hardest subject and she perceives that her grades aren't good. My perception of her math skills is that she is quite successful. In fact, I made her co-banker in the class, because at the beginning of the year she tested high in her knowledge of addition, multiplication and subtraction facts. At first she does struggle with new concepts, but with practice Alicia retains the knowledge well.

In the *Vending Machine* problem, Alicia choose to draw pictures of the possible coin combinations and to use words to record her thinking. Even though many students in the class used a chart to record different combinations of coins, she felt more comfortable drawing pictures. In previous problems that were similar, I showed the class a way of recording their facts using a chart. In the survey that followed the *Vending Machine* problem, Alicia's responses were all very positive. For question ten on the survey, she responded that she felt certain she had persisted in trying to solve this problem.

Both the video and the audio tapes show Alicia working very diligently and attacking problems without delay. Furthermore, when students were given permission to share what they had done with others, she was willing to share and also to accept ideas from the others in her team. This was apparent in her classroom performance and was noted on one of the videos. In an interview, Alicia shared that she knew she had improved her problem solving skills throughout the year. She felt that it was important to be able to persevere, because it would help her with any problem that happened in her life. When Alicia took the *Problem Solving Inventory* questionnaire she received a total score of 109, while the class averaged 100.8. This indicates that overall she is an above average problem-solver. A breakdown of this score shows that she was above the class average in her ability to predict a solution or to make a plan, she learned from past experiences and scored higher than the class average on her self esteem about solving problems. She was slightly below the class average in her use of multiple strategies. (See appendix D for a table.)

It is my judgment that she improved in both problem solving and in persistence. I also feel she would have been more successful if she had used some of the suggestions (i.e. the chart) that we had practiced this year. She seemed to persist in her old ways of attacking the problem, which gave her fewer solutions in a multiple answer problem. This is further supported by her self report on her use of multiple strategies on the *Problem Solving Inventory*. Alicia scored 13 points in her use of multiple strategies when solving a problem, which is below the class mean of 15.2.

This specific study looked at of improving students' persistence. Alicia did so and she felt proud. The major evidence that I have for her improvement in her persistence was observing how frequently she had given up on open-ended problems at the beginning of the year. She would turn in her paper quickly, after finding one or two solutions, or often asked for my help by saying, "I don't get it," or "I already found two ways. Are there any more?" At the end of the study, Alicia asked for help less often and found it challenging to keep working to see if she could find different solutions on her own. In the *Problem Solving Inventory*, given at the end of the study, Alicia strongly agreed that she had improved in her problem solving.

Edmund

I chose to follow Edmund closely, because he did not seem to persevere in many paper and pencil type activities and always seemed willing to let other team members come up with solutions without much input from him. Edmund was polite and cheerful, and did not appear to have any glaring learning or emotional problems. Of all the case study subjects, he was the most deficient in his persistence at the beginning of the study. The main evidence I have for this was my observations of his performance during class.

I was not too sure of his family structure and life style, as I had not had much contact with his parents. Most notes sent home, including report cards, were delayed in being answered and his parents did not show up for school activities or conferences.

During the initial student-teacher interview, Edmund was a little shy and uncomfortable. The answers that he gave were not elaborate. He stated that his mom worked full time in a bank and that his dad fixed cars in a shop at home in their garage. In the evening, they were all home doing various activities. He enjoys playing Nintendo and riding his bike. He says he feels happy being home and did not elude to any ill feelings. Because his parents sometimes work on the weekend, they don't go on many family outings and do not play together. He did say that for being student of the week, his dad gave him a dollar. He also claimed that they would pay him if he improved his grades. He feels that in some things he has persistence, but not in math. He doesn't know why he gives up.

My perception is that Edmund is a kinesthetic learner and does persist when manipulating real objects, rather than abstract paper-pencil type activities. Earlier in the year during a unit on electricity, he persisted in making a toilet paper tube flashlight and took delight in helping others that were not as successful. He mentions this in the interview and wished that we could do more of this type of activity.

In the *Vending Machine* problem, he chose to draw pictures of the different combinations of coins, which is further evidence of his need for manipulating objects when thinking. He came up with six different solutions. When asked to write about his thinking, he kept it very brief. In the video and audio tapes, Edmund spends some of the time being distracted by the activities in the classroom. He checks what other students are doing, he watches the person filming the video, and only works in short spurts. Edmund does have trouble getting his ideas down on paper and his spelling and other writing skills are poor. Even when encouraged to write things with the best spelling he knows, he still has a difficult time. One video shows Edmund able to verbalize his instructions to his partner, although he was not very successful in writing them down as he was instructed. When Tim, his partner said, "Oh, why didn't you write down what you said," Edmund decides to try again (i.e. persist). This was an interesting clue about what motivates some students and validates the reasons for collaborative learning groups.

In the survey following the *Vending Machine* problem, Edmund feels positive about the experience and feels that he persisted in solving the problem. He is unsure that his answer is correct, but feels good about his effort. My perception is that he indeed has improved his persistence, however not to the extent of some of his classmates. For example, at the beginning of the year Edmund would delay starting an open-ended problem. I would have to remind him that there were several different ways to find an answer and to start by first reading the problem. He never wanted to try on his own, rather he wanted to work with someone else on the problem. When I allowed him to work with a partner or a team, he seldom came up with any of the solutions and let others do most of the work. In the self esteem category of questions from the *Problem Solving Inventory*, Edmund had a score of 11 which shows that he is below the class average of 13.5 in self-esteem.

At the end of the study Edmund was working on problems independently for a greater amount of time and had a greater desire to try to solve them on his own. On the Student *Checklist About Problem Solving*, following the *Vending Machine* problem, his response to question 11 was that he would still want to find the answer out for himself even if someone else figures out the problem before him. This shows a definite increased desire to try things on his own. When faced with a completely unfamiliar problem, as in the *Draw a Shape* problem referred to with Tim above, he still had greater difficulty getting started on his own, but when given encouragement or ideas on how to start thinking about the problem, he was more willing to try again on his own. It is apparent that Edmund has improved in his persistence and that his knowledge of the importance of persistence will go far in helping him improve at a faster rate than he did before. I also feel that although his family is caring and happy, they do not do much to work directly with Edmund to improve his skills. With his increased persistence a little work at home could make a big difference.

Tim

I chose to follow Tim, because I knew some things about his family and wondered about the importance of a students' family background on persistence. His parents were frequently involved in school activities and Tim's work. I felt that he was a hard working student, but not gifted. He already persevered in most tasks, but found math, especially problem solving, more difficult than other subjects. I was hoping to increase his persistence in problem solving and give him more confidence in Math.

During the initial student-teacher interview, Tim was relaxed and answered the questions with ease and with elaboration. Many of his family's activities centered around their house boat at Don Pedro Dam. During spring and summer, they went to the lake every other weekend. While at the lake, he was allowed to go off exploring on his own and the family played games in the evening. The family did many things together and Tim felt free to ask his parents for help with his school work. He felt that he asked his mother for help more than his father. Both of his parents are employed full time in professional jobs. Both parents have also been active in school activities and attended all conferences and special programs. They communicated on a regular basis with me and responded to all my communications. They report working with Tim, side by side, on difficult homework projects and assignments.

In the *Vending Machine* problem, Tim chose the chart method to keep track of his information. In the video tape of this activity you can see that he took time to draw his graph very carefully, before even starting to work on the problem. At first this may seem like an unnecessary waste of time, but for Tim it may have been a thought gathering time. When asked about using this chart method, he simply said that he wanted it to be neat. Tim found seven different combinations and was precise in the description of his thinking. From the *Student Checklist About Problem Solving*,, most of Tim's answers a 'strongly agree' except when asked if he would like to work on the problem more. Some responses that he agreed with were, that he felt better about his problem solving ability, and that he persisted in solving the problem. When I questioned him about not wanting to work on the problem more, he simply said that the time we spent was more than enough (We had spent around two and a half hours from presentation to closure.)

My perception is that there was definite growth in Tim's progress toward greater persistence. Previously in math, he waited until I helped him, before attempting different ways to figure out a problem. He often asked if he could take problems home so his parents would help him. After I explained how important persistence was and that I would be watching and grading the classes' growth in persistence, Tim became willing to struggle with the problems before asking for help. Based on the last interview and his progress during the last report card period, I found Tim more able to risk persisting on his own. In addition, I discovered that, in most cases, Tim could figure out problems by himself. This success, according to him, was a good feeling.

Stacey

Stacey was already a good student and comes from a large family who has a history of good academic performance at Garfield. Before this study and the resulting lessons in the value of persistence, Stacey often looked for confirmation from her fellow team members before trusting her own judgment. This showed a lack of self-confidence, even though it was evident that she was very able to succeed. Many students displayed this tendency. I suspected that it resulted from our school's emphasis on cooperative learning over the last five to seven years. Without discounting the value of collaborative learning, I decided for the purpose of this study, that their should be an emphasis be on individual work first, before collaboration. I chose to follow Stacey to see if she could persist in problem solving and become more self-reliant.

In the *Vending Machine* problem, Stacey used the chart method to keep track of her facts. She came up with ten different ways, which was good compared with the class average of six. In the *Student Checklist About Problem Solving*, following this problem, Stacey felt she wanted more time to work on the problem. When I asked her about this, she felt that there might be some hidden trick and she might be the one to discover it. However, after the collaborative closure part of the lesson, she felt that she indeed had done a good job of discovering all possible ways.

While watching the video of the drawing lesson, Stacey's partner found a mistake in the order of the directions that Stacey had written. After pointing this out, Stacey immediately sought to correct her mistake. She has a great desire to please and wants very much to be correct.

During the first interview, Stacey was relaxed and responsive to the questions. She was happy in her family and liked going on family outings on their boat. However, the outings were often with older siblings and did not include her parents because of their job demands. Stacey talked about trying to get up on water skis, and how she hasn't succeeded yet. She explained how she was afraid to try, because her brothers and sisters might tease her. The person she asks for help most of the time is a sister-in-law who lives with the family. The reason Stacey likes to ask her, is that she is very encouraging and always patient and kind. It seems that family teasing hurts Stacey and makes her unsure of herself. Her family is Samoan and they work hard to preserve some customs of their country. All of the children know how to make leis and have visited Samoa, from time to time, to celebrate family occasions.

In addition, Stacey's family has responded to all necessary information and school communications. They came to parent-teacher conferences and open houses. However, they do not involve themselves beyond those activities. With a large family, the parents have had to divide their time with their other children's activities. The parents seem to have a good handle on organizing their large extended family. Throughout the year, Stacey's assignments have always been completed on time and done neatly.

By the end of this study, Stacey was confidently working on her own and found it less frustrating when answers did not come immediately. She felt positive about her progress in persistence, but she still had difficulty feeling sure about the correctness of her answers. Stacey needs a lot of affirmation to trust her very capable self. Throughout the year, I gave Stacey additional responsibilities to try to send her the message that I trusted her and knew that I could depend on her to follow through and do the job well. I made certain to praise her when she took risks to try things that were difficult, without first checking to see if others agreed with her.

Other Interesting Findings and Conclusion

For the sake of consistency, I chose these particular children to study because I was sure that they had "traditional" intact families. I also wanted to find out if there were patterns in the family's interaction, that contributed to each students' persistence. Of the four children, Tim's family seemed to give the most one-on-one, direct parent help with homework projects. Comparing the work he did at the beginning of the year, it was apparent that his growth was the greatest of all the students by the end of the year.

At times I was concerned that his family helped him too much, thus causing him to have difficulty in starting a problem due to his fear of not being correct. I communicated this concern during a conference with his parents and they seemed to adjust their help. Tim also became less concerned about taking work home so that his parents could help, and he became less fearful of making mistakes.

With Stacey and Alicia, most of their help came from older siblings. However, both these girls are second youngest in very large extended families. One can understand why the parents have delegated the task of helping with homework. In contrast to Tim, who is the oldest child of two, Stacey and Alicia also made excellent progress, but the quality and the jump in their skills was to a lesser degree than Tim's.

Lastly, Edmund's growth was evident too, but most of his guidance came from what we did in the classroom plus what little work he did on his own at home. While being supportive and valuing education, his parents did not work with Edmund directly on his homework. The interview revealed that Edmund, being the oldest child, had no older siblings to turn to for help. Often his homework was incomplete or never turned in.

I also noticed similar patterns with the other children in the class. It seemed the more involved a parent was in directly helping their child on a one-to-one, head-to-head pattern, the more the student developed during the year. Furthermore, I can begin to see that these parents may need to be less involved as they help their children learn organizational habits that will make future assignments easier.

The knowledge I gained from this study will help me share with parents what they can do, to better help their children with homework. Some of these ideas include: being in the same room when your child does their homework; reading the assignments so that you are aware of what your student is studying; reviewing your child's homework before returning it to the teacher; beginning by finding something to praise your child about on the work they did; praising them on trying to work through the assignment on their own, without easily giving up; then, giving a suggestion or two about how they could improve the assignment; asking your child questions about their assignments; showing interest in their work, by asking to see what they are doing; finding ways to extend and support what your child is currently learning in school, by planning family outings and starting conversations.

In conclusion, this action research was challenging to me. It gave me new insight as to what motivated my students to work toward greater persistence. I am certain that most of the students will continue to develop persistence, now that they have become aware of its importance.

In summary, the things that I used to help motivate my students' to increase their persistence included:

1. Simply explaining the importance of persistence.
2. Making them accountable for improving their own persistence by including persistence in their individual grades.
3. Modifying my approach to cooperative learning, so that students worked individually first, before collaborating with their team mates.
4. Making students aware of the grading rubric, so that they had an idea of how to improve their math.
5. Helping students to self-evaluate, by reflecting on their progress through self-report surveys and using the scoring rubric for self evaluation.

The above changes in my teaching, helped students want to persist on their own. Another benefit of the students' increased persistence was that it made my job easier. I found students improved their work, before they even turned in for me to look at. Students began to critique their own papers and to raise their standard of performance, without me needing to tell each child individually or have them do their work over. They volunteered to redo the work, before I even saw it, which was a new behavior for them.

References

While not directly referred to in the write up of this report, these documents provided information relevant to my research.

Office of Educational Research and Improvement U.S. Department of Education, Hard Work and High Expectations: Motivating Students To Learn. April 1992.

Mc Daniel, T. R. The Ten Commandments of Motivation pg. 127 of The Ohio State University at Newark Education Academic Challenge Program Conference Proceedings, Perrysville, Ohio, May 4 - 5, 1990.

Kraus, W. H. "Don't Give Up" The Mathematics Teacher

Grubb, J. Using Computer Environmental Simulations to Enhance Student Decision-Making (Problem Solving Inventory). The Ohio Sate University at Newark Education Academic Challenge Program Conference Proceedings, May 29 -30, 1992, Perrysville, Ohio. pg 105.

Problem Solving Inventory Continued

Circle the number which best represents the extent of your agreement.	Strongly AGREE					Strongly DISAGREE
12. I have the ability to solve most problems even though initially no solution seems to be immediately apparent.	1	2	3	4	5	6
13. When trying to think of ways to handle a problem, I do not try to combine different ideas together.	1	2.	3	4	5	6
14. When I become aware of a problem, one of the first things that I do is to try to find out exactly what the problem is.	1	2	3	4	5	6
15. I judge the usefulness of each alternative solution that I consider for a problem before generating any new alternative solutions.	1	2	3	4	5	6
16. When confronted with a complex problem, I do not bother to develop a strategy for searching out information relevant to defining the problem.	1	2	3	4	5	6
17. I try to predict the overall result of carrying out any particular course of action.	1	2	3	4	5	6
18. I am usually able to think up creative and effective alternatives to solve a given problem.	1	2	3	4	5	6
19. After making a decision, the outcome that I expected usually matches the actual outcome.	1	2	3	4	5	6
20. When confronted with a problem, I do not usually examine what sort of external things in my environment may be contributing to my problem.	1	2	3	4	5	6
21. When confronted with a problem, I tend to do the first thing that I can think of to solve it.	1	2	3	4	5	6
22. When a solution to a problem was unsuccessful, I do not bother to examine why that solution didn't work.	1	2	3	4	5	6
23. When making a desision, I weigh the consequences of each alternative and compare them against each other.	1	2	3	4	5	6
24. When confronted with a problem, I routinely examine my feelings to help assess what might be happening within that problem situation.	1	2	3	4	5	6
25. In trying to solve a problem, one strategy that I often use is to think of past problems that were similar.	1	2	3	4	5	6
26. After I have tried to solve a problem by implementing a course of action, I take time to compare the actual outcome with what I thought should have occurred.	1	2	3	4	5	6

Appendix D: Problem Solving Inventory

This is NOT a test. There are NO right NOR wrong answers. These questions are designed to find out how you normally react to problems and events in your daily routines. Please respond to the items as honestly as you can; we are interested in an accurate portrayal of how you handle problems. Ask yourself: *Do I ever behave this way?* Your responses will, of course, be kept confidential; the information gathered is for program evaluation uses only. Your willingness to take the time to respond honestly and carefully to this inventory is very much appreciated.

DIRECTIONS: Read each of the 26 statements carefully. Indicate the extent to which you agree OR disagree with each statement by using the following alternatives:

1 = Strongly AGREE 2 = Moderately AGREE 3 = Slightly AGREE

4 = Slightly DISAGREE 5 = Moderately DISAGREE 6 = Strongly DISAGREE

Circle the number which best represents the extent of your agreement.	Strongly AGREE					Strongly DISAGREE
1. When confronted with a problem, I generate possible alternatives until I am unable to come up with any more ideas.	1	2	3	4	5	6
2. Sometimes I do not stop to examine a problem; instead I muddle ahead, acting out of habit and/or custom.	1	2	3	4	5	6
3. I generally select the first good alternative that comes to mind.	1	2	3	4	5	6
4. When making a decision among alternatives, I do not take time to consider the chances of each alternative being successful.	1	2	3	4	5	6
5. When confronted with a problem, one of the first things that I do is survey the situation and consider all the relevant facts.	1	2	3	4	5	6
6. When confronted with a problem, I stop and think about it before deciding on the next step to take.	1	2	3	4	5	6
7. After a problem has been solved, I do not bother to analyze the positive and negative aspects of the solution.	1	2	3	4	5	6
8. When I attempt to think of possible solutions to a problem, I do not think of very many alternatives.	1	2	3	4	5	6
9. I make snap judgments and later regret having made them.	1	2	3	4	5	6
10. When confronted with a problem, I do not try to change vague or unfamiliar terms and ideas into more concrete or recognizable terms and ideas.	1	2	3	4	5	6
11. I have a systematic method for comparing alternatives and making subsequent decisions.	1	2	3	4	5	6

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Student Checklist About Problem Solving

STUDENT CHECKLIST ABOUT PROBLEM SOLVING

Directions: Circle the most correct. Number 1 is strongly agree, and number 5 is strongly disagree.

1. I had enough time to work on this problem. 1 2 3 4 5

2. I would like to work on the problem some more. 1 2 3 4 5

3. I am better at problem solving than earlier this year. 1 2 3 4 5

4. After working on this problem, I feel: 

5. If I shared my work on this problem with someone who likes me this is how I'd feel:

6. I feel these kinds of problems are important to try. 1 2 3 4 5

7. I tried the following strategies: graph/chart, pictures, look for a pattern, write down the facts, try and check, other

8. If you checked other in question 7, what was the other strategy that you used?

9. I feel sure that I have the correct answer. 1 2 3 4 5

10. I feel that I persisted in trying to solve this problem. 1 2 3 4 5

11. If someone else figures out the problem before me, I still want to find the answer out myself. 1 2 3 4 5

Appendix C: The Vending Machine Problem

Sample Open-Ended Mathematics Task
Grade 4

The Vending Machine

Maria wants to buy a 75-cent snack from a vending machine. The machine takes only nickels, dimes, and quarters. Maria has 7 nickels, 5 dimes, and 2 quarters.

Part 1
Show all of the different ways she could pay for the snack. You may use words, diagrams, or charts.

Part 2
Which of your ways uses the fewest number of coins? Explain why this is true.

Part 3
Write about your thinking and how you solved your problem.

Appendix B: Student Interview Questions

SURVEY QUESTIONS FOR PERSISTENCE STUDY 3/28/94 - Interview

First Engage the student in some informal conversation before starting with the questions to make her/him feel more natural.

1. If you were given the whole afternoon to do anything that you wanted to, what would it be?

2. There might be some questions that you will need to ask to help draw the student out regarding question #1 such as:
   - What else would you consider?
   - How would you feel while doing ______?

3. Could you describe a typical weekday evening at your home?
   - Who is there, What are you doing, What are others doing, Describe how you are feeling.

4. What comes to mind when you think about a typical weekend at your home? Could you describe a typical weekend?

5. Could you describe a vacation time with your family?

6. When you get stuck on your homework, who would you usually ask for help?

7. Tell me about a time when things were really difficult for you?

8. Questions that relate to #7:
   •What did you do? •How successful do you feel you were at solving this problem? •How do you think ______ felt? •How do you feel when you think about this problem?

9. What is your favorite thing to do with you family? •With your friends?

Question Frame for talking with a student about a specific problem that they have already worked on.

1. Do you remember working on this problem?

2. Can you tell me about what you did and thought as you worked this?

3. Did you get stuck at all?

4. Did you try any different ways to solve it before you arrived at your answer?

5. Do you feel your answer is correct? Why/Why not?

6. What makes you want to stick to this problem to try to figure it out? Or What would help you to stick to this kind of problem to help to figure it out? Or If student didn't persist with the problem solving ask; What caused you to give up on the problem? What do you think would help to make you try a little longer next time?

Appendix A: Math Scoring Rubric

CLAS GRADING RUBRIC MATHEMATICS

6- shows in-depth accurate thinking. Meets and often exceeds expectations, they are always correct and complete, and use appropriate representations (like words, diagrams, graphs, pictures etc.). Generalizations and connections are supported by precise logical arguments using different approaches and appropriate mathematical tools and techniques. They can explain how they solved the problem in a clear step by step fashion.

5-same as above except that there are some minor flaws.

4-shows good mathematical thinking and understanding of age appropriate math concepts. They use representations (words, diagrams, graphs, pictures) although some may have a few minor mistakes. Student work shows appropriate use of mathematical tools and techniques.

3-shows partial mathematical thinking and understanding of mathematical ideas. Some responses are correct; however, gaps in understanding are evident and representations (words, diagrams, graphs, pictures) need development. There is an acceptable use of tools and techniques.

2-shows limited mathematical thinking and understanding of mathematical ideas. While some answers are correct, student work often fall short of providing workable solutions. Tools and Techniques are rarely used or are used incorrectly.

1-shows little or no mathematical thinking and understanding of mathematical ideas. Responses show little or no progress toward accomplishing mathematical tasks. There is little correct or correct use of tools, techniques or representations.

Summary Tables

Self Report Scores from the Problem Solving Inventory

Student Name (Class mean score)	Sum Score (100.8)	Attitude about *PS (22.9)	Efficacy toward PS (15.5)	Perceived Persistence (15.4)
Alicia	109	27	7	15
Edmund	91	22	3	15
Stacey	109	22	4	19
Tim	111	24	5	12

*PS = Problem Solving

Self Report Scores from the Problem Solving Inventory

Name (mean)	Lack of PS Strategies (14.7)	Uses Multiple PS Strategies (15.2)	Predict, Plan, PS Approach (35.8)	Uses Past PS Learning (9.2)
Alicia	14	13	41	12
Ed	13	9	37	12
Stacey	18	14	39	10
Tim	20	16	39	9

*PS = Problem Solving

Self Report Scores from the Problem Solving Inventory

Name (mean)	Makes a PS Plan (21.6)	Identifies the Problem (10.6)	Checks Answer After (16.3)	Self Esteem About PS (13.5)
Alicia	21	8	19	15
Ed	20	12	15	11
Stacey	23	13	18	13
Tim	23	12	15	13

*PS = Problem Solving

C.A.T.S. 1st
Curiosity And Teaching Science to 1st graders

Stacy Beagle-Thornburg
Castlemont School
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Abstract

I began my research project with the goal finding ways to develop greater curiosity in my first grade students. From my investigations, I found that I needed to change the way I questioned my students. I learned that to promote curiosity, I had to come up with more open-ended questions. Coming up with them wasn't easy. I tried to tie together good questioning techniques and daily science lessons to get the final desired product, a curious student. In my research, I drew up class surveys, had daily questioning sessions where either myself or other students asked questions, and I wrote down observations of progress we made. For example, we took a common item in the classroom and asked questions to it. We tried to go one step further every time. Ultimately, I found that my goal was to find ways to change my own questioning techniques and to give students the tools to become more aware of their own surroundings and to ask more questions about their surroundings. From my research I also came to suspect that the lack of or the abundance of rich "life experiences" played a major role in the fundamentals of my students having a curious mind.

The Origin of the Problem, Problem Statement and Research Questions

"Science is more than a body of knowledge; its a way of looking at the world and ordering one's experience." states an article in *EDTALK* titled, *Why is science a unique, valuable, and potentially exciting area of education.* The article goes on to say, "The study of science presents an incomparable opportunity to open young minds to new vistas and to equip them with intellectual tools that will guide learners for the rest of their lives." In choosing my topic for this action research study, I thought deeply about what I was not seeing in my classroom, both in this year and in previous years. My students seemed to lack the drive to find out more about almost any given topic. They took too much for granted and always seemed to go along with whatever I said. I wondered how does one equip a child with the tools to be curious learner? Is curiosity taught or genetically determined in each individual? Is a persons environment a catalyst or a cause of low or high curiosity? What is the connection between how a child reacts to a science related activity and their life experiences, i.e. museum trips, airport visitation, libraries, zoos, plays, and outdoor exploration?

Because students in my first grade class at Castlemont School appear to have limited curiosity in the area of science, I was interested in finding the answers to some of these questions. One of my theories is that limited curiosity is a result of the lack of life experiences. I have observed that some children's lives seem relatively void of experiences. This is especially noticeable when compared to children who come from an environment that is rich in experiences or from families with a scientific background. For example, I found that children who were taken places such as the library, a museum, or theatrical plays, had a certain quality of wonderment about them. They often drew from these experiences to make connections or a hypothesis about a topic that I or another student brought up. From my observations, the student who lacked the background knowledge or "wonderment" seemed to fall short when attempting to make connection between one thing and another. I want **all** students in my classroom to have an awareness, to observe things around them, and to be able to communicate their findings to others. To test the theory that providing rich experiences could encourage curiosity, I planned to ask more in depth science questions and surround my students with interesting science topics that they would want to know more about. I wanted to try to increase the degree of rich "life-experiences" at school. Would students become more curious as a result of my questioning techniques? I set out on a journey to find out.

School Context and Background Information

Built nearly three decades ago Castlemont School will be celebrating its thirtieth year in October of 1994. One of eight elementary and three middle schools in the district, Castlemont is located on the San Jose/Campbell boarder and serves both of these communities. Castlemont is a kindergarten through forth grade school. The 1993-94 enrollment neared the 790 mark. In 1992-1993 the breakdown of student ethnicity was as follows: 68% Caucasian, 22% Hispanic, 5% Asian, 4% Black and 1% other. At the beginning of the 1993-1994 school year, Castlemont adopted Life Lab as its science curriculum.

This year, science was one of our main school focuses. I teach first grade along with 6 other first grade teachers; two of the teachers share a contract and another is a bilingual teacher who is teaching a kindergarten through second grade program this year.

I will begin my fourth year of teaching in September of 1994. In 1990, I graduated from Fresno State University and then continued my education in the Fresno State credential program. Upon finishing, I was hired by the Campbell Union School District in August of 1991. My strength in teaching is in the language arts area. I have had a lot of inservice in this area and feel very comfortable teaching it. Science education is an area that I am currently working on, so that it will ultimately be as strong as my ability to teach language arts. Science is a very fascinating field. I have thoroughly enjoy learning more about how to teach it in the classroom.

I have 30 students who come from very different backgrounds. Roughly half of my students come from a two-parent family, some of which both parents work outside the home. The other half of the children live with a single parent who works outside of the home. Families where both parents work usually are not able to volunteer in my classroom. Families where one parent is at home during the school day usually volunteer in the classroom at least 3 hours a week.

When walking into my classroom, one would find a cooperative learning environment with the desks situated facing each other in groups of six students. I generally have an open door policy on any topic that is brought up or taught in class. For example, if a child wants to know about something like why there is shade in front of our classroom door in the afternoon, I would take time right then to explain the movement of the sun as the day progresses. In addition, I might possibly have the students conduct a week long experiment and graph or log on where the sun appears to be at different times during the day. This approach has worked wonderfully once the class ground rules and discipline are in place and students know how to discuss a topic without interruption or turning the discussion onto an unrelated topic.

Methodology

An article in ED TALK titled, *What roles do questioning, discussion, and reflection play in learning science?*, describes that a question raised either by the teacher or a student can set learning into motion, can set the tone for class conduct, and can drive experimentation. This is essentially what took place in my classroom. Because I observed that children can have different levels of curiosity, I wanted to put into motion a "curiosity provoking" classroom. First, I began by asking students open-ended questions daily. Sometimes intentional questioning occurred once a day or five times a day, depending upon the interest level of the class. Once I began asking questions that either paralleled the day's science activity or were independent of the topic, the students picked up on this and began their own quest for asking questions. They asked questions either to me or to other classmates. For instance, if I were teaching about how plants "drink" water, I might pose a question in the morning to stir their thinking such as, "How do plants eat?" After asking the morning's question, I would take down the students' thoughts and proceed with the day's science lesson.

The following description is a written account of the questions posed to the class by myself or ones that came up through the curiosity of a student. I was beginning a science unit at the onset of this action research project and felt that this would be the opportune time to begin my probing of students' curious minds. I started a unit about living things by asking the class what they thought a living thing was. They were to discuss this idea with their cooperative group members for 30 seconds. I then asked for raised hands to give examples of living things. The responses ranged from trees (which I found out later was a hard concept for 6 year olds to grasp that a tree actually lived) to dinosaurs. The question arose, from one of my most mature students, that if a dinosaur was a living thing that breathed and ate like humans, then are humans living things? This was the beginning of my quest to see what I could do in the classroom setting to get more of my students to ask curious questions like that one.

After the discussion on living things and what characteristics a living thing possesses, I had 10 groups of 3 children get together with a piece of paper folded 3 times the long ways. The paper was to begin with the first person in the group drawing the head of a living thing in the top rectangular box. The second person drew a body, and the third the legs. Each participant could not look at the proceeding drawings, they could only see what they themselves were drawing. When the picture was completed, the group leader brought it up to me and we opened them up in front of the class for all to see what "living thing" was drawn.

During the lesson I observed that some of the children were not used to sharing their work with others. They were even less comfortable having other children drawing on it! Another observation was that some children seemed unaware that plants, trees and flowers are also living things. The entire class drew people, insects, or animals. I learned as a result of this lesson that the children were very motivated to learn about living things and what classified something as a living thing.

After we focused on asking questions in class and practiced this skill, I began to see an improvement in the children's questioning techniques. The next activity that I introduced to the class was a written activity titled, "Mr. Grizzly, I have a question" (see appendix A for a sample of this lesson). In this lesson, the children were to use their newly acquired questioning skills to ask our living thing for the day a list of questions. This was the first activity of its kind. I could see that there was a distinct difference between the students who asked higher-order questions and those who didn't. According to Bloom's Taxonomy, a higher-order question would be a question that involved interpretation or seeing a relationship between two things. For example, "Mr. Grizzly why do you have more fur in the winter?" can be compared to a lower-order memory/ recall question like, "What's your name?" I was unsure shy some students asked higher-order questions and others didn't. I began to think it was possibly related to their maturity level. However, I began to see an apparent pattern being set. I observed that most of my students wanted to learn more about bears and checked out more book about bears from the library. They loved to compare different kinds of bears. This showed me that their curiosity was being stirred and they wanted to know more. The few children that did not seem any more interested seemed to be the same children that were hard to get interested in any questioning activities.

The next group of activities were simply question-asking sessions brought on by me or a student. First, I asked students in the room to pick out something that wasn't living, and to imagine what if would be like if it were. If it were living and if it could talk, what would you ask it? One student asked the phone on the wall, "Why do you ring at all of the important in class times like tests, roll call, and lesson time?" Another student asked, "Who is on the other end of the line when it rings?"

The next daily question I asked was, "How does the weather change from season to season?" This was a treat for me, because for a long time I thought I knew, however I had always given the wrong answer. When I asked the students, one stated that, "the sun gets more fire in it, the sun's rays bounce off of the moon and back down to earth." Another thought that, "The sun rotates around the earth and when it's close it's summer and it's far away when it's winter." Yet another decided that, "there's a lot of electricity up in the sky and the sun gets hotter from the electricity in the summer." And finally one student said, "it snows a lot in the winter that is what makes it cold." After completing of this session, I noticed that the children who normally sat and seemed not to care, were actually beginning to show signs of involvement. These students were listening to the students who were talking and some were actually agreeing with some of the "answers" given.

After this action research project had been going on for a few months, the children could begin to see that asking questions about something could stir up a little fun. They knew more than likely that we would perform an experiment when ever a question about something was brought up. They loved this. In March, on St. Patrick's Day, someone gave me a carnation with green-tipped petals. It sat on the table for three days before anyone even noticed that this was and unusual flower color. Finally, one student asked me how the petals turned green. That night I went to the grocery store and bought celery, clear plastic cups, and blue food coloring. The next day each of us we wrote down what we thought was going to happen when the celery when it was placed in the blue water. The responses ranged from "it'll get peanut butter in the middle" to "I think the blue coloring will have an effect on it." We put the celery in the cup with a solution of blue food coloring and water and watched it for 2 days. On the 3rd day, the children were so excited to see that the celery turned blue at the top. This was just like the carnation because of the way water travels through a plant. This was a spur-of-the-moment experiment based on one child's question. The children loved it. They were bursting with anticipation in the morning to see what happened over night. Was this the curiosity that I hoped I had sparked?

My final curiosity quest was to see how the children would respond to a survey about caterpillars. The survey set out to find if the students in my class enjoyed the month long unit on insects. A couple of highlights of the unit were, watching caterpillars transform into butterflies and digging up dirt to see what kind of critters lived there. Did the students have their interest or curiosity sparked by my questioning techniques? Did they still want to know more? Is their interest still sparked and do they want to continue to know more about insects? To find some answers to these questions, I gave an attitude survey at the end of an insect unit in May. (See appendix B for a sample of this attitude survey.)

Analysis, Findings and Implications

I have found the term curiosity to be difficult to define and difficult to collect tangible data on. How can you measure which students have it and how their curiosity changes? Once I realized what could be useful as data I was on my way to recording very interesting conversations, spur-of-the-moment questions or phrases from discussions in my classroom. No one, not even I, could have predetermined, prepared and then presented to the class the inquisitive and well thought out questions that we came up with on-the-spot.

The data that was collected was very beneficial. I obtained written accounts of class discussions that began with either a teacher-appointed question or a student's observation followed by a student's question. I asked questions of the class to see what level of curiosity I might get. This ranged from children looking out the window, and others having their hands up, but when called upon saying, "I forgot," to those who you could really see the wheels turning in their heads. This group of children were really thinking, pondering the ideas, and then raising their hand with either a better question pertaining to mine or an idea of why they thought what they thought.

After talking to and observing some of the parent volunteers in my class I found just how significant of a role they could play in the life of a student. For example, if a parent is interested in what their child or any child is learning, particularly in the area of science, it seems as though the child is more excited about the topic. Perhaps this is because the parent has taken an active role in helping the child at home with projects or discussing the science topic with their child. In this way, the parents make science topics into a family project rather than always separating home and school.

Finally, the success of my educational research was that I learned to encourage students' curiosity. The children picked up very quickly on my questioning and every day they went one step further with their responses or their own questioning. I also found that when learning science and acquiring the habits of curiosity, students need to run experiments, sort items, observe and collect evidence. An *EDTALK* article titled, *Why is science a unique, valuable, and potentially exciting area of education?*, explains that children need to develop their own hypotheses by debating, following hunches and asking even more questions. By looking at my teaching and working to promote curiosity, I feel that I built a class environment in which students asked fundamental questions to be investigated. If a student wanted to know more about something, the environment that I built allowed them to do follow-up investigating. They could do this by looking in books, doing an experiment, or opening up the ideas to other children which ultimately opened the door to more curious questioning sessions.

I set forth on this classroom research because I felt that the children in my class had a very limited curiosity level. I ultimately wanted to find out why this was and what I could do with my classes to remedy this problem, a problem that I find a shame in education today. Although I did not come to any entirely obvious or thoroughly substantiated conclusions from this study, I feel that I started these children on the road to great thinking and questioning. Children's minds seem to be fed information and they just absorb it without asking questions of how, and why. Although I began this research in January, half way through the school year, I could see a definite difference between the initiative my students took in asking questions from January to the end of the school year. The children at the beginning of the year seemed comfortable having their thinking done for them. The opposite was true for most students at the end of the year. They had begun to question and think for themselves. I think as educators and parents we do a lot of assuming. We assume that children are born natural thinkers, natural observers, and natural scientists. I have found for children that many of these aspects need to be taught and then worked on daily. Not only did this daily work on questioning help my students, but I also learned an extensive amount from my research and findings. I found that for some students in my classroom, the more questions I asked to foster curiosity, the more I learned that a child's previous life experiences or lack of them contributed to their ability to really want to find out more about the topic at hand. To support the proceeding statement, I found that a girl in my class whose father is a scientist and whose mother stays home with her two younger siblings, came to school everyday with a mind open to science. She was the first one to ask a question, to be involved in discussions and to write interesting accounts of what she thought might happen "if..." She was the first one to want to build a homemade kite for kite flying day. She was the one who over the weekend would build houses for a pet mouse and bring them to school for show-and-tell. I compare her to another individual in my class who does not have these experiences. This child often sat in front of the television from the time he came home from school until bedtime. Rather than actively doing, images were continuously fed into his head with little room for thought or question. This is the student in my class, who never wanted to respond to questions such as, "How did the flower petal turn green?" Its not that he doesn't want to answer the question, it is that he doesn't have the tools, past experiences, or thought processes to help him through the question and the "let's find out" stage that is so exciting.

Future Actions and Further Questions

Now that I believe that students who come from a life that is rich in experiences and their experiences can positively effect their curiosity, I would change my teaching techniques. This is what I would do for the low children to boost their curiosity levels. I found that involving children in decision making and planning science experiment helps to heighten their curiosity and causes them to want to know more. If students help make a list of what we need for an experiment or even decide where to display their work, this can contribute a great deal to their interest. When the children help, they feel that they are an important part of a process. They are more involved and more excited, which leads to greater curious. Another thing that contributes to successful science activities is to send a newsletters to all parents describing a forthcoming homework project and the items that the child may need for this experiment. In this way, the parent has ample time to prepare their child the experience and participate in what they are doing.

After spending a little less than a year doing this research project, I realize that I have only begun my quest for learning how to foster curiosity in my students. I realize that it takes a lot of training and I plan to keep up the work that I have started. I want to go forward with new ideas, test them out, and work to put them into place.

In my next year of teaching I would do some things differently. Now I am aware that children need to be stimulated in life by having rich experiences, before they bring those experiences back to the classroom to reflect on and retrieve answers from. Early next year I will make a point to interview the children in my class, to see what kinds of pre-first grade experiences they have had. I will try to find out what they are most interested in and build from there. I have also learned that because times change so fast, teachers have to be very flexible and change with the times. I have to continue to look for what drives children and use this information as a tool to teach all subjects areas, and especially science. If having a class garden stimulates my students, I certainly will use the garden to teach as many components of living things, water, soil and weather as I possible.

For additional research, it would be interesting to find out if there is a connection between all students who have rich life experiences and those who are very curious.

References

Bloom, Benjamin S. (Ed.). *Taxonomy of Educational Objectives Handbook I: Cognitive Domain*. New York: David McKay Company, 1956.

Kober, N. *EDTALK: What roles do questioning, discussion, and reflection play in learning science?* Washington, D.C.: Council for Educational Development and Research, 1993. 44.

Kober, N. *EDTALK: Why is science a unique, valuable, and potentially exciting area of education?* Washington, D.C.: Council for Educational Development and Research, 1993. 13.

Rutherford, F. J. *Science for all Americans*. New York: Oxford University Press, 1990.

Appendix A: Sample Student Lesson to Encourage Questioning Skills

Mr. Grizzly, I have
a question...
Why do you eat
fish in sted of tevse?
Why do you gro
fur in the witr?

Appendix B: Attitude Survey on Students' Interest in the Insect Unit

FIGURE 6.2

NAME ______ ROOM 19 TEACHER Thornburg

1. This is how I feel about caterpillars:

2. This is how I feel when I read about butterflies:

3. This is how I feel when I see a caterpillar

4. This is how I feel when I touch a caterpillar:

5. This is how I feel when I have a question about a caterpillar or butterfly:

FIGURE 6.3 *Reading attitude survey*

Hopkins, David. 1985

First Graders Become Scientists

Kathy Curran
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Abstract

In the past students in my class were 'pulled-out' fifty minutes a week for science. Due to our new adoption of Life Lab, I wanted to see if students could internalize the scientific processes of asking questions, collecting data, and making data based valid conclusions in my class. By increasing the frequency of science activities and working on these skills, we all became scientist. During this process, I monitored both the questions I asked and the ones my students asked. As a result I learned that my students didn't initially ask higher-order questions, but I found out they were capable of it. As my own questioning moved away from mastery questioning toward higher-order questioning, so did the student's. In addition, by the end of the year they learned the importance of validating their conclusions based on data. Amazingly these students gained a better understanding of the scientific process. They became SCIENTISTS!

Problem Statement and Origin of the Problem

In looking at my teaching style, my classroom make-up, and the new science curriculum, I felt I needed to revamp and up date my science program. I was not satisfied with the way my classroom science curriculum was developed. I wanted to bring more science teaching from me into the classroom. I also have noticed that the state frame work in math and science is moving towards having students create the learning environment, become accustomed to asking questions and become problem solvers. This philosophy is spreading across the curriculum; I wanted to try it out. Our school adopted Life Lab, a garden-based program, which is an innovative approach to science. The program includes a comprehensive Life, Earth, and Physical science curriculum, where learning is centered within the context of a school garden. This interested me, especially since I enjoy gardening. Now I found an avenue that interested me, but I wanted the students to become interested and active learners too. Furthermore, I wanted science to occur in the classroom and not solely in the Science Lab, where most of the science teaching had happening thus far. I thought that my science program could be enriched if I taught lessons that focused on the science processes of: asking questions, collecting data, and making data-based valid conclusions through the Life Lab program. I hoped by doing this that both my students and I would first expand our questioning skills and second develop an ability to validate our conclusions based on observations and data we collected.

Research question

If students engage in the processes of science more frequently, will this provide an avenue for students to improve their own asking of questions, collecting data and making data-based valid conclusions?

Background on myself

I am a graduate of St. Mary's College in Moraga, California, with a Liberal Arts Diversified B. A. and my Life Time California Elementary Credential. I've spent three years aiding in the Resource and Reading Specialist Department, seven years teaching third grade and eight years teaching first grade in the San Ramon Unified School District. Science is not a strong subject for me. Liberal art is my strength. This action research project was a challenge to my teaching style. Science seemed to be theoretical, threatening and difficult to teach to young children. Therefore, I left it mostly up to the science lab teacher and added a few supporting lessons of my own.

Background on the Class

All of the students in my self-contained first grade class became my research subjects. My class is one-third of the first grade population at Montevideo Elementary School in the San Ramon Unified School District, in California. The school is located in an upper middle-class socioeconomic suburb in the San Francisco Bay Area. My class consists of thirty students ranging in ages from six to seven years in age. There are thirteen females and seventeen males with a small diversity in cultural background; most are Caucasian. The class ranges in ability from G.A.T.E. students to those with learning processing difficulties. The majority are of average ability. The students' parents are from a diverse set of professions. In most homes, both parents work.

My class is set up in a horseshoe, open-desk formation. Math, literature, science, and free time activities occur on the outside of the horseshoe and an open discussion center is in the middle. In addition, for fifty minutes a week students go off to the Science Lab and do hands-on science with another credentialed specialist teacher.

Learning to Ask Different Kinds of Questions

I wanted my students to learn how to be scientists, so I considered what it means to be a scientist. Scientist ask questions, but my first graders didn't seem to ask questions. Therefore, first I needed to find out what type of questions I asked and the type of questions my students asked. I began to think of ways to classify our questions and to document what was said. The easiest way to document what they asked, I found was to write down the students' verbal questions when doing a science lesson. Later, I wrote down all of the students' answers to my questions.

To analyze these questions, I put the questions into categories. I came up with four categories (mastery, involvement, understanding and synthesis) based on four different questioning strategies. These different categorizing strategies were *Thinking Skills*, *Bloom's Taxonomy* , *Thoughtful Education* questioning and *Questioning Formats*. My main tool was the *Thoughtful Education* questioning groups. The following table shows the types of questions that are included in each of the four different groups.

Thoughtful Education Questioning Categories	
Mastery:	**Involvement:**
Who was the...? When was the...? What happened first, second...? Describe the facts... What were the steps...? What did you observe...?	What would you do? How would you feel? What else did you consider? How do you think ___ felt? What is your preference? Describe your feelings.
Synthesis:	**Understanding:**
Compare ___ to___. What are the similarities? What are the differences? Group the following... Summarize...	What if...? What comes to mind when...? How is ___ like ___? Imagine you are... What are the consequences?

Questions I Gathered

While I prefer the *Thoughtful Education* model, I have included the other models for comparison in the tables below. Following the description of each category, I wrote down the students' questions and separated them into each of the *Thoughtful Education* categories (Mastery, Involvement, Understanding, and Synthesis.) This data is listed below according to the date and the context of the lesson being done.

CATEGORY of QUESTIONS	QUESTIONING MODEL
MASTERY	
Thoughtful Education	Mastery
Blooms Taxonomy	Knowledge - Comprehension
Thinking Skills	Recall - Gathering Information
Questioning Format	Description

Students questions = S **Teachers questions = T**

February 4, 1994

Life Lab Activity - *Home hunt*: In this lesson, students look for animals' homes around the garden and school ground. They graph their results and try to discover similarities.

T: What questions can we ask from our chart and can we answer these?

S: Which home has the most pictures of animals?

S: How many animals are in the middle?

S: Which homes had the least pictures of animals?

S: How many animals are there?

S: How many homes did we find?

February 28, 1994

Life Lab Activity - *Munchtime*: Students collect small garden animals to see if the creatures eat leaves. If they do eat leaves, they look at what kind of holes they make in the leaves.

S: What does this animal eat?

March 1, 1994

Class Activity - *Bear Unit*: For about a month, students learned about many different kinds of bears that live in the North American continent. These questions were asked during one class discussion at the end of the unit.

S: Do the bears ever stop growing?

S: How long does a bear live?

S: How do bears eat?

S: How do bears kill their prey?

S: How do bears get their food?

S: How do bears make their dens?

March 2, 1994

Life Lab Activity - *Safe Colors*: Students use colored dots of paper as models for insects. They predicted which color will be the easiest and which will be the hardest to find after the colored dots were tossed out in the grass.

T: Thinking of our pretend bugs. Compare them to real bugs we caught in the Bug Hotel activity. How do the colors relate?

April 1, 1994

Life Lab Activity - *Outdoor Pets Plant Search*: This is a post assessment activity in which students transplant their "pet" plants into the garden and compare the way their pet plants look now with how they looked as new seedlings.

S: Which plants start from seeds, bulbs or slips?
S: What kind of seeds are there?
S: Are our seeds going to grow?
S: What are bulbs?
S: What are the names of South American plants?
S: How long do plants live?
S: How long will it take our plants to grow from seeds to plants?

May 1, 1994

Field trip to Lawrence Hall Of Science Berkeley: We went on a field trip to see an exhibit on dinosaurs.

S: How big is a real dinosaur egg?
S: Is it bigger than a football or a human?

May 22, 1994

Life Lab Activity - *Outdoor Pets in the Garden*: Students went out to the garden in search of animals that may live there.

T: What did you notice about your bean plant that is different from other plants?

CATEGORY of QUESTIONS	QUESTIONING MODEL
INVOLVEMENT	
Thoughtful Education	Involvement
Blooms Taxonomy	Application
Thinking skills	Organize
Questioning Format	Comparison

February 24, 1994

Life Lab Activity - *Home Hunt*: See description above.

S: Are the animals only insects?

S: Which animals are common and which animals are least common?

February 28, 1994

Life Lab Activity - *Munchtime*: See description above.

S: Does the bug eat leaves from bushes or lettuce?

April 10, 1994

Life Lab Activity - *Pet Plant Album*: Students observe, measure, and record changes in a seedling for one month.

T: Did your drawing prediction of your plant look similar to your actual plant?

S: Is there a comparison between the leaf count and the measurement of the plant.

S: What is new about the plant this week?

May 22, 1994

Life Lab Activity - *Outdoor Pets in the Garden*: See description above.

T: What have you done in your garden at home?

T: How are you going to know if the plants in our garden are the one's we planted?

T: Can anyone find a bean plant?

T: How has the bean plant changed?

T: What do we have to do to the radishes?

T: Do these plants look like bean plants?

T: How does the plant feel different?

T: How do you know the plant is a weed not a bean plant?

S: Can I take the weed home and put it in water to see if it will grow?

CATEGORY of QUESTIONS	QUESTIONING MODEL

UNDERSTANDING	
Thoughtful Education	Understanding
Blooms Taxonomy	Analysis
Thinking skills	Analyze -Brainstorming
Questioning	Analysis-Problem solving

February, 28 1994

Life Lab Activity - *Munchtime:* See description above.

S: Will the bugs eat our garden?

S: What will happen if the bug does not eat?

April 1, 1994

Life Lab Activity - *Outdoor Pets Plant Search*: See description above.

S: What kind of water do plants need?

S: How do they have seedlings?

S: How do plants grow?

S: How do plants pop out of their seeds?

April 10, 1994

Life Lab Activity - *Pet Plant Album*: See description above.

T: Why did the plants grow more leaves each week?

May 18, 1994

Life Lab Activity - *My Weather Report:* In this post assessment activity students record the weather and in personal weather reports they tell how the weather affects them and the garden.

T: How is the weather effecting the garden?

T: How does wind effect the garden?

T: How does the weather effect the plants after looking at our graphs over the past several months.

May 22, 1994

Life Lab Activity - *Outdoor Pets in the Garden*: See description above.

T: Why do we pull weeds?

CATEGORY of QUESTIONS	QUESTIONING MODEL
SYNTHESIS	
Thoughtful Education	Synthesis
Bloom's Taxonomy	Synthesis
Thinking skills	Hypothesis-integrated
Questioning Skills	Problem Solving-Fiction

February 28, 1994

Life Lab Activity - *Munchtime:* See description above.

S: What will happen if he does not eat?

March 2, 1994

Life Lab Activity - *Safe Colors*: See description above.

T: Thinking of our pretend bugs, how do they compare with real bugs we caught? What do you conclude? What can you find out from your chart?

T: If you were a bird what bug would you look for?

March 1, 1994

Class Activity - *Bear Unit:* See description above.

T: Does the location of the bear determine their food?

April 10, 1994

Life Lab Activity - *Pet Plant Album*: See description above.

T: Looking at the graph from week one and week two, what has happened?

T: Looking at the growth chart, what has happened?

T: What conclusion can you make about the plant's leaf growth and it's growth in height?

May 1, 1994

Field Trip to the Lawrence Hall of Science: See description above.

S: I wonder what it would be like to have long teeth like a saber tooth.

May 22, 1994

Life Lab Activity - *Outdoor Pet Plant Search*: See description above.

T: What do you think we need to do to our garden?

T: What are some of the characteristics of a bean plant?

T: Do we want those ladybugs to stay in our garden? Why?

T: How can you tell that after a flower a bean will come? Is there any evidence

T: Does this look like The plant's shadow?

After categorizing these questions, I found they could be analyzed more easily if I broke them into two major groups: lower-order and higher-order questions. The mastery group became lower-order, closed-ended questions. Involvement, understanding, and synthesis groups became higher-order, open-ended questions.

After looking at my data, I noticed that at the beginning of the research I was asking direct and specific questions. I found myself looking for a yes or no answer or a specific recall answer. These questions were basically mastery questions dealing with comprehension and knowledge, which is a lower order questioning skill. For example: "What bugs did you find? What was your bug doing?" This is a good process for testing students on specific information learned, but I was also interested in having my students acquire the knowledge on their own. I wanted them to come up with the question that lead to their acquired knowledge. Furthermore, I wanted my students to learn to become scientists and to go through the scientific process from beginning to end. To find a beginning I asked them what is a scientist? They stated that a scientist is a person that does experiments. Next I asked how does he or she do this? They replied, "Scientists ask questions?" Now we knew the first step. Then they said, "they collected information or data." This was to be step two. Then what do you do with the data that you collected? The students said, "the scientist then tries to answer his/her questions." This became step three. Now we knew as a class that we needed to ask questions, collect data, and then learn to make a valid conclusion from the data we had collected. This was a lot to ask from the class of first graders. We began looking at our scientific process step-by-step.

First, I looked at our questioning skills and decided that if I wanted my students to ask more questions, and higher order questions, I would need to change the format of my questioning. Typically, I asked mastery questions, therefore the students answered them in a mastery form. When I wanted my students to ask questions I would use the key phrase, "I want you to be scientists" and with this cue the students began to ask the questions.

At the beginning of my research, I noticed that I was asking mastery questions. As you can see from the table below, the students also asked mostly lower-order mastery questions. They seemed secure in asking these questions. Mastery questions seemed to come when the students were allowed to collect some data first, such as in the lessons: *Home Hunt, Safe Colors*, and the *Bear Unit*. (See appendix A for samples of these lessons).

I believed my students asked lower order questions because those were the types of questions they were accustomed to hearing from me. As time passed I began to change my questioning. I tried to get my students to ask questions by saying, "If you were a scientist what would you ask?" With practice, I began to ask more higher-order questions from the involvement, understanding and synthesis categories. These higher order open-ended questions were asked during the lessons: *My Weather Report*, the *Pet Plant Album* and the *Outdoor Pet Plant Search*. I accomplished this task by posting the three higher order thinking categories and their sample questions in the back of the room. When I was asking questions to my students, I could then glance at them to refresh my memory and to remind me to ask these higher order questions. This teacher modeling also opened up new horizons for the students' questioning skills. Consequently, the students' questioning skills began to change. In analyzing the questions in the different categories I found the following:

LOWER ORDER QUESTIONING (MASTERY)

Beginning of Research Feb. 24-94 to March 2-94	**End** of Research April 1-94 to May 22-94
Students asked: 65% (11 of 17 questions)	**Students** asked : 47% (9 of 19 questions)
Teacher asked: 33% (2 of 6 questions)	**Teacher** asked: 5% (1 of 22 questions)

HIGHER ORDER QUESTIONING (Involvement, Understanding, and Synthesis)

Beginning of Research Feb. 24-94 to March 2-94	**End** of Research April 1-94 to May 22-94
Students asked: 35% (6 of 17 questions)	**Students** asked: 53% (10 of 19 questions)
Teacher asked: 67% (4 of 6 questions)	**Teacher** asked : 95% (21 of 22 questions)

From the data above I noticed that the students began to ask higher order questions. Towards the end of the research there was an 18% shift to higher order questioning during the months of April and May. There was also a drastic shift in my questioning skills too. I had a 28% shift toward higher order questioning. I concluded that I consciously changed my questioning skills from a lower order to a higher order of thinking. I became very conscious of the questions I asked and tried to write down one or two open-ended questions when planning each lesson. I also referred to my chart in the back of the room as often as possible. I tried to let the students become the scientist and generate the questions themselves. There seemed to be a larger difference from beginning to end of the study on the teacher's part. Perhaps this is because an adult is more capable of thinking on a higher questioning level and I was consciously trying to change my questioning model. The students were unaware of the change, but they knew I wanted them to create questions similar to a scientist. The students are young but have now been exposed to higher-order questioning. Perhaps their change was smaller than the teacher's due to their ability and the short exposure to a different questioning style. I feel if a short period of time created an 18% growth in asking higher order questions, then a longer exposure could create a larger change. According to Piaget, as the child develops a higher level of thinking and reasoning, then their growth will be further enhanced by exposure. Another possible reason for this change in students' questioning was that, the students enjoyed the Life Lab garden activities and are by nature inquisitive. By doing more science in the classroom and the garden they began to see how exciting science is and that asking higher-order questions gave them more interesting data to use and ask questions about. They also learned not to be afraid to ask questions and that the teacher isn't the only one who can generate learning in the classroom. Students learned that from their questioning they could learn on their own.

Learning to Make Data-Based Valid Conclusions:

After doing more science, the students expanded their ability to ask questions. This was step one in becoming scientists. They gathered data for step two, and began to realize that just saying some thing wouldn't always prove their answer or validate their conclusions. Through experience of the teacher continually asking them, "How did you get your answer? Prove your answer to me. Show me how you acquired your answer?," the students realized that they could use their data to validate their conclusions. They learned that a picture told a thousand words, a photograph is better than a drawing, and a graph showed a picture, but a graph of the actual objects was even better. An example of this was in the *Safe Colors* activity from Life Lab. The students searched for different colored dots of paper as model insects, and predicted which color would be the easiest to find in a lawn. They collected their data and brought it back into the room. I asked them what they had learned or concluded from the lesson and how are you going to prove your ideas? The students decided that they were going to graph their results. I asked if this was the best way to validate their conclusions? The students stated that if they graphed the actual colored dots onto their graph, it would be more convincing. So, they did both types of graphs and proceeded to answer both their questions and my questions. (See appendix A and B for a sample of these lessons, questions and responses.)

Also in the *My Pet Plant Album* activity from Life Lab, the students kept a journal about the growth of their plants. They drew pictures of the plants and recorded the height and leaf growth. Along with their drawings they also graphed the plant's growth. This gave them information to refer back to when answering their own questions or questions I had posed.

Another activity which gave students practice in validating their information was *My Weather Report* from Life Lab. We kept a weather log each month and recorded the temperature, and the type of weather for each day. At the end of the month we graphed the different types of weather for the month. We did this for an entire four months. Then, we asked weather questions each day and each month. Once we started our plant study, we noticed that our weather study overlapped and had an important role in the garden. Students began to notice that the weather determined what needed to be done in the garden. This was determined by following the graphs they had made through-out the research project.

The students learned that a graph gave them information. They could physically visualize their data. They were also able to see that one research project could lend it's self to another. For example, they used the weather charts to look at the effects the weather had on the garden. They began to see that the conclusions in the weather unit helped them to prove the answers to questions about their garden. An example of this was when I asked, "How did the weather effect the plants for the month of April?" The students replied, "It's been sunny most of the month which helps the plants grow. Our plants are growing. It has been sunny according to the graph and we have had to water the garden." They began to see they had to be very observant and be able to communicate their observations. Writing answers at this stage was difficult because they were just learning how to write, but they could graph, draw pictures and verbalize their conclusions. This was a big step. Verbally formulating a question of higher order, collecting scientific data, and forming a valid conclusion was my priority as a first grade teacher. (See appendix B for more sample questions and responses.)

Conclusions

At the end of the research I gave the class a test to indicate whether they were able to draw valid conclusions based on data presented to them. The test went over information that we concluded from our garden observations of our bean plants growing and predictions about the plants and about the bugs in our *Safe Color* activity from Life Lab. The questions allowed me to verify if the students had acquired the knowledge of our plant unit and weather they were able to make valid conclusions from the data that was given. (See appendix C for a sample of the test.) The test contained six questions. One point was given for each correct answer, such that a perfect test would receive a score of six. The class mean score was 4.9 out of six questions, which indicates, that overall the class scored high both in knowledge and their ability to draw valid conclusions. There were four questions which tested for valid conclusions. The mean was 3.4, which indicates that overall the class understood the process of validating conclusions. The statistics for mastery of the knowledge included a total of three questions. The mean was 2.4, which also indicates that the students had a good grasp of the knowledge being presented. In looking at these statistics from this one test, I believe the students had a fairly good mastery of specific plant knowledge and a good handle on making valid conclusions.

In looking at the data collected in a short period of time from my students' questioning skills and from the test I gave them at the end of the year, I am in agreement with the idea stated in two articles from EDTALK. These two articles were titled, "What instructional methods support scientific thinking and problem solving?", from Instructional Methods and "Why is science a unique, valuable, and potentially exciting area of education? from Essential Science Learning. Like the authors of the articles, I began to see:

> "Science is more than a body of knowledge; it is a way of looking at the world and ordering one's experience. ... The type of problem solving recommended in research more closely parallels the processes and habits of mind that scientists use, including logical reasoning, questioning, analysis, and hypothesizing. This form of problem solving helps students gain a deeper understanding than simply memorizing science facts. Good science teaching, also encourages students to be curious, creative, open-minded, skeptical, and willing to collaborate with others. Developing the thinking process of the activity of finding out, is as important as knowing the answer."

I found out that my students were going about the tasks of observing, collecting evidence, describing, and sorting. The next step for them involved asking more questions, following hunches, developing hypotheses, debating, and defending their conclusions to others. By having my students pose questions this set learning in motion. From there the students took the questions home and looked through their research materials and some even used their computers to fine answers to bring back information to the class. They were setting their own learning in motion by working to ask higher-order questions, collecting data and validating their conclusions.

Implications for Teaching

From the data I have collected and how I saw my students grow, I am convinced that using higher-order, open-ended questioning will benefit my teaching. I saw my students take charge of their learning this year, especially compared to previous years where the science was basically taught in the science lab. The students were excited about learning and being the scientist. Science also became more enjoyable for me. I plan to continue this style of teaching next year beginning in September. I hope to see an even larger growth in the students science process skills. I also can see from the state frame work that this is the form of change that is being asked for. We are to encourage our students to ask questions, collect data and form and explain conclusions. Science is not the only area this is occurring. Math is also asking for a big change away from presenting formulas towards developing questions, finding different solutions and discussing them. I see that this method has worked for the short period of time I have used it and I feel I can continue to use it throughout the year in all subject areas. I am looking forward to a motivational year with the students creating the learning and me being the facilitator.

REFERENCES

Blosser, P. E., *How to Ask the Right Questions*, Washington, D.C.: National Science Teachers Association, 1991.

Freedman, R. L. H., *Open-Ended Questioning: A Handbook for Educators*, Menlo Park, CA: Addison-Wesley Publishing Co., 1994. pp. 12

Jaffe, R. (Curriculum Director) *Life Lab Science - Earth Is Home*, Developed by Life Lab Science Program, 1992.

Kober, N. *EDTALK: Why is science a unique, valuable, and potentially exciting area of education?* Washington, D.C.: Council for Educational Development and Research, 1993.

Kober, N. *EDTALK: What instructional methods support scientific thinking and pro'lem solving? Washington,* D.C.: Council for Educational Development and Research, 1993.

Appendix A: Science Lessons Used in This Study

Indoor and Outdoor

Time
40 minutes

Related Subjects
Social Studies
Language Arts

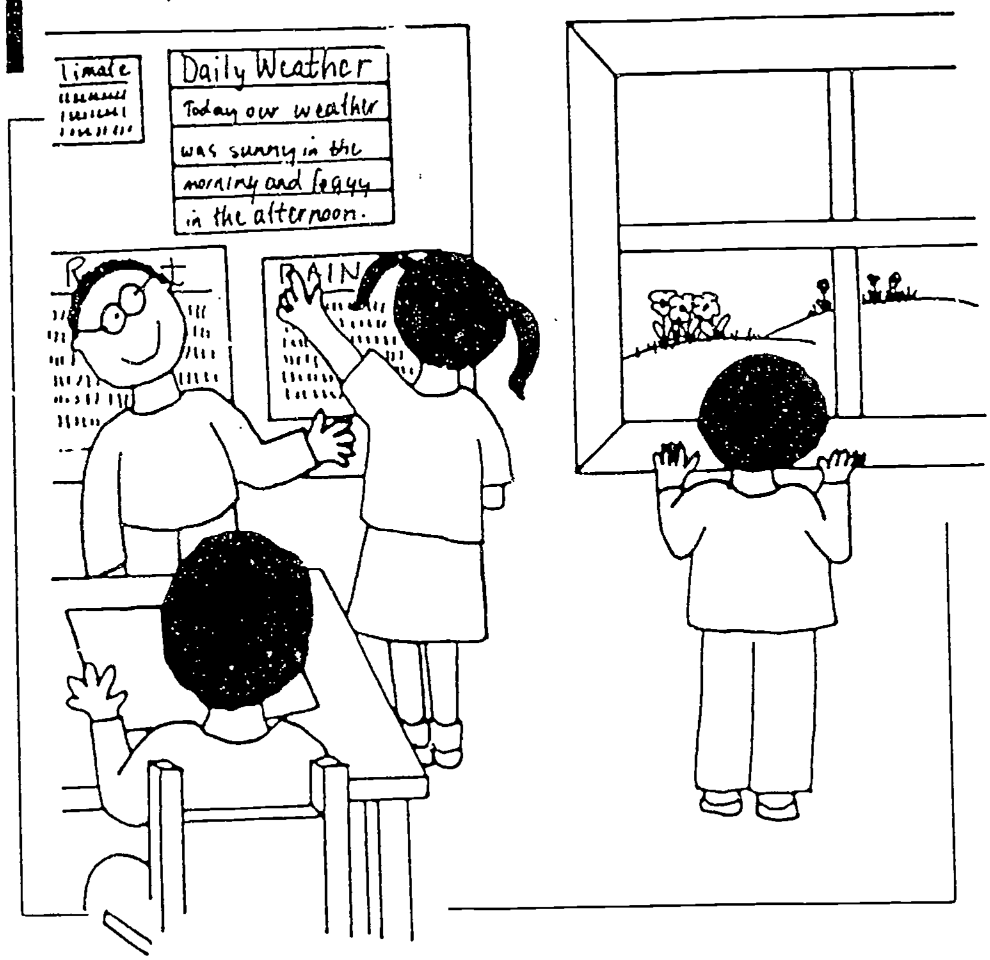
Process Skills
Applying
Communicating

Materials
For the Class:
- Little Book, *It's Saturday, HOORAY!*
- Weather Chart
- Temperature Chart

For Each Student:
- Lab Book, pp. 57–60
- crayons or markers
- pencil

My Weather Report

In this postassessment activity, students record the weather, and in personal weather reports, tell how it affects them.



Outcome

Students demonstrate their understanding of relationships among weather phenomena and between the weather and their activities.

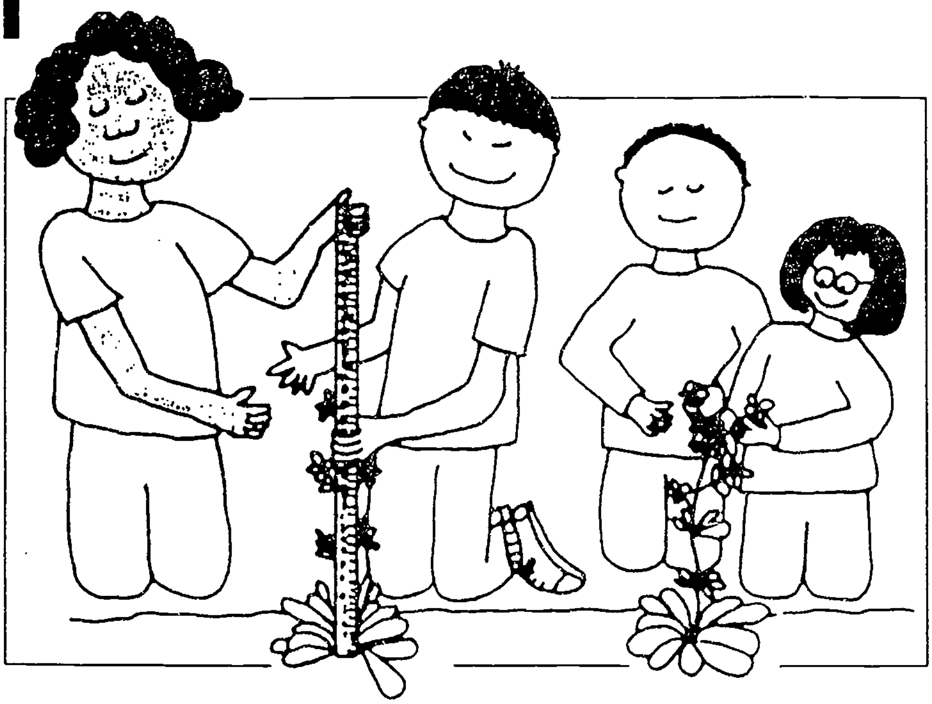
For the Teacher

In this activity, students communicate what they have learned in their study of weather by creating their own weather report. They record the day's weather as well as their own responses to it—what they wear outdoors and what they do during the day that depends on the weather. Students also predict tomorrow's weather. In doing so, they reflect on relationships among various elements in the weather.

This is a time when you can assess how well students are able to make connections between various weather phenomena and their activities. As students work on their books, you will want to circulate among them to observe their drawings and discuss their conclusions.

Pet Plant Album

Students observe, measure, and record changes in a seedling for one month.



Outcome

Students practice making predictions, taking measurements, and recording data.

For the Teacher

Consider the lilies of the field. They may appear to be basking idly in the sunshine, but in fact they do toil, right around the clock. Most plants do their growing at night, using food produced during the day. New growth may emerge from buds at the tip of the plant, from buds along the stem, or from lateral buds at or just below the soil surface. While some plants, such as bamboo, may grow as much as a foot in a single day, most plants grow so slowly that people go about their business without ever noticing. In fact, students may not realize that even most trees are getting bigger all the time.

This activity focuses attention on plant growth. Students record their predictions and data on pages in a Pet Plant Album. They use the album throughout the unit to compile, organize, and analyze information about their pet plant. In the last activity in the unit, students transplant their pet plants into the garden.

Indoor

Time
45 minutes, plus 30 minutes per week for the next 3 weeks

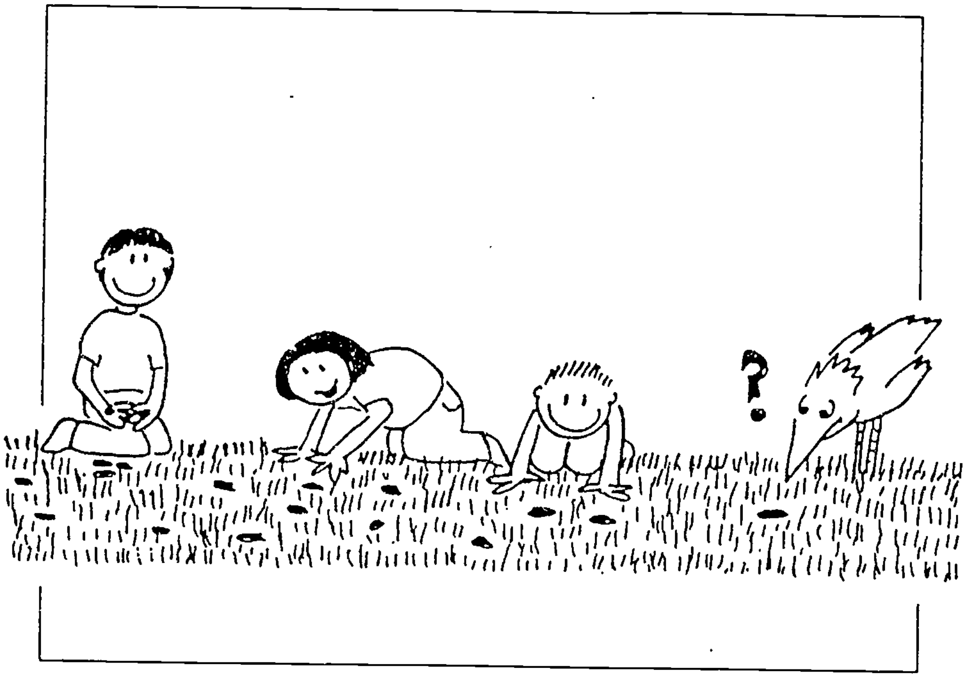
Related Subjects
Math
Language Arts

Process Skills
Measuring
Comparing

Materials
For Each Student:
- pet plant seedling
- Lab Book, pp. 65–68
- 4 8" x 1" strips of tagboard or construction paper
- paste
- unifix cubes (optional)

Safe Colors

Students use colored dots of paper as model insects, and predict which color will be the easiest and which will be the hardest to find in a lawn.



Outdoor

Time
40 minutes

Related Subject
Math

Process Skills
Observing
Modeling

Materials
For the Class:
- about 35 paper dots, in equal proportions of red, yellow, blue, and green
- clipboard
- 2 envelopes

For Each Student:
- Lab Book, p. 97

Outcome

Students show an understanding of how color can help to protect an animal.

For the Teacher

In this activity, students discover how color serves as camouflage. Many animals are camouflaged, since it is in the interests of both predator and prey not to be seen by the other. Adaptive coloration is an excellent example of evolution in action. Prey that is not camouflaged is easily found by predators and eaten. Prey that is hard to find survives and passes its characteristics on to its offspring.

Animals that do not taste good or that stink, sting, or otherwise protect themselves can afford to be a bright color. Sometimes animals that are edible or not dangerous mimic the appearance of these colorful animals. Hover flies, which don't have stingers, mimic stinging bees. Viceroy butterflies, which do not taste bad, resemble the bad-tasting monarchs.

Indoor and Outdoor

Time
Part 1: 30 minutes
Part 2: 15 minutes on two consecutive days

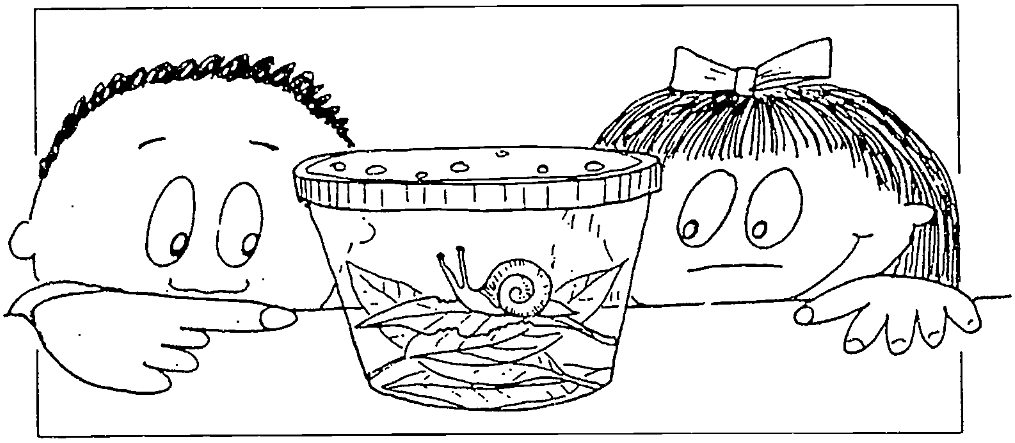
Process Skills
Observing
Comparing

Materials
For the Class:
- masking tape
- *The Very Hungry Caterpillar* by Eric Carle (optional)

For Each Group of 4:
- 1 pint-size clear plastic container with lid
- paper towels
- rubber band

Munchtime

Students collect small garden animals to see if the creatures eat leaves and, if so, what kind of holes they make in the leaves.



Outcome

Students compare patterns of holes made in leaves by different leaf eaters.

For the Teacher

Someone is chewing the leaves of your favorite garden plant. You search the immediate area for the culprit. Was it that snail under the plant, the caterpillar on the plant, the funny-looking bug with the shield on its back, or that bird hopping off to the next garden bed? Plant-eaters abound in the garden; home is where food needs are met.

In this activity, students collect garden invertebrates (animals without backbones) to see if and how they eat different types of leaves. Some of the leaf-eating invertebrates students may discover include: snails, slugs, all sorts of caterpillars, cucumber beetles, and grasshoppers. Most animals leave distinctive markings on leaves as they munch. Snails, for example, chew large, irregular openings from the outside edge of a leaf, while caterpillars make small holes in the middle. For pictures or detailed descriptions of these leaf-eaters, consult one of the identification guides listed in Recommended Literature, and *Gardening Know-How for the '90s*, pp. 96–97.

Students will not need to identify the invertebrates they collect. The aim of the activity is to observe what the animal eats in the garden and in the animal hotels. Remind students that the collecting containers are called *hotels* because they are temporary vessels rather than permanent homes. For information on how to care for small animals in captivity, see Animal Hunt in the Exploring Animal Life Unit, p. 204.

Outdoor

Time
Part 1: 35 minutes
Part 2: 25 minutes

Related Subject
Math

Process Skills
Observing
Comparing

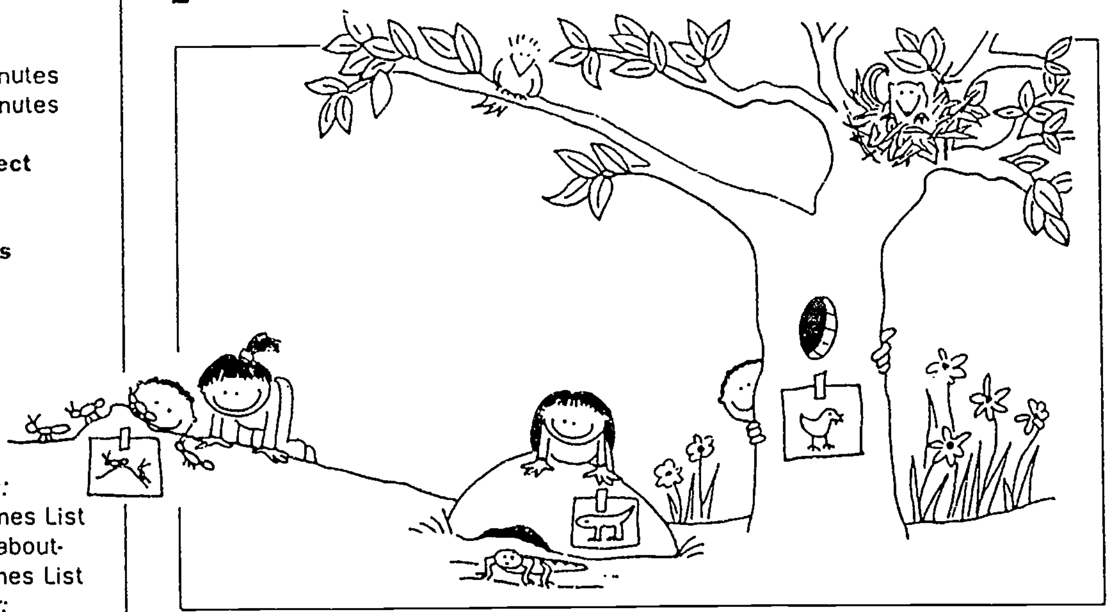
Materials
For the Class:
- Animal Homes List
- Questions-about-Animal-Homes List

For Each Pair:
- 2 4-inch squares of paper (with adhesive if possible)
- 1 lapboard or drawing surface
- 1 pencil
- 2 pieces of masking tape

For Each Student:
- Lab Book, pp. 91–94

Home Hunt

Students look for animal homes around the garden and school grounds to discover similarities and differences.



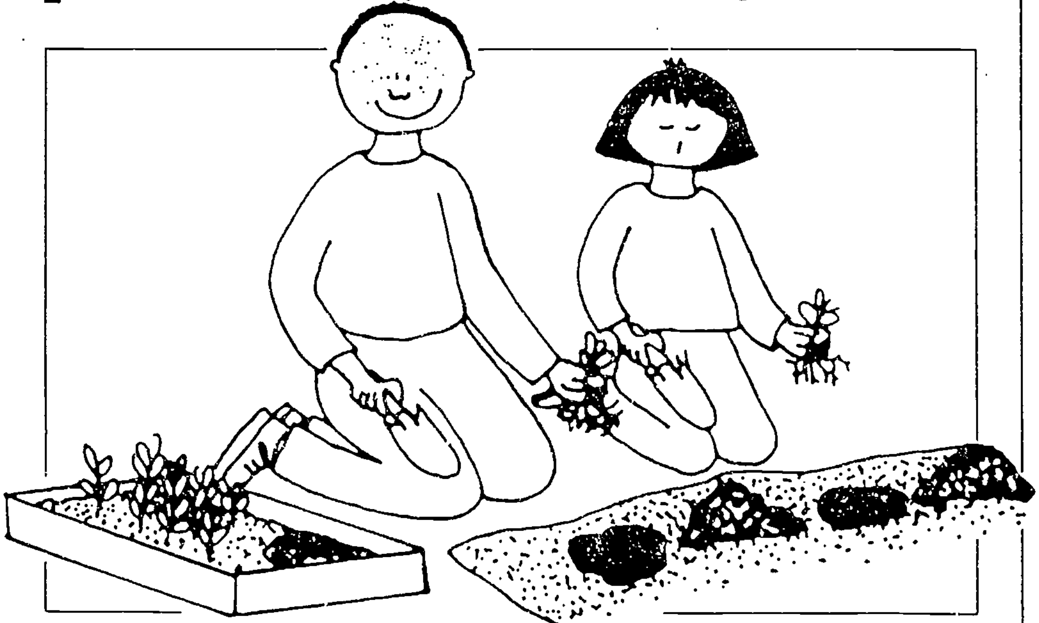
Outcome
Students compare and contrast different animal homes.

For the Teacher
In this activity a home is defined as any place an animal uses for shelter. There are basically two kinds of homes: those that are found and those that are constructed. Worms, gophers, moles, and some spiders construct tunnels in the soil. Squirrels, wood rats, mice, and birds make nests out of sticks and grasses. Other animals such as ground beetles, velvet spiders, pill bugs, and centipedes use rocks or logs as shelter. Aphids, caterpillars, and spittlebugs simply make their home wherever their food source is. Other animals, such as grasshoppers and butterflies, are so mobile that they never stay in one place long enough to have more than a temporary shelter.

As students locate various animal homes in the garden, they mark them with a picture so that others may also share in their discovery. The purpose of this activity is to allow students to observe possible animal homes (a pile of sticks, for example) and then explain their reasons for deciding that these sticks are home to an animal. (A beetle was seen in and around the pile of sticks.) In the process of sharing such discoveries, students communicate their understanding of what an animal's home environment is like.

Outdoor Pets

In this postassessment activity, students transplant their pet plants into the garden and compare the way their pet plants look now with how they looked as new seedlings.



Indoors and Outdoors

Time
60 minutes

Related Subjects
Art
Math

Process Skills
Comparing
Communicating

Materials
For Each Student:
- Pet Plant Album
- pet plant
- sheet of drawing paper
- crayons
- craft stick or label

For the Class:
- watering can
- 4 or more trowels
- Plants List from Life Lab Center
- extra seedling for each group

Outcome

Students compare ideas they had about plants at the beginning of the unit with new knowledge they now have about plants.

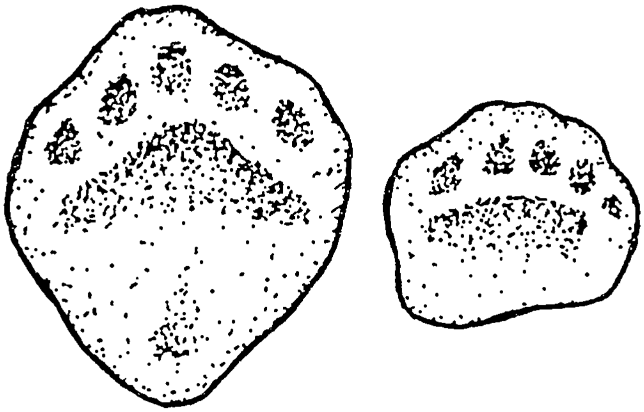
For the Teacher

In this unit, students have begun to explore the mystery and wonder of plants. They have gained an understanding of the features and characteristics common to all seed-bearing plants, as well as insight into the life cycle that has the potential to turn a single, tiny seedling into a forest. As students apply this knowledge to their observations of the world around them, they will continue to experience the amazement, joy, and wide-eyed wonder of discovery.

In this activity, students transplant seedlings—their pet plants—to the garden. As they do so, you have many opportunities to assess what they have learned about plants: particularly, the characteristics of a plant, the diversity of plants, and the life cycle of a plant. Before going to the garden, students review the predictions they made and the questions they asked at the beginning of the unit, and compare that information to what they now know. In the garden, they identify plants and plant parts and predict how various plants will grow. By listening to students' observations, you can evaluate how much they have gained through their investigation of plants.

Name_______________________________ *Science*

Bear Tracks

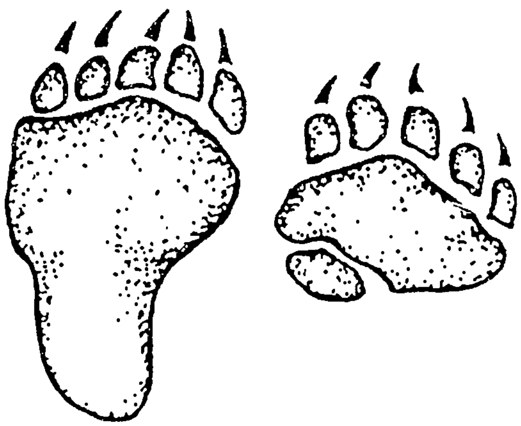


____

bear

____

bear



____

bear

grizzly black polar

Appendix B: Questions and Validating Conclusions

Below is the data on the conversations between the teacher and student as I was trying to get my students to validate their conclusions. The student responses have been paraphrased and are not word for word since I tried to make complete sentences out of some.

T = Teacher's questions S = Students' questions and responses

Life Lab Activity - *Safe Colors*:

T: What can you conclude or did you find from your chart?

S: Our chart shows we found more blue than other colors.

S: Yellow, and green were the hardest groups to find. They had the lowest number on our chart.

S: The reason is because the yellow and green bugs are camouflaged with the grass.

S: Red bugs were the second easiest to find because it was almost the brightest color.

T: If you were a bird what bug would you look for?

S: Blue bugs because it was the easiest.

T: Compare our pretend bugs to the real bugs we caught for our bug hotels. How do the colors relate?

S: The bugs were black and the color blue comes closest.

Life Lab Activity - *My pet plant album*:

T: Did your plant prediction from your drawing occur?

S: Yes it grew a stem and leaves.

T: Looking at your leaf graph from weeks one and two, what has happened?

S: The plant grew more leaves.

S: It grew two leaves in week one and then in week two it grew eight more; ten leaves in all.

T: Why did this happen?

S: It takes time for the seed to grow into the plant and get more leaves.

T: In measuring your plants; what has happened?

S: In week one the plant was tiny and in week two it grew bigger.

T: Is there a correlation between the number of leaves and the plant's measurement?

S: In week one the plant was small and had two leaves and in week two the plant grew bigger and had more leaves.

T: What conclusion can you make?

S: The older the plant gets the more leaves it gets.

S: The older the plant gets the taller it gets.

Life Lab - *My Weather Report*:

T: Can you make a statement from your weather charts (graphs) from January to May?

S: Most of the weather in February and March has been cloudy.

S: In all the months sunny weather was the most.

S: Snowy days are the least and that is because it doesn't snow in California much.

S: In March and April it rained so we might say rain comes in the spring time mostly.

S: Windy weather came in March to May.

T: How does the weather effect the plants for the month of April?

S: It's been sunny most of the month which helps the plants grow.

S: Our plants are growing.

S: It's been sunny and we've had to water the garden.

S: Because it's been raining and sunny it makes the ground not hard and our seeds can grow.

S: Our radishes and beans are coming up.

S: It's been sunny and rainy and it helps our plants grow.

T: How does the wind effect our garden?

S: The wind gives our garden air to breath.

S: The wind picks up the water which means we have to water each day.

Appendix C: End of the Year Test on Students' Ability to Use Data to Draw Conclusions

Statistics table: These statistics were generated using Data Desk™ to analyze the test results.

Summary statistics for **Sum** of all questions (six points total)

Mean 4.9

Numeric 28

Standard Deviation 0.98

Summary statistics for **Valid Conclusions** (four points total)

Mean 3.3

Numeric 28

Standard Deviation 0.75

Summary statistics for **Mastery** questions (three points total)

Mean 2.5

Numeric 28

Standard Deviation 0.69

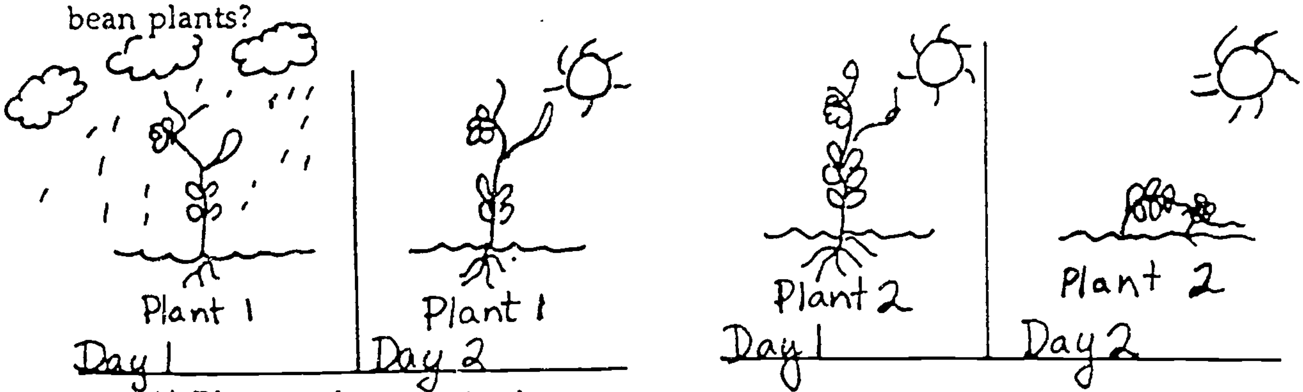
The statistics on this test were done on the total number of questions of which there were six.

The statistics for looking at student's abilities to draw valid conclusions based on data, were on a total of four questions: numbers 1, 3, 5, and 6.

The statistics for students' mastery of certain garden related concepts were based on a total of three questions: numbers 2, 4, and 5.

END OF THE YEAR RESEARCH TEST

1) Which sentence would best describe what effect the weather had on our bean plants?



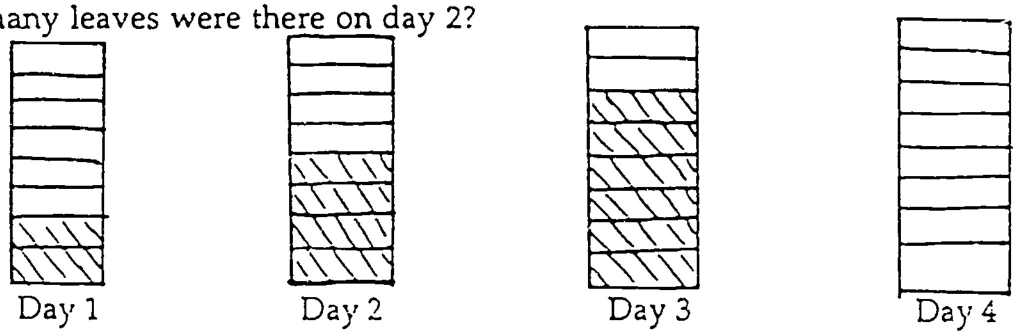
____ A) Plants only grow in the sun.

____ B) Plants only grow when it rains.

____ C) Plants grow when they have sun and water.

____ D) All the answers A, B, and C are correct.

2) How many leaves were there on day 2?

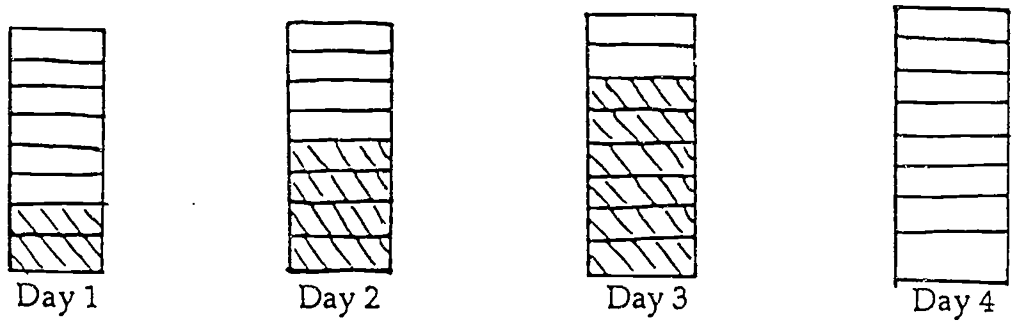


____ A) two leaves

____ B) four leaves

____ C) six leaves

____ D) eight leaves



3) Predict how many leaves will grow on day four?

____ A) two leaves

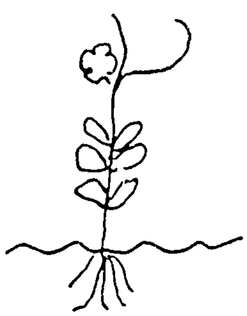
____ B) four leaves

____ C) six leaves

____ D) eight leaves

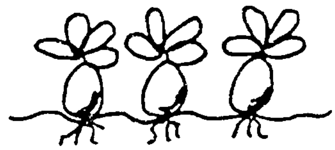
4) After the bean plant has a flower, what stage of the plant cycle will happen next? Draw it below.

plant 1



plant 2 (you draw)

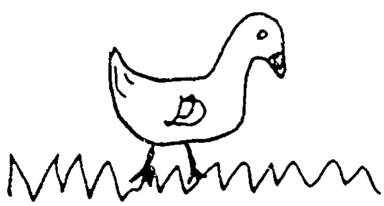
5) What's wrong with this picture?



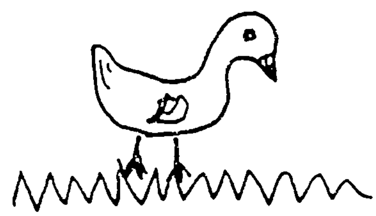
____ A) Radishes did not grow.

____ B) The radishes are not under the ground.

____ C) There is more than one radish per plant.



Bird A



Bird B

Draw green grass under both birds. Put seven black bugs in the grass under Bird A. Put four green and three yellow bugs in the grass under Bird B.

6) Which bird will eat the most bugs and why?

It's All in the Question
(Or is it?)

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Abstract

Science makes me sweat. I want it to be neatly packaged with a beginning and an end, and have an answer that children can take home. Often, I find that my science projects are none of these things. They can be noisy, messy, and inconclusive. Consequently, I am left feeling exhausted and unresolved about what science should look like in my classroom. I asked myself, "How can I structure science lessons so that children will learn? What ideas do children need to take with them from one lesson and from one year's curriculum?" Using these questions as a focal point for my Action Research report, and with the help of my fellow Far West researchers, I narrowed the scope of my project to examining my use of questioning techniques. I wanted to see if changing the way that I asked questions would lead to deeper thought on my students' part and more focused lessons on my part. I also wanted to see if the children could start using the types of questions that I used to help themselves probe more deeply into their own thought processes. Ultimately, would they be able to use questions to get themselves unstuck when faced with a tricky problem?

My study centered around the Thoughtful Education Task Rotation model for questioning. Before I built new lessons based on the Thoughtful Education system, I wanted to determine what kinds of questions I asked and my students' asked. This would allow me to make a comparison between the questions I asked initially to those I asked after using the Thoughtful Education model. I discovered that before using the Thoughtful Education model I asked questions from only two of the four quadrants, the Mastery (factual knowledge) quadrant and the Involvement (feeling) quadrant. The children also only asked questions from these two quadrants.

The end of the school year approached quickly and my investigation into the full application of the Thoughtful Education model was exciting but limited. From this research I learned that when I asked questions from the Understanding, Synthesis, or Application quadrants, students' hands and ideas were flying. After investigating the process of teaching science further, I am beginning to conclude that

the Thoughtful Education Task Rotation model may be too limited in its scope as an instructional tool, but it may be just dandy as an assessment tool.

McKinley Elementary School Profile

McKinley School is one of the oldest elementary schools in San Leandro, California, dating back to 1917. At present our enrollment is 353 students in grades kindergarten through fifth. We have two classes at each grade level plus a second/third grade split class. In addition to the 13 regular education classes, we also have a Resource Specialist Program, that serves students with learning disabilities, a Special Day Class serving students with severe disabilities, and an English Language Development Program assists students who have limited English and non-English proficiencies. Our S.P.I.C.E. (Special Program Classroom Environments) program ensures that children with severe handicaps are fully included in the regular classroom program. Our staff includes two physical education specialists, a vocal music teacher, a school psychologist, and a speech and language specialist.

Classroom teachers are supported by three instructional assistants, three Special Education assistants, and one assistant who provides services in our library. A secretary, full-time custodian and part-time night custodian complete the McKinley picture.

Student Profile based on 1992-1993 Statistics

American Indian/Alaskan	1%
Asian	10%
Pacific Islander	1%
Filipino	2%
Hispanic	20%
Black	16%
White	50%

Personal Profile

A minute can change a lifetime. My minute came 13 years ago during a conversation that I had with a colleague while I was working at the Women's Needs Center, a division of the Haight Ashbury Free Medical Clinic. She asked me about my plans for the future. I told her that I really wanted to be a teacher but with the closed job market I didn't see how I could manage. She informed me that her husband had just been hired by the Daly City School District and that the market was, in fact, opening up. I applied to San Francisco State's credential program the next day.

I have worked happily for the San Leandro School District for the past ten years. I have taught a third/fourth grade split, fourth and fifth grades, and am currently in my second year of teaching second grade. A three year tenure as "Teacher in Charge" allowed me to see many sides of different educational/classroom issues.

Questioning Techniques as a Focus

At the end of the 92-93 school year I was taking down a bulletin board in McKinley's front hallway when my former fifth grade students Steve, Ted, and Dan stopped by on their way home from middle school to tell me about their current experiences in eighth grade. After we exchanged news, I asked them what they remembered about the colonization of America, a unit that I had spent a great deal of time preparing and they had spent a great deal of time learning. They grinned, shuffled their feet, and muttered something about a video project that they had completed. When I pressed for further details, I discovered that they had retained very little information. I was dismayed by this interaction. Why was I teaching if my students weren't learning? What skills were they taking with them?

When Far West Laboratory invited McKinley, and 3 other school's staffs, to participate in a science based action research project during the 93-94 school year, I thought that it would be a way to look at my teaching practices. (Not only was I questioning my practices, I was also changing grade levels from fifth to second.)

After several meetings with the action research team, I decided to look at my questioning practices. To clarify why I chose questioning techniques as a central theme, I would like to introduce a portion of an article published in, *How to Ask the Right Question*, by Patricia Blosser. She states,

> "If you consider your major responsibility to be that of the transmission of a body of knowledge, one of your primary objectives is probably exposing your students to as much of the large amount of accumulated information of science as they can comprehend at their given level of intellectual development. Most of the questions you ask to determine how well you are achieving this objective are of the

closed question type and probably the majority of those questions stress cognitive-memory thinking."

She also states, "If you feel that one of your most important contributions to your students is providing them with the opportunity to learn to use process skills, to investigate and identify problems, and to develop methods for possible solutions, you will open up your questioning and give your students the opportunity to think." This statement indicates that questioning techniques have a major impact on meaningful learning which addresses my concern about what skills my students take with them at the end of the year.

To further focus my research, I revisited materials that I received in a Thoughtful Education course, taught by Dr. Harvey Silver. Thoughtful Education is a method of teaching that addresses different learning styles in order to reach all children. Although the philosophy of different learning styles is not new, the comprehensive methods that Thoughtful Education uses are unique and dynamic. Dr. Silver and his co-workers have devised methods of teaching that engage the children's thought processes. One of these methods is called 'task rotation', which is a system that takes a teaching unit and rotates it through Thoughtful Education's four quadrants of learning. This model relies on questions to build knowledge and seemed to be a good tool to both view and change my questioning techniques. (See Appendix A for an outline of the Thoughtful Education four quadrants of questioning.)

Problem Statement

Working with the action research team, I developed the following problem statement: I believe that students in my second grade are not grasping science concepts in part because I don't have a good understanding of how to ask effective science questions. The statement led to the following questions:

* How does student work change as my questioning changes?
* Will students be able to internalize the process of questioning and begin to use it as a part of their thinking process?

The Plan

My research plan was to:

* tape record a variety of lessons to get a sampling of the questions that I ask.
* tape record sharing time to get a sampling of questions that children ask.
* analyze the kinds of questions that the children and I were asking by identifying where the questions fit into the four quadrants of the Thoughtful Education model.
* see where gaps in questioning styles existed and build lessons to address these gaps.
* see if the children were able to start asking themselves meaningful questions in order to solve problems.

Taking this plan one step at a time, this is what happened:

I told the children that I would be looking at the questions that we asked each other. I explained that I was doing this so that I could be a better teacher and so that they could learn more. They accepted this and they even tried to help. One day Rudy asked a question during sharing. Aware that I was taping this session, Jocelyn bellowed across the room, "Did you get that Mrs. Skehan-Marshall, he said, 'Is that your favorite one?'"

Recording lessons:

Over the course of two months, I recorded the questions asked during three science lessons, one math lesson, one sharing session and two reading lessons. I did this using different methods including using a tape recorder, a volunteer recorder, and recording the questions myself. The tape recorder was annoying. I couldn't get the volume right, the tape broke, and it took a long time to listen and record the information. The children were aware that it was on and some were distracted. The volunteer recorder was great. She sat in the back of the room and quietly took notes. The problem was the availability of the volunteer. Getting her often enough and at the right times posed a problem. When I took notes, the children paid attention and we were able to stay focused. It did however, take away from the spontaneity of the lessons because I needed to stop and write.

Recording during sharing time:

When I began this project, it seemed the logical time to record questions that the children asked was during sharing time. For about ten minutes a day five or six children shared something they brought from home. Their classmates asked them questions about the objects. I found the questions were the same day after day: "Where did you get it?"; "When did you get it?"; "Who gave it to you?" and their very favorite question, "Is it your favorite one?"

Although I tried to get them to vary their questions by pointing out the repetitive nature, their questions remained the same. I think that this happened for two reasons:

1. They didn't have an alternative model for other possible questions.
2. Matthew gave me a clue about the reasons for the repetitive nature of sharing-time questions. He was standing in the front of the room facing his classmates during sharing. When Johnie asked him, "When did you get them?," he breathed a sigh of relief and answered, "Wednesday." He then muttered, "I knew that one." This told me that he needed to feel safe during sharing.

I believe all of the children felt the same way. They felt that they needed to be able to answer any question that came their way. With this unspoken agreement all of the children asked the same questions time and time again, knowing that when it was their turn to share they too would know the answer to the inevitable, "Is it your favorite one?"

Recording during reading and science times:

In order to get a sample of the types of questions that the children asked each other, I chose to observe their reading time. During one lesson the children first read a story. Then one child became a character from the story while other children in the group asked questions of the character. When they asked questions, I recorded them. This method worked well. I was able to get a good sampling of questions. I think that this method was successful for the following reasons:

1. The groups were smaller - 14 children, instead of 28.

2. The children weren't on the line to answer questions, a fictitious character was. The children weren't risking as much of themselves in the process and consequently were more open and creative.

During the three science lessons, I had a volunteer record the questions. This worked well because I was able to focus my full attention on the students and the lesson.

Analyzing Data

The next step in my research was to analyze the data that had been collected. First, I grouped the questions into the four Thoughtful Education quadrants: Mastery (rote memory/recall), Understanding (knowledge of how things work and knowledge of concept as a whole), Involvement (understanding from a personal point of view) and Synthesis (taking what is know and applying it to a new concept or situation). After grouping the questions, I calculated what percentage of the questions were asked by the teacher and students in each of the four quadrants.

Analysis of Questions

Question breakdown
Science questions asked by **teacher**:
(3 different lessons with a total of 49 questions)

Mastery (14 questions) =	29%
Understanding (25 questions) =	51%
Involvement (10 questions) =	20%
Synthesis (0 questions) =	0%

Question breakdown
Total questions asked by **students**
(7 different lessons with a total of 71 questions)

Mastery (23 questions) =	33%
Understanding (12 questions) =	17%
Involvement (36 questions) =	51%
Synthesis (0 questions) =	0%

I wanted to compare the types of questions that the students asked in different curriculum areas, so I broke the analysis down into categories by subject.

Science lessons: there were 3 different lessons
(**students** asked a total of 15 questions)

Mastery (7 questions) =	47%
Understanding (2 questions) =	13%
Involvement (6 questions) =	40%
Synthesis (0 questions) =	0%

Sharing lesson: there was one lesson
(**students** asked a total of 12 questions)

Mastery (6 questions) =	50%
Understanding (2 questions) =	17%
Involvement (4 questions) =	33%
Synthesis (0 questions) =	0%

Reading lesson: there were two lessons
(**students** asked a total of 44 questions)

Mastery (10 questions) =	23%
Understanding (8 questions) =	18%
Involvement (26 questions) =	59%
Synthesis (0 questions) =	0%

<u>When I looked at the data I realized several things:</u>

* Although the sample is small I believe it is reflective of my teaching and the students' questioning.
* I was under the impression that most of my questions were from the mastery quadrant because I believe that it is the easiest quadrant from which to generate questions. In fact, more that one half were from the understanding quadrant.

<u>Which leads to the following additional questions</u>:

* How much mastery type questioning is necessary, or useful when teaching science, before one moves to questions from the understanding quadrant? For example: Doesn't a child need to know what a flower is before s/he can compare it to a

carrot? Or, can a child learn what a flower is by comparing it to a carrot?

* Just because a question is in a particular quadrant it isn't necessarily a good question. Which leads to: How do you train yourself to ask consistently good spontaneous questions?
* By practicing planning good lessons, will you become better at asking good questions spontaneously?
* The quality of my questions was inconsistent. For example: During one science experiment I said to the class, "I wonder if the Kleenex will stay dry?" As I read that question I realized that the students probably don't care what I wonder.
* Is there a best sequence for science questions to be asked?
* What is the best way to have the children internalize questioning techniques so that they can make use of them when needed?

* There were no questions from the synthesis quadrant. I don't know the significance of this, however it was interesting to note. (It was especially surprising since I enjoy thinking in that quadrant when I do my own work.)
* Since I only recorded the questions asked and not the responses, I would not be able to analyze how the student's work was changing.

I thought that it would be interesting to compare the questions that the students asked to the questions that I asked. I discovered the following:

Involvement quadrant: highest frequency of **student** questions = 51%
lowest frequency of **teacher** asked questions = 20%

Understanding quadrant: lowest frequency of **student** questions = 17%
highest frequency of **teacher** asked questions = 51%

Mastery **quadrant:** middle frequency of questions for both,
Mastery questions asked by **students** = 33%
Mastery questions asked by **teacher** = 29%

Synthesis quadrant: Neither the teacher or the students asked any questions from this quadrant

Synthesis questions asked by **students** = 0%
Synthesis questions asked by **teacher** = 0%

<u>When I looked at this data the following thoughts came to mind:</u>

* Is it better to phrase more of my questions in the involvement mode, since this seems to be where the children are most comfortable?
* When the children are introduced to another model of questioning, will their questions grow and change?
* How much do developmental issues (age appropriate) come into the picture?
* If the children asked each other questions in the science arena, would the distribution of questions stay the same as they did for the reading lessons?
* Would the type of questions asked by students and teacher change from one curriculum area to another if more modeling of questions occurred?

Building Lessons

My next step was to build lessons that addressed some of the issues that were raised by the analysis of questions asked. Unfortunately, I was running out of time. It was now the middle of May. This is what I was able to do:

* Put up a bulletin board display with the Thoughtful Education task rotation model of questioning. (I thought that this would be a constant reminder for all of us to use a variety of questions in our work.)
* Refer to the bulletin board and call my students' attention to the types of questions that I was using.
* Encourage them to use the board to help them change some of their questioning patterns.

Building New Questioning Opportunities

In the time remaining in the school year, I was able to record one additional lesson. I intentionally used a synthesis question after a field trip to the San Francisco Zoo. (During their visit, the children had an opportunity to touch snakes, chinchillas, opossums, and turtles.) During one questioning session, I asked them to tell me how a snake and a chinchilla were alike and how they were different.

My parent recorder and I were amazed by the enthusiasm these questions generated. Almost every hand in the room went up. I don't know if it's because they loved the zoo trip so they were more enthusiastic about the question or if the type of question gave them more material from which to construct an answer. As the students walked out to recess, they were discussing my next question, "If you were from Mars, how would you describe a zoo to your friends?"

Conclusions

When I look back to see if I answered my original action research questions, I realize that I have gained partial answers and some intuitive guesses.

Thoughts about the first research question:
(How does students' work change as my questioning changes?)

Because I don't have the children's answers recorded, I am not able to fully evaluate this question. I realize that the students' development would be a factor. I wondered how much of the childrens' progress could be attributed to teaching style and how much to developmental stages? How could this be measured?

Thoughts about the second question:
(Will students be able to internalize the process of questioning and begin to use it as a part of their thinking process?)

I think that perhaps the Thoughtful Education Method is not developmentally appropriate to use as a questioning model for second graders. It was hard for my second graders to form questions in each of the four quadrants because some of the questions require knowledge of the subject. This is particularly true in the understanding and synthesis quadrants. All children might not have the necessary knowledge. The next step might be to research different models of questioning to see what would work with students.

After getting this far in my research and report, I began to read *Primary Science: Taking the Plunge*, edited by Wynne Harlen. As I was reading, I realized that I want my teaching of science to look like my teaching of reading and math. I want science to be familiar. Yet, by its very nature science is different. For example, the children can hold a novel in their hands and explore, but they have to search in a larger, messier, and noisier arena when they study science. The book, *Primary Science* says,

> "Science begins for children when they realize that they can find things out for themselves by their own actions: by sifting through a handful of soil, by blowing bubbles, by putting salt in water. The ideas they may have at the start of such actions may be changed as a result of what they do, what they see and how they interpret what happens. So the kind of science we are talking about concerns basic ideas which can emerge from simple investigations of objects and materials around. What ideas do emerge will depend not only on the events but on the way the children reason about them, on the way they process the information, that is, on their process skills."

With this in mind, I know that I need to look at the total picture of how I currently teach science, before I isolate questioning techniques as a focal point. If I don't do this, I will continue to try to stuff science into a nice neat corner of the room.

Possible Next Steps

One possible next step in this research would be to study what the specific science process skills are and how children best develop them. Then I would look at the areas where task rotation questioning would be most fitting.

<u>However, using the information that I have gathered I plan to:</u>

1. Use the Thoughtful Education Model of questioning in co-operative groups rather than whole class instruction. This would:
    * give each child the opportunity to work with this type of questioning.
    * get the Thoughtful Education language out more quickly.
    * structure lessons more around the Thoughtful Education model.

2. Include parents in the study. Supply them with a list of sample questions, encourage them to use these when they are working with their children. Periodically evaluate this process with parents.
3. Structure homework to include the Thoughtful Education Model.
4. Investigate other models of questioning that may be more accessible to children when they ask themselves questions to solve problems.

Extensions Studies

* Include the Teacher Expectation Student Achievement (TESA) model: This is a model for addressing childrens' achievements based, in part on questioning techniques. Further research could be done as a case study.
* Include a gender analysis. Is there similar and equitable questioning from both boys and girls?

References

Blosser, Patricia. *How to Ask the Right Question*. NSTA 1991

Harlen, Wynne. *Primary Science, Taking the Plunge*. Heinemann Educational Books, 1985

Hanson Silver Strong and Associates. *Thoughtful Education*, 10 West Main Street, Moorestown, N.J. 08057

Appendix A: Thoughtful Education Questioning Categories

The following model for asking questions is taken from Silver Strong's educational materials known as, *The Thoughtful Education Task Rotation Model.*

Mastery:
(Lower-Order Questioning)

Who was the...?
When was the...?
What happened first, second...?
Describe the facts...
What were the steps...?
What did you observe...?

Involvement:
(Lower-Order Questioning)

What would you do?
How would you feel?
What else did you consider?
How do you think ___ felt?
What's your preferences?
Describe your feelings.

Understanding:
(Lower-Order Questioning)

Compare ___ to ____ .
What are the similarities?
What are the differences?
Group the following...
Summarize...

Synthesis:
(Higher-Order Questioning)

What if...?
What are the consequences?
How is ___ like ___ ?
Imagine you are..
What comes to mind when...?

How Forcible are the Right Words
Bible, Job 6:23

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Abstract

My first grade students use very simplistic and repetitive descriptive works, such as "cute" and "nice." I wondered, could I improve my students vocabularies by increasing their observational skills? Could I change the children's' use of written adjectives by providing a variety of concrete experiences, such as observing live animals? These questions became the focus of my teacher action research project. After providing students with many different live animals, discussing what they noticed and exploring new adjectives, I found that their writing changed. The children pulled new vocabulary works from class discussions. They used sensory words that they had previously ignored, such as smell and sound words. Overall, their descriptive vocabularies improved. Yet, I was surprised to find that there was little change in color, touch, shape, and smell words used by my first graders. However, the children used a substantially higher number of sound words and describing words that were not related to sense.

Origin of My Research Topic

Vocabulary is one indication of intelligence. A limited vocabulary can mean limited success. Words are the tools of thinking. Therefore, the more words you have in your command, the clearer your thinking will be expressed. For these reasons, I always look for special ways to improve my first grader's learning. When we began a new science program called Life Lab, at our school, I chose to do an action research project. In this project, I wanted to find out if students' vocabulary and writing skills could be improved by developing their scientific observation skills.

Problem Statement

Although my first grade students are capable and certainly verbal, I wanted them to use more **sophisticated** language when speaking and writing. The children use words like "nice" and "cute" repetitively. Because the world and its wonders excite children, it naturally motivates and inspires them. I wondered, could children's curiosity and excitement serve to develop their vocabularies and improve their writing skills?

I suspected that improving the children's observational skills could foster greater language development and written abilities. With this in mind, I designed an action research experiment to test this theory.

Methodology

I began my research by collecting and keeping students' writing from February through June. For a comparison, I kept creative writing assignments from both February and May, where students used adjectives to fill in blanks. Then, I compared their adjective use during this period. During this course of time, I worked to develop the students' science process skills by having them practice observing and comparing. The science lessons required students to observe and interpret phenomena. Later, they recorded their observations in journals. I used the journals to compare their language skills before and after incorporating the scientific processes of observing, comparing, listening, speaking, reading, and writing.

The students began their observations by bringing in data of their own and comparing it to other student's data. The children preferred bringing in live animals. After observing the data (animals) and comparing, I engaged students in discussions that challenged them to expand their vocabularies and articulate their ideas. Next, students applied their newly acquired vocabularies to writing by recording their observations and comparisons in journal. I felt that repeated observations could increase the number and variety of describing words the children used when they wrote individually.

The children couldn't wait to bring in their live specimens to observe. These specimens included: frogs, tadpoles, hamsters, guinea pigs, iguanas, rabbits, dogs, kittens, birds, and two rats! Everyday I had many pleas from children wanting to share their data. Ryan even brought in his dad! How could I tell Ryan, "No!"?

During these lessons, I lead the discussion by challenging students to develop their vocabularies and articulate their ideas. I specifically encouraged the children to use their five senses when describing the animals. I attempted to assist students in increasing their vocabulary and acquire increasingly complex and accurate descriptions by pointing out their simplistic vocabularies and placing an emphasis on the use of many different sensory words. I asked the children to write at least three words for every category in their journals. These categories included: touch, smell, size, color, shape, sound, and taste. Therefore, they had to think about all different categories of descriptive sense words. I directed student's attention to examples of **rich** and **powerful** language by providing examples myself, both verbally and in writing. If a child describes an animal as "nice", I asked, "Does it look nice? Smell nice? Describe HOW the animal is nice." Then the children would find words to describe the "nice" smell or feel of the animal. Inside each student's journal an abundant and eloquent list of descriptive adjectives was provided. I divided the list into six groups of word types including colors, sounds, taste, smell, and touch. (See appendix A for a sample student journal.) Working cooperatively on these lessons, students could synthesize and integrate their observations with others. Following discussions, students recorded their observations, both individually and in groups. This process helped integrate the skills of observing, comparing, listening, speaking, reading, and writing.

I was hoping to see students synthesize and apply their new vocabularies when writing individually. In multiple activities, children were encouraged to find accurate and sophisticated words to describe the observations. Students played games, where their use of more accurate and precise adjectives helped them win. (See appendix B for a sample of the assignment *Critter Guess*.) When working on the *Critter Guess* game and the observation journals, students were able to work with friends to discuss and choose the best describing words. When working cooperatively, children could **not** look at another child's journal descriptions to copy their words, yet even while they were writing individually, I allowed quiet discussion among the children. Students were also able to touch, smell, observe, and listen to all of the living animals. (I thought it best to let Ryan's dad escape the sniffing test.)

To measure students' progress in using more complex words, I decided to compare the children's use of adjectives in January and February, before scientific observation lessons, to their use of adjectives several months later. The written assignments I used for comparison was a fill-in-the-blank creative writing lesson. On the creative writing forms that I used for comparison, a parent or older student wrote in the students' choice of adjectives. Each child would tell the helper what word to write in the blank.

Later, I wanted to see if the children used more sophisticated language in their fill-ins **after** scientific observation and repeated practice in articulation. I would use similar creative writing fill-ins for comparison. (See appendix C for sample creative writing forms.)

Another science enrichment program I chose to use as part of my action research included the incubation and hatching of duck and goose eggs. This observation experience was extremely powerful and rich. As expected, this project was absolutely inspirational! Unfortunately, it inadvertently appealed to the other five hundred children in our school. Our classroom was very popular during this incubation and hatching project. Through this project, my students observed the eggs daily as they were incubating and made weekly comparisons. By using a light bulb they saw the baby birds as they grew inside. It was fascinating to observe and record the changes.

Now the children had a personal experience to discuss and write about. When teaching I always attempted to connect students' new knowledge and rich language to their observations and our discussions. For example, Leslie brought in a pet parr in March, that we observed and discussed in particular its wings. Later in June, we compared the baby duck down to the parrot's feathers. Looking back, the students noticed the differences in the feeling of the two types of feathers. By providing real experiences, students could compare and interpret the difference of touch. While this program was continuing, children were challenged with new vocabulary. They also articulated their observations as they watched the ducklings hatch, grow and swim. Students made graphs, charts, and many drawings to show their findings.

Several students even pursued these scientific activities further with parents. Yes, several children took the ducklings home and watched them grow. Gavin took home the goose.

Analysis

A Chinese proverb say, "A journey of one thousand miles begins with one small step." My students certainly began their odyssey-into a rich and powerful vocabulary with this small step in the first grade.

To look at how/if student use of descriptive words changed, I analyzed their work in a couple of different ways. First, I counted, categorized and compared the children's use of adjectives in the before and after fill-in-the-blank creative writing assignments. Second, I randomly selected a few student's journals to look at in a more detailed, qualitative way.

Quantitative Analysis of Adjective Use in Creative Writing Assignments

I began by collecting students' writing from January, before we did any science lessons on observing, discussing and comparing data. Then, I counted and compared the number and type of descriptive words used in May, after these observation lessons. Both times, the children were asked to verbally fill in the blanks. I attempted to use very similar types of sentences in the comparison. In January, the writing subject was bears and there were nine blanks. I used ducks as the writing subject in May and had ten blanks. In May, the writing subject was ducks and there were ten blanks for descriptive words. Due to the focus of our study, I used animals as the subjects in all of the writing. (See appendices C and D for sample forms and summary tables of students' adjectives.)

To analyze their use of words, I then compared the work of eleven randomly chosen children; this included papers from six girls and five boys. I compared their early adjective use in January to the adjectives used in May after intensive observation of living animals. The following table is a summary of students' adjective use pertaining to the five senses. The numbers in parenthesis show

Adjectives used by 1st graders

Type of Adjectives	Jan.	May
# of different color words total blanks filled ( )	8 (13)	7 (13)
# of different shape/size words total blanks filled ( )	2 (6)	0 (0)
# of different touch words total blanks filled ( )	5 (14)	6 (13)
# of different smell words total blanks filled ( )	0 (0)	2 (2)
# of different sound words total blanks filled ( )	0 (0)	*6 *(13)
# of other adjectives that are not sensory words total blanks filled ( )	13 (14)	14 *(27)

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A brief summary of the number of adjectives students wrote in each sensory category are described in the following paragraphs.

Colors: In both January and May, the students filled in thirteen blanks with color words. They also used about the same number of different color words and the same overall percentage of color words. In January, the children used eight different color words. By June, the students used seven different color words.

Shape/Size: In January, the children used two size words, "little" and "small." In May, they did not use any type of size or shape words.

Touch: In January, the children used five different touch words. In May, they used six different touch words. In January, they used these five touch words to fill in fourteen blanks. In May, they used the six different touch words in a total of thirteen blanks.

Smell: In January, the students did not use any smell words. By May, the children used two smell words, "ugly" and "smelly."

Sound: In January, the children did not use any sound words. By May students used six different sound words thirteen times. This represented the largest and most substantial change in the children's use of sensory adjectives.

Other Adjectives and Describing Words: In January, the children used a total of thirteen different describing words. By May, students used fourteen different describing words. In January the children used those thirteen words to fill in fourteen blanks. By May the students used fourteen different describing words to fill in twenty-seven blanks.

In summary, I found that there was little or no change in the number of color, touch, shape, or smell words that the children used. This was surprising. However, there was an increase in the number of sound words used. In January, the children did not use any sound words in their descriptions. By January, the eleven children had used six different sound words fourteen separate times when filling in the blanks. They also used describing words, that were not sense related, decidedly more often after observing and discussing.

Qualitative Analysis of Adjective used in Science Journals

When the children made observations of different specimens, they wrote about their experiences in their science journals. These journals had an extensive list of adjectives in the front and a page to draw and describe each animal being observed. When observing, I asked the children to write at least three words for every category including: touch, smell, size, color, shape, sound, and taste. Consequently, they had to think about all different descriptive sensory words during the observation period. Later, they recorded this information into their journals. These journals acted as a record of students writing samples and word choices over several months.

For an analysis of students completed journals, I compared their use of adjectives from February through June. In general, I found that students had processed their listening, speaking, reading, and writing skills. When reading student entries over a several month time span, I began to see evidence that their language was becoming richer and their ideas more clearly articulated. The journals had examples of rich language previously missing in the students' daily written work and verbal articulation. In order to demonstrate evidence of these findings, I pulled two student's journals completely at random.

First I pulled Ryan's journal to look at. Ryan vocabulary was extensive **before** he entered first grade, therefore I was hard pressed to find any descriptive word included in his journal not previously used or known to Ryan. Clearly, Ryan's is very bright. On a standardized test, his vocabulary skills were beyond the fifth grade level, which is up to where the reading test reported grade equivalents.

Next I pulled Gio's journal. He had difficulty with first grade academic skills. In early April, while observing a frog, Gio recorded twenty-nine descriptive words. He recorded words like: circular, moist, squishy, rubber, and squeaky. His descriptive words were all accurate and more extensive than I'd expected. The next day when describing the two rats, Gio followed instructions and written three descriptive words under each category. All of his adjectives were fairly accurate and included the words: fat, long, small, smooth, warm, fuzzy, brown, silver, white, perfume, sweet, ugly, squeaky, talking, stuttering, and close. (I have corrected his spelling for this report.) Overall, he did not show a greatly increased use of more complex language. This is in part because Gio was not able to complete his journal. He was pulled out of class for resource help and could not finish the written part of his observations..

Lastly, I pulled Stephan's journal at random. Stephan performed at an average level academically. When describing the frog, he recorded the words: egg-shaped, oval, silver spots, green, white, black, army green, moist, bumpy, wet, cold, stinks, pond (smells like), noisy, and musical. Clearly, Stephan had used very powerful and accurate language. Previously the children, Stephan included, would describe animals as "cute" or "gross". Their vocabulary did not often extend beyond several overly used words when talking or writing. When describing the rat the next day, Stephan again used strong accurate language. He chose the words: skinny, long, oval, brown, white, silver, awful, sweet, perfume, furry, fuzzy, cuddly, noisy, clicking, quiet, crunchy, cold, and salty. (I suppose that if you ate a rat it would be crunchy, cold and salty.) Interestingly, Stephan had included taste, even though I had omitted this area as part of the requirements. I found he had used extremely sophisticated and accurate language. Again, I would have expected him to write "cute" or "ugly" and not go much beyond those simplistic descriptive words. In his written work, he applied language from class discussion that was challenging for him.

Even though she was not part of my random selection of students, I was particularly interested in Melina's journal. She entered our classroom in September and spoke Portuguese, but no English. I expected to see very little cultivation of language skills, beyond her rote memorization of vocabulary. Strong willed, bright and determined, Melina was communicating verbally with her classmates by the beginning of October. Melina began reading by December. On March 14, when she began entering data in her science journal, Melina listed only color words to describe a frog. She wrote: green, army green, black, brown, black, and white. After our discussion and verbal sharing of observations, the very next day Melina entered seventeen different adjectives describing the two rats. She listed: circular, little, fat, brown, white, sweet, fuzzy smooth, bumpy, perfume, ugly (smell), smelly, snorting, noisy, and yummy. Melina was expressing herself using articulated language. In addition, she applied some newly learned language and made comparisons in her writing. Much of her word choice was accurate. She certainly had not yet acquired words like circular and snorting in her working vocabulary. Yet she had included this language in her journal.

Upon examination in June, after four months of practicing their observation skills, I found that all of the children had included increasingly complex vocabulary when recording words in their journals. I was pleased to see that the children had written down sophisticated words that had been articulated in both teacher-directed and student-directed discussions.

Conclusions

In conclusion, improving the children's' observation skills fostered more descriptive verbal language and increased their written abilities. By bringing in their own animals as specimens, the children enjoyed observing them. When the students practiced new vocabulary and made comparisons over a four month period, they enlarged their descriptive vocabulary beyond simplistic and over-used words like "cute", "nice", and "ugly". Furthermore, when students recorded new words from class discussion in their individual journals, I was able to see a substantial increase in their use of complex and accurate descriptive words over a four month period. Although I expected that the children would use thier newly acquired descriptive vocabulary words, when doing creative writing assignments, I found that their adjective use did not change dramatically. However, in their science journals I did see a significant increase in the number of descriptive words the children used. They no longer used two or three words over and over.

I also found that the children used sound words, and other adjectives that are not sense related, much more often after practicing using their observation skills. I feel this occurred because the children became more aware of animal sounds from their observations of living animals. They also used sound words more in their creative writing.

Implications for Teaching and Further Action

As a result of this study, I plan to expand my science objectives this year. I felt that the children really benefited from my efforts to bring more science into the classroom through my research. Science proved to be a very active, enjoyable, learning experience. After spending a year of looking at my science teaching, I like science better.

I also plan to continue researching my teaching objectives and practices through student work. I felt that I learned some valuable lessons about the way I teach. First, I learned that the children love to learn what I love to teach. When I am excited about a subject, so are they. Second, sometimes I do not attain the goals I initially set out, however the final results are sometimes better than the results I planned.

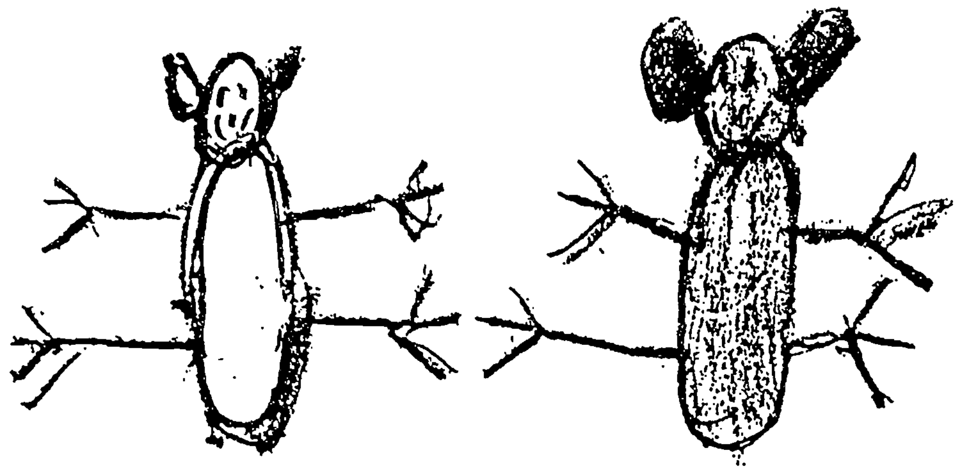
I believe that I can always improve the way I teach through analyzing the data I collect and comparing students' work from one period of time to another. If I can gathered enough varied and accurate data from each time period, then through reflection, comparison, and analysis, I can know that I have met my objectives. The results will be clear. Learning the process of teacher action research was the most valuable asset for me. I will use research to check myself, to see if I attain my goals and to learn to be as successful of a teacher as I can.

Appendix A: Sample Science Journal

Critter

Name ______

Date 4-14-94



Draw a picture of your critter.

I observed ~~X~~ 2 Rats.

It looked Skinny, oval, long.

It felt mooshy, smooth, fussy.

It smelled smelly, perfume, sweet.

It sounded noisy, loud, squeaky.

Observations

Name
Date 4-13-94

shape Long oval Sikinny	color lite Brown wite copper
touch mushy Smooth fussy	smell Smelly perfume Sweet
sounds noisy Loud Squeay sounds	more... cold Salty old

critter's name
2 Rats

GR. 1

Appendix B: Assignment *Critter Guess*

Please write in descriptive words. You will <u>win</u> if the next group can guess correctly!

CRITTERS HIDE 'N SEEK

Names_

Environment

A. Colors
1. white gray
2. black

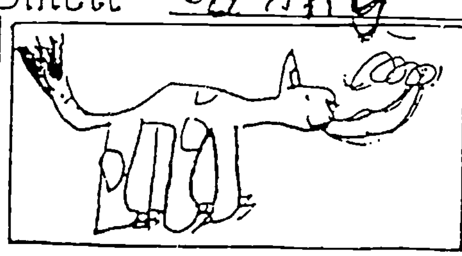
B. Shapes
1. oval
2. round

C. Feel
1. Soft nice
2. smoth

D. Covering
1. bumpy Soft

E. Enviroment
1. barn on A farm

F. Smell stinky bad



Draw Your Critter

Appendix D: Table of Adjectives Used by First Graders

BEAR POEM - BEFORE OBSERVATION SKILLS TAUGHT

february adj. list-before

1. color
2. shape
3. sound
4. taste
5. smell
6. touch
7. other

	# times used	adjective type
afraid	1	7
athletic	1	7
baby	1	7
beautiful	2	7
big	2	2
black	5	1
black eyed	5	1
blonde	1	1
blue	1	1
blue eyed	7	1
brave	1	7
brown	7	1
brown black	1	1
brown eyed	3	1
clowny	1	7
cool	3	6
cozy	2	6
cub	2	7
cuddly	11	6
cute	3	7
cute eared	1	7
dark brown	1	1
fast	6	7
fluffy	2	6
flying	1	7
friendly	4	7
fun	1	7
funny	4	7
furry	1	6
fuzzy	7	6
good	4	7
grizzly	1	7
happy	2	7
kind	1	7
little	2	2
messy	1	7
nice	8	7
night	1	7
ninja	2	7
polar	1	7
pretty	3	7
ribboned	1	7
skinny	1	2
sleepy	1	7
small	2	2
smart	1	7
soccer	1	7
soft	10	6
sonic	1	7
squeeky	1	3
weird	1	7
white	5	1
white shoed	2	1

1st Guess Who Critter Game - Early March
Late birds done in a group
VERY BEGINNING OF LESSONS OF OBSERVATION

Africa	N/A
awful smell	5
bad smell	5
bad smell	5
black	1
black	1'
black	1
black	1
brown	1
brown	1
brown	1
bumpy	6
bunny stink	5
cicle	2
cicles	2
circle	2
dark brown	1
egg shaped	2
fat	2
feels like a rug	6
feels nice	6
forest	N/A
fur	6
furry	6
furry	6
good smell	5
gray	1
gray	1
gray	1
hairy	6
heart	2
light brown	1
lines	1
nice smell	5
oval	2
oval	2
oval	2

color	SHAPE	sound	taste
20	12	0	0

smell	touch	other
7	19	

oval	2
rectangular	2
rough	6
rough	6
round	2
round	2
smooth	6
smooth	6
smooth	6
soft	6
soft	6
soft	6
soft	6
soft	6
soft	6
soft	6
stinky	5
stripes	1
tall	2
white	1
white	1
white	1
white	1
white	1
white	1

Can Bugs Teach Children to Read?
(Using Science Topics to Interest Low Readers and Improve Reading Skills)

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Abstract

As an elementary school teacher, I have encountered two problems that are especially frustrating. First, there never seems to be enough time in the school day to teach all that should be taught, and second, what should be done for those children who have low reading ability and little interest in reading lessons. In this three month research project I tested out one solution which seemed to take care of both problems. I discovered a science topic that my low ability reading students were interested in and then developed a unit around it that integrated reading. Through the integration of science and reading over a nine week period, time was made available in the school day for other curriculum topics, and students who previously lost interest in reading lessons maintained interest and increased their reading skills.

Background Information

This action research project took place at Castlemont School in Campbell, California, which is located approximately sixty miles southeast of San Francisco. Castlemont has been open for 30 years, and is one of eight kindergarten through fourth-grade schools in the Campbell Union School District. The district also contains three middle schools for grades five through eight. Castlemont has an extremely large and fairly diverse student body. Total student enrollment for the 1993-1994 school year was approximately 740 students whose ethnicity broke down as follows: 68% Caucasian, 22% Hispanic, 5% Asian, and 4% Black. Other ethnic groups made up the final 1%.

The first grade class that took part in this research had 28 students who were ages 6 and 7. One unique feature of this class was that the number of girls (19) was significantly larger than the number of boys (10). Most of the students were from solid middle class or lower middle class backgrounds, although some were from families receiving government aid.

All of the students were English speaking and the majority of them had their educational needs met in the regular classroom as opposed to being pulled-out by specialists. Approximately 5 of these students qualified for extra help funded by California's Chapter One program, which supports low achieving kindergarten and first grade students. Although not yet identified, some of these students will qualify for resource help as well as gifted programs as they move into the upper grades. In general the class was in the mid-to high ability range and most of the students had begun to read by March.

The teacher-researcher who completed this action research project was in her third year of teaching first grade, and very open to trying new teaching methods in the classroom. Her background is strongest in the areas of teaching Language Arts using the whole language approach, and teaching Mathematics using manipulatives.

Problem Origin and Problem Statement

This research began with the teacher feeling frustrated and overwhelmed. I was frustrated by the fact that there never seemed to be enough hours in the school day to devote time to all the areas of the curriculum that needed to be taught. In addition, I was a fairly new teacher who still had a long way to go before mastering, and effectively using the district's curriculum in all subject areas. On top of those factors, the school district and my individual school decided to adopt two different, new science curriculums for which I was now being held responsible. Frustrated and overwhelmed, I began to search for ways to make teaching first grade more manageable.

The first thing I felt I needed to do was to set priorities about what the students needed to know by the end of the school year. For first grade, learning how to read, and the mastery of several mathematical concepts seem to take precedence over other areas of the curriculum. In addition, this school year was the year of two new science program adoptions, and naturally these would also be a priority. When I began thinking of a topic for research, I was thinking along the lines of how to integrate curriculums and make the most out of classroom time.

In my three years of teaching reading I had noticed that low readers and nonreaders tended to lose interest in reading lessons. Perhaps this was because they felt it was something that was too hard. But when I taught science, these same children usually wanted to be involved and displayed a natural interest and curiosity. I began wondering if it would be possible to use the natural interest these students showed for specific science topics and transfer it into interest and improvement in reading skills through an integration of these two subject areas. With some more thought and refinement of this topic, my research problem statement evolved to be: **"Can science be utilized to help low or nonreaders, who show a natural interest in science, gain reading skills and interest in reading?"**

Methodology

I began my research by collecting some preliminary data to use as a comparison point as my project progressed. In late February, I completed a reading skills assessment with all my students to determine the range of reading abilities within my class, as well as to identify students who were nonreaders or emerging readers. In mid-March, the class filled out a *Reading Attitude Survey* that asked about their feelings toward reading (see appendix A). In early April, I administered an *Interest in Science Survey* to the students which asked them to indicate their level of interest for specific science topics, such as plants, insects or doing experiments, by coloring in a sad, neutral, or happy face (see appendix B).

With this preliminary data collected, I was able to identify three students with a low reading ability who showed interest in science. I chose to follow these three closely for the duration of my research. One students was a nonreader, and the other two were low readers. Based on the *Reading Attitude Surveys*, all three showed some mixed feelings, both positive and negative, about reading. I conducted individual interviews to obtain more information about these three students' ideas and attitudes toward reading. (See appendix C for a list of the interview questions.)

The next step in my research was to present a well integrated science and reading unit to my students so that every time we were doing science we were also reading and vice versa. I decided to use the general science theme of bugs and insects for the basis of my unit because it was a topic that the class seemed to have a general interest in as indicated on their *Interest in Science Surveys.* Additionally, the three students I chose to follow indicated a high interest in learning about insects on their surveys.

I planned and presented a unit to my class over a period of nine weeks based on daily scientific observation of living bugs we kept in our classroom and on quality children's literature. My hope was that their reading skills would improve because of their interest. I began my unit by reading The Very Hungry Caterpillar, by Eric Carle, which prompted our in depth study of the life cycle of butterflies and moths. In addition, I bought some caterpillars through a science education company that we were able to observe as they spun their chrysalises and emerge as painted lady butterflies. Over a three week period, the children observed daily and noticed changes in the caterpillars and their chrysalises. We kept a journal of what they saw. When the butterflies emerged, the students observed as they dried their wings, and began to fly. The children fed the butterflies sugar water, watched them drink, and collected flowers for their "butterfly house." All of the students were extremely excited about the caterpillars and butterflies and learned a considerable amount just by observing.

The next insect that we studied was the cricket. I began our study by bringing in some crickets I bought at a pet shop. The students watched the crickets for several hours, then I asked them to tell me what they would like to know about the crickets. After we had made our list of questions, I read the class The Very Quiet Cricket, also by Eric Carle. This book gave us answers to some of the questions students had asked. Additionally, we read about crickets in other books and encyclopedias to find the answers to the other questions. We could only study crickets for three days because they began to die after a couple of days in our classroom. We thought it would be best to release them before any more died.

Next, our supply of red ants came in the mail so we set up a giant ant farm to put them in. The children observed the ants for a week, they were amazed at how hard all the ants worked and how they quickly built tunnels in the sand. We fed them ant food and gave them water every couple of days. To go along with our observation of the ants I incorporated the children's book Two Bad Ants, by Chris Van Allsburg.

The last literature book I included in this unit was The Very Busy Spider, by Eric Carle, which prompted our study of spiders. We learned about different kinds of spiders and that spiders are not insects because they have eight legs instead of six. We learned about how spiders protect themselves, get their food, and reproduce. We even went on a "bug hunt" around the school where each student had a paper cup and tried to catch any kind of bug they could find. We came back with moths, ladybugs, spiders, ants, earwigs, and other unidentified bugs, which we observed for a few days before releasing. We finished our spider study with every student writing and illustrating their own version of The Very Busy Spider.

In order to show students' parents what we had learned and to culminate our unit on bugs and insects, I wanted each student to make a book that detailed what the class had studied. However, before we started our bug book, the children were going home and telling their families about the bugs and insects in our classroom. We began our bug book as our final project of the year.

I copied book pages for each child that had a picture of a particular bug or insect on it, and lines below the picture for writing. We first completed the pages to our books that were about the bugs and insects we had previously studied: caterpillars, butterflies, crickets, ants, and spiders. The writing for each bug or insect contained information that the students had learned on what each eats and how it gets food, how it moves or protects itself, where it lives, and other things that make it unique. After these pages were done, I introduced some new insects (the ladybug, the honey bee, the grasshopper, the housefly, and the praying mantis), each of which we read about and completed a book page on.

At the culmination of this integrated science/reading unit, I repeated some of the assessments I had administered at the start of the action research project to obtain some comparison data. I completed an end of the year reading assessment with all my students, but was particularly interested in whether or not the three students chosen as case studies would show improvement in their reading skills following the integrated insect unit. I also interviewed these three students again to see if their ideas about reading had changed or if their enthusiasm for reading had increased. Lastly, I administered the same *Interest in Science Survey* to the entire class to see if their interest in specific science topics had changed.

Findings, Analysis, and Implications

When I administered the *Interest in Science Survey* at the culmination of the insect unit I found that my class showed an increased interest in three topic areas, including learning about insects. They showed decreased interest in four areas, and one area remained the same. On the pre-unit *Interest in Science Survey*, the areas of highest interest were planting seeds, and learning about animals. In comparison, the post-unit survey showed that the areas of highest interest were learning about insects, and doing experiments. Statistical tests on this data, using the program Data Desk™, indicated that these increases and decreases were not statistically significant, and could be due to chance or error. However, one can not ignore the fact that on both the pre and post *Interest in Science Surveys* the class indicated heightened interest in areas they had recently studied.

The three students I observed and monitored with regard to reading also showed some interesting changes on the assessments I administered. More detailed case studies on these three students follow in the text below.

> **The first student**, a seven year old boy, had some difficulties answering the questions I posed to him during his pre-unit reading interview. He sometimes did not understand what I was asking, and was not able to be articulate in his answers. He was still working to master identification of upper and lower case letters, and knew only a few of the letter sounds. For these two reasons he was identified as a nonreader, although

he told me that he liked to read. He said that reading meant, "looking at books and pictures," without mentioning anything about words. He felt that he was not a good reader because good readers, "look at books, sitting down." This is an extremely active child who has difficulties sitting still long enough to concentrate on the task at hand. He felt that a person can become a good reader by, "getting help from someone who is a good reader," and thought he had improved his reading skills in first grade, "just a little." When asked what he liked to do with his free time at home he said he liked to play and watch TV. When asked if he spent any of his free time reading, he said, "I look at pages by myself."

After the integrated science unit was completed, this same student had mastered upper and lower case letter recognition, and knew approximately 50% of the letter sounds. However, I would attribute much of this improvement to the fact that this student's mother had begun giving him additional help at home in these areas during the same time that we were studying insects. During his post-unit reading interview this student revealed that he had learned a considerable amount about what it meant to read. He told me that he could now, "read a little," because his mom was helping him look at the words, and he was reading with her at bedtime. He had previously thought reading was easy work, and now he felt that it was fun, but hard.

In class, this student showed heightened interest, and paid closer attention when we were doing activities that involved the topic of bugs integrated with reading. He would come to school and tell me stories about bugs he had seen. On more than one occasion he brought his 'bug house' filled with insects for the class to look at. He checked out insect books from the library, and constantly looked at the pictures. Often he wanted me to read them to the class because he could not. I found him adept at memorizing facts about different insects and recognizing similarities between them. This surprised me, because I had not realized that his memory and reasoning skills were this well developed.

The second student interviewed, a seven year old girl, could identify all the upper and lower case letters, and knew approximately 50% of the letter sounds. Additionally, she could sound out some simple three letter words and read a few others on sight. For these reasons, she was identified as an emerging reader. In her pre-unit reading interview she stated, "I sort of like to read." She felt that reading means, "knowing what each word means when you look at it." She told me she was, "kind of" a good reader and still, "needed to work on it more." In her opinion, "good readers can read things other people can not." They become good readers by, "practicing every day." She felt that she had improved in reading since being in first grade, and stated, "In kindergarten I couldn't even read, and now I can read more." When asked what she liked to do with her free time at home she said she liked to watch TV and play games. She told me that she sometimes spent her free time at home reading with her mom, dad, or sister.

After the integrated science unit was complete, this same student had mastered all of the letter sounds, and considerably increased the number of words she could read on sight. I would attribute these improvements to developmental readiness for reading on the student's part, as well as to activities that were occurring in the classroom. To my knowledge, no significant changes in help with reading took place at home. During her post-unit reading interview this student showed some significant improvements in her self-confidence with regard to reading which showed through in the statement, "In kindergarten I guessed a lot and I don't guess any more." Additionally, when asked what she would do with her free time at home she told me that her first choice would be, "read a book." Her second choice would be, "read another book," and her third choice would be, "play with her bird."

Throughout the school year, this student always worked hard and consistently showed interest in the activities we were doing in class. She showed a heightened interest when I introduced the butterflies to our classroom. She spent a lot of time watching the caterpillars spin their chrysalises. One interesting note about this student was that she indicated a decreased level of interest in learning about insects upon culmination of the insect unit. This may be due to the fact that she had learned all she wanted to learn about insects, and was ready to move on to another topic.

The third student interviewed, a seven year old boy, was the strongest reader out of these three students. He had mastered his letter sounds, was building a strong sight word vocabulary, and could read some simple sentences. For these reasons he was identified as a beginning reader. In his pre-unit reading interview he was asked if he liked to read and responded, "No, not really. It's kind of hard." He told me that reading meant being able to, "look at words and know what they say." However, he did not consider himself a good reader, because good readers could, "read hard books." He felt that he had become a better reader since coming to first grade because he could, "read more words." When asked what he liked to do with his free time at home he said he liked to play Nintendo and play with his dogs. He said that he did occasionally spend his free time at home reading, sometimes alone, and sometimes with his mom.

Upon culmination of the integrated insect unit, this student was beginning to read simple paragraphs and books on his own, which was a considerable improvement in his reading skills. To my surprise, he continued to demonstrate a negative attitude toward reading. In his post-unit reading interview he stated, with regard to reading , "I just can't do it, it's too hard." The responses of this type that I received on his post-unit reading interview did not correspond with the in-class observations I had made. During his sharing time, this student would bring books to read to the class and on several occasions had volunteered to read books to me. He always seemed to be excited when he was successful at reading, but at times did need a little extra help to get started.

On his post-unit interest in science survey, this student indicated a decreased interest in insects, although he chose to write about them in his journal and often used his free time to draw pictures of them. He would go out at recess and catch bugs, as well as show his mom what was happening with our butterflies, ants, or crickets when she dropped him off and picked him up from school. On one of these occasions, his mom talked to me about her son's increased enthusiasm and excitement for school since I had begun bringing insects into the classroom for the students to observe. She was very supportive of what I was doing, because she had seen positive results in her son.

In the cases of these three students, two general trends emerged. The first trend I saw was that all three of these students displayed and maintained a high level of interest when we were doing activities that involved predicting and observing in connection with the living insects being kept in our classroom. It became very clear that having the caterpillars, butterflies, crickets, and ants in the classroom excited and interested the children. They spent much of their free time watching what the insects were doing.

The second trend was that even though each student had different reading abilities, all three acquired significant new reading skills during the time that the integrated insect unit took place. Considering the time and effort I have put into this research, I would like to say that these improvements could only be attributed to my efforts with these children, but this is probably not the case. I feel my efforts did play a part in their reading improvement, but other factors like additional help at home, and developmental readiness for reading were also crucial factors in their reading improvement.

Future Actions and Questions

If I now look back on my original research question: **"Can science be utilized to help low or nonreaders, who show a natural interest in science, gain reading skills and an interest in reading?"** I feel the answer is yes, but I do not feel that I succeeded in isolating and displaying this connection with the data I collected. As I stated above, I feel that my efforts, in conjunction with other factors, did play a part in the reading improvement of these students.

If I were to continue this research in the future, I would be interested in setting up a situation where science interest and reading improvement could be more closely linked with a larger number of students. But, this additional research could only be done after improvements took place in my teaching and data collection skills. Right now I am satisfied with my new knowledge of how to obtain information from my students regarding their interests and how to use this information to interest them in specific areas of the curriculum.

References

Carle, E. *The Very Busy Spider* . New York, NY: Philomel Books, 1984.

Carle, E. *The Very Hungry Caterpillar.* New York, NY: Philomel Books, 1969.

Carle, E. *The Very Quiet Cricket.* New York, NY: Philomel Books, 1990.

Kober, N. *EDTALK: What we know about science teaching and learning.* Washington, D.C.: Council for Educational Development and Research, 1993. 65-66.

Ostlund, K. L. *Science Process Skills: Assessing Hands-on Student Performance.* Menlo Park, CA: Addison-Wesley, 1992.

Van Allsburg, C. *Two Bad Ants.* Boston, MA: Houghton Mifflin, 1988.

Appendix A: Reading Attitude Survey

Name ______________________________

For each pair of words below place an X on the blank that best tells how you feel about--

READING

like	____	____	____	____	____	hate
work	____	____	____	____	____	fun
good	____	____	____	____	____	bad
sad	____	____	____	____	____	happy
exciting	____	____	____	____	____	boring
hard	____	____	____	____	____	easy

Appendix B: Interest in Science Survey

Name

using magnifying glasses	learning about weather
learning about insects	doing experiments
learning about animals	learning about your body
planting seeds	watching plants grow

Appendix C: Questions from the Reading Interview

Name ______________________________

READING INTERVIEW

1. Do you like to read?

2. What does it mean to be able to read?

3. Do you think you are a good reader? What does it mean to be a good reader?

4. How do people get to be good readers?

5. Do you think you have become a better reader since you have been in first grade? Why?

6. What is your favorite book? Why?

7. Name a few things that you like to do with your free time at home.

8. Do you spend any of your free time at home reading? Do you read by yourself or with someone?

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Selected Bibliography

Calhoun, E. F. (1993, October). "Action Research: Three Approaches," *Educational Leadership*, 24, (1), 62-65.

Carr, W., & Kemmis, S. (1986). *Becoming Critical: Education, Knowledge, and Action Research.* Philadelphia: The Falmer Press.

Cochran-Smith, M, & Lytle, S. L. (1990, March). "Research on teaching and teacher-research: The issues that divide." *Educational Researcher*, 19 (2), 2-11.

Elliott, J. (1991). *Action Research for Educational Change.* Philadelphia: Open University Press.

Goswami, D., & Stillman, P. R. (1987) *Reclaiming the Classroom: Teacher Research as an Agency for Change.* Portsmouth, NH: Boynton/Cook Publishers, Inc.

Hopkins, D. (1985). *A Teacher's Guide to Classroom Research.* Philadelphia: Open University Press.

Kemmis, S. & McTaggart, R. (1988). *The Action Research pPanner.* Geelong, Victoria, Australia: Deakin University Press.

Mohr, M.M., & MacLean, M.S. (1987). *Working Together: A Guide for Teacher-Researchers.* Urbana, IL: National Council of Teachers of English.

Nixon, J. (1981). *A Teachers Guide to Action Research; Evaluation, Enquiry, and Development in the Classroom.* London: Grant McIntyre Ltd.

Oja, S. & Smulyan, L. (1989). *Collaborative Action Research: A Developmental Approach.* New York: Falmer Press.

Sagor, R. (1992). *How to Conduct Collaborative Action Research.* Alexandria, VA: Association for Supervision and Curriculum Development.

Winter, R. (1989). *Learning from Experience: Principles and Practice in Action-Research.* New York: Falmer Press.

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"I think that if I spend more time doing this kind of critical reflection it would be the driving force behind my curriculum, which is how it should be, instead of letting the curriculum drive me, which is the way it is."

Kerrie Skehan-Marshall
2nd Grade Teacher

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"I am learning to practice how to do research, how to look at problems in the classroom, how to investigate the source of the problem, and then look into the ways that the problem might be solved."

Karla Ball
2nd/3rd Grade Teacher

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"I want to find out: can the natural interest ... in science topics be utilized to help them [1st graders] gain reading skills and an interest in reading?"

Sheila Erwin
1st Grade Teacher

∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞

"Ultimately, from this Action Research project, I found that my goal was to find ways to change my own questioning techniques and to give students the tools to become more aware - and to question their own surroundings."

Stacey Beagle-Thornburg
1st Grade Teacher

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