MURMSI Action Research Final Report : May 22, 2005

"The Effectiveness of Kindergarten Science Lab Books in Increasing Higher Order Thinking Skills"

By Karen Tyler

Introduction:

The purpose of this action research project was to investigate if the short term use of student generated science lab books in science investigations help kindergarteners to increase their knowledge, application, and comprehension levels of critical thinking skills, based on Bloom's Taxonomy. Being in a model school, many of our routines in our Readers, Writers, and Math workshops are researched based. These elements are then implemented school-wide from grades kindergarten to fifth grade. Currently, no standard school-wide routines for a science workshop are used. Science is often integrated into other curriculum areas and workshops. In upper elementary grades (4th and 5th) science lab books are considered to be an extremely useful tool for increasing comprehension. The format of a science lab book has similar elements (labeling) to the elements taught in Kindergarten Functional Writing. I would like to use my action research project to determine the validity of introducing in Kindergarten the science lab book as one short term "genre" study done for Functional Writing, similar to how an "author study" on Eric Carle is now incorporated in Narrative Writing. If it proves valid for kindergarten, then I believe this action research project would help establish science lab books as an integral and important component of any science workshop routine. This would dramatically improve learning in all grades, but especially grades K, 1, 2, and 3 where science lab books are not currently being used at all.

Area of Focus Statement:

Implementing Science Lab Books in kindergarten could be an effective tool in science investigations to increase critical thinking skills as identified in Bloom's Taxonomy**.**

Review relevant research literature

A review of the relevant research supported the fact that critical thinking, using Bloom's Taxonomy, increases learning (Seddon, 1978). Furthermore, using different types of questions as a way to lead to different levels of critical thinking has been encouraged by Barton (1997). Encouraging science to be integrated in English is encouraged in upper grades(Springer, 1976), which would support the possibility of integrating it in lower grades. The importance of asking the kind of questions that promote learning is also integrated into in science –based inquiry. (Harlem, 2001) Relevant research also indicated that the National Research Council in their National Science Education Standards supports the importance of writing as well as discussing science. They state that an important part of inquiry learning is the "oral and written discourse that focuses the attention of students on how they know what they know and how their knowledge is connected to other ideas." (NRC, 1996)Further internet searches on the use of written discourse or science lab books in kindergarten produced no journal articles. The successful implementation of science lab books in other elementary grades has been discussed and outlined by Campbell and Fulton, 1974, in their book: "Science Notebooks: Writing about Inquiry." This book provided a framework for my research as

it provided a written structure that could guide students' thinking and learning to ask inquiry based questions, describe what they learned through experimentation, and then think about what the results meant..

The Number and Type of Students Targeted

The research will be conducted on 27 Kindergarteners in a model school for America's Choice Standards Based Literacy. There will be two control groups of kindergartners with a similar range of ability in the same school.

Controls & Variables

Controls:
All teachers will have conducted same previous activity and corresponding pre & post tests.
All teachers will provide similar opportunities of the same duration for students to have prior experience with item being tested during week 1.
All teachers will teach the same science inquiry lesson utilizing the same AIMS lesson format and plan in week 2.
All teachers will have students take the same final test.

Variables:
The research group will reinforce science investigations by recording data in their student generated science lab during week 1 and 2.

Resources

"Big book" Lab book

Spiral top flip memo pads for students in research group specifically designated for use as science lab books

Pre/Post test materials for valentine candy AIMS activity

AIMS Science lessons and student materials for Valentine candies and Jelly Beans distributed

Test for Jelly Bean activity distributed

Research Question

Can the short term use of student generated science lab books in science investigations help kindergartners to increase their knowledge, application, and comprehension levels of critical thinking skills, based on Bloom's Taxonomy?

Approach: Initial investigations using an open ended question format for a pre and post test in conjunction with a valentine Aims activities indicated the need to gain more qualitative data that would could be obtained in the time line given. As a result, a qualitative post test was created for the Jelly bean Aims activity that was used for this research project.

Negotiations Undertaken:
The principal of Twin Lakes Academy Elementary, Ms. Menard, was notified in writing of my selection as part of the MURMSI action research project as well as my interest in trying to implement science lab books that were being used currently by our fifth grades teachers in kindergarten.(Jan.10, 2005).Parents were informed of the research project in the class newsletter(Jan.11, 2005). Permission letters were sent to parents in my class (January 11,2005).Consultations were held with 5th grade colleagues, Ms. Marcia Rivas and Mr.Jim Naccarato, to determine what essential parts are required in a lab book and what inquiry investigations are best suited to this format. Suggestions and arrangements were made to attend a science workshop from Feb.1-3, 2005 based on their experiences having attended a similar science workshop discussing lab books (Jan.11, 2005). Participation of my colleagues was gained through discussions at grade level meetings (Jan.14, 2005) and their newsletters (Jan.31, 2005) and permission letters were sent out subsequently. Parents in my class were kept updated through subsequent newsletter (Jan.25,2005; Feb.8,2005; Feb23,2005). Presented to Twin Lakes Elementary Faculty meeting on April 13, 2005.

Research Timeline

January 2005- May 2005

Data Collection plan:

The following types of data were collected during the project.

Pre-test/Post Test in preliminary science activity
Teacher Observations
Student Lab books, Feedback
Test in control versus research group

Data Analysis and Interpretation:
Pre and Post test from preliminary science activity using valentines Aims activities were designed using open ended questions to try to "measure gains in ability to do inquiry." Examination of those pre and post tests that used open ended questions like "What did you wonder about? reflected more the developmental nature of kindergartners concerns than to science. For example, when asked what they would wonder about responses varied from what activities they might do with their parents to if Buzz Lighting was real.

Another important consideration was the fact that the preliminary pre and post tests required a lot of teacher time to test one on one with students that took away from actual teacher teaching time. The final test was designed so that the students could do the test on their own.

The research question and final test were redefined and narrowed down to what they now are so that data collected could provide information to answer the current research question.

Teacher observations of how successful the science lab books were at helping to guide and focus student inquiry learning was supported by the new found enthusiasm of the students to write and do science.

The design and use of a qualitative test to measure and collect data that would reflect learning based on the use of the lab books was implemented.

Data Sample: Final Test

Karen Tyler's Action Research Test:

Class_____Name_____ Date_____
Predict which is more:

red orange purple black pink yellow green

Count:
0 1 2 3 4 5 6 7 8 9 10

How many altogether ?
0 1 2 3 4 5 6 7 8 9 10

Circle another way:
1 2 3 4 5 6 7 8 9 10

__ __ ___ __ ____ ___ __ __ __ ____
10 10 10 10 10 10 10 10 10 10

(Bar Graph)

10
9
8
7
6
5
4
3
2

1
red orange purple black pink yellow green

Data Collection

4/8/2005

Control H- No Lab Books
more count ten fraction red orange purple/black green
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 0 1 1 1 1
0 1 1 1 1 1 0 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 0 1
1 1 1 0 1 1 1 1

Control S-No lab books

1 1 1 0 1 1 1 1
0 1 0 0 1 1 1 1
1 0 0 0 1 1 1 1
0 0 0 0 1 1 1 1
1 0 0 0 1 1 1 1
1 0 0 0 0 1 1 1
1 0 0 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
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1 1 1 0 1 1 1 1
0 1 0 0 0 0 0 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
0 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1

1 1 0 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 1 0 1 1 1 1
1 1 0 0 1 1 1 1

T-Used Lab books
0 1 1 1 1 1 1 1
0 1 1 0 0 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 0 0 1
1 1 1 1 1 1 1 1
0 1 1 0 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
1 1 1 0 0 1 1 1
1 1 1 1 1 1 1 1
0 1 1 1 1 1 1 1
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1 0 1 0 0 0 1 1
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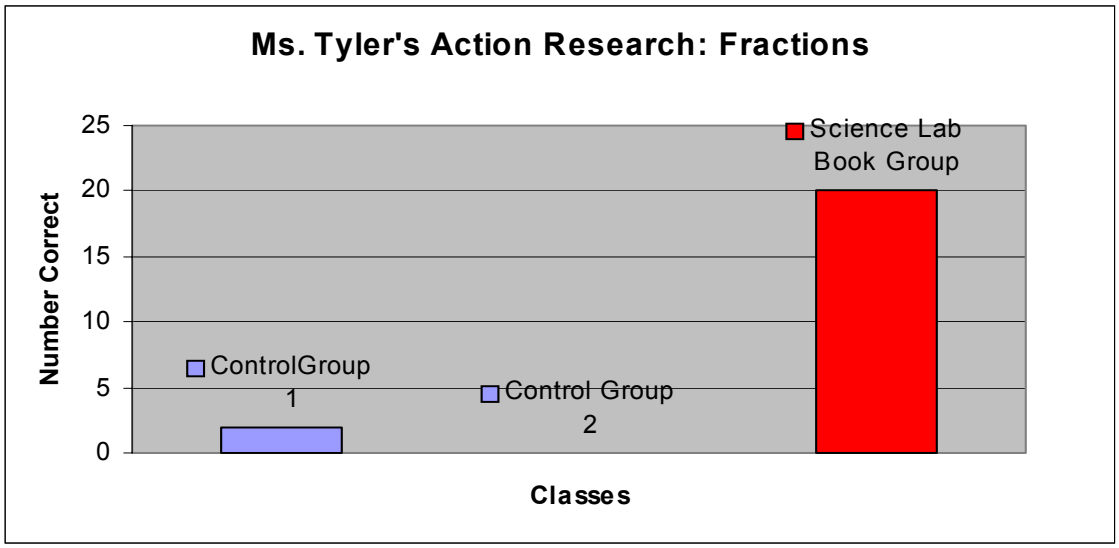
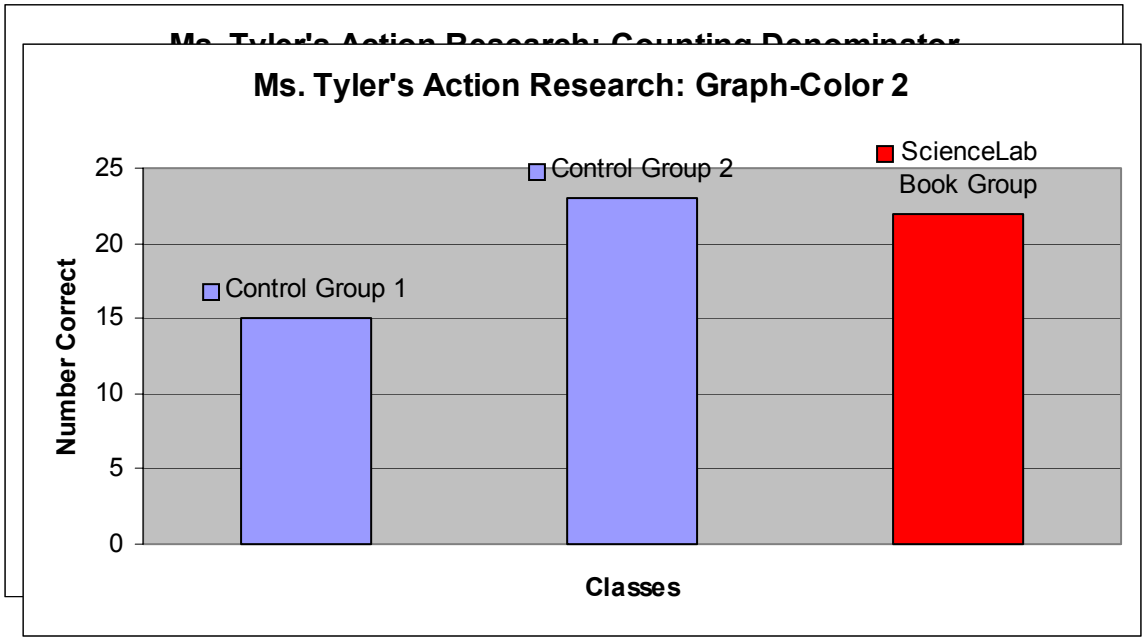
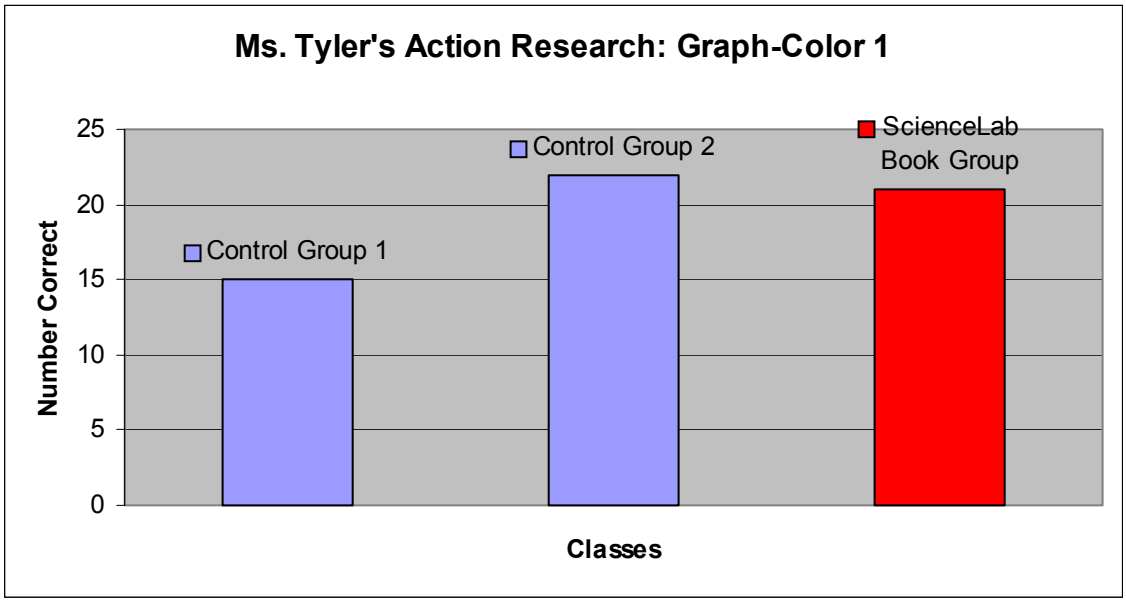
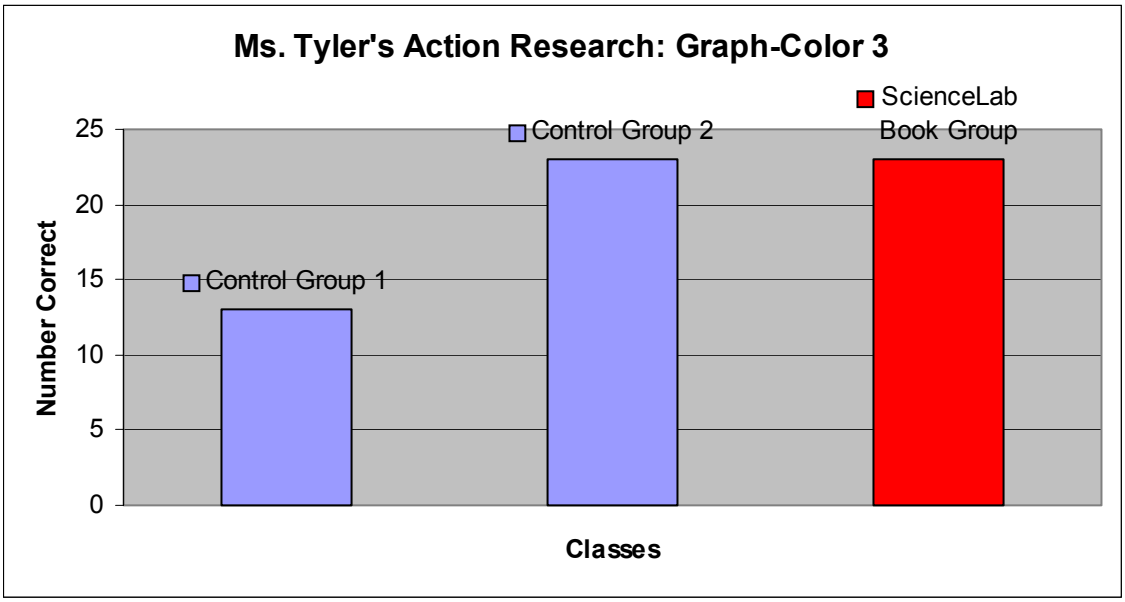
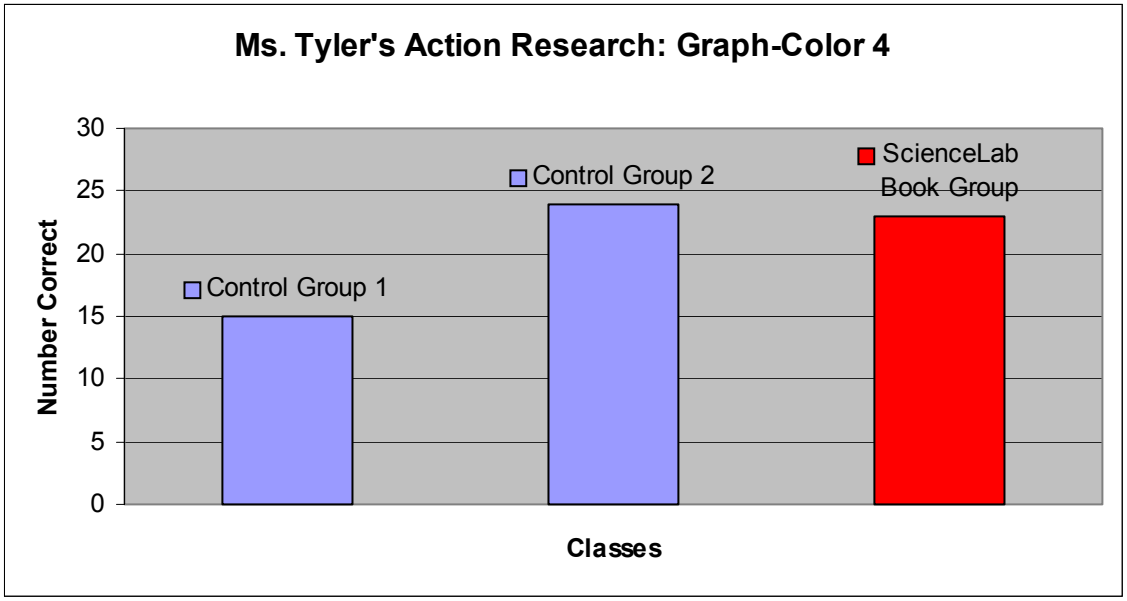
1 1 1 1 1 1 1 1




Ms. Tyler's Action Research: Graph-Color 2
Number Correct
25
20
15
10
5
0
Control Group 1
Control Group 2
ScienceLab Book Group
Classes


Ms. Tyler's Action Research: Graph-Color 1
Number Correct
25
20
15
10
5
0
Control Group 1
Control Group 2
ScienceLab Book Group
Classes


Ms. Tyler's Action Research: Graph-Color 3
ScienceLab Book Group
Control Group 2
Control Group 1
25
20
15
10
5
0
Number Correct
Classes


Ms. Tyler's Action Research: Graph-Color 4
30
25
20
15
10
5
0
Number Correct
Control Group 1
Control Group 2
ScienceLab Book Group
Classes

Data Collection:

Question One: Predict Which Is More.(Predict) Control Group One got 14/15 correct or 93 %. Control Group Two got 18/24 correct or 75%.Science Lab books got 17/25 correct or 68%.

Question Two: Count the color. (Numerator) Control Group One got 15/15 correct or 100%. Control Group Two got 19/24 correct or 79.1%.Science Lab books got 24/25 correct or 96%.

Question Three: How Many Altogether.(Denominator)Control Group One got 15/15 correct or 100%. Control Group Two got 15/24 correct or 62.5%.Science Lab books got 24/25 correct or 96%.

Question Four: Circle another way.(Fractions)How Many Altogether.
(Denominator)Control Group One got 2/15 correct or 13%. Control Group Two got 0/24 correct or 0%.

Question Five : Graph.(Red) Control Group One got 15/15 correct or 100 %. Control Group Two got 12/24 correct or 91%.

Question Six : Graph.(orange) Control Group One got 15/15 correct or 100 %. Control Group Two got 23/24 correct or 95%.

Question Seven : Graph.(purple/.blue) Control Group One got 13/15 correct or 86%. Control Group Two got 23/24correct or 95%. Science Lab books got 22/25 correct or 88%.

Question Eight : Graph.(green) Control Group One got 14/15 correct or 93 %. Control Group Two got 24/24 correct or 100%.Science Lab books got 24/25 correct or 96%.

Analysis and Interpretation of Data:
The research question was to determine if the short term use of science lab books increased knowledge, application, and comprehension levels of critical thinking based on Bloom's Taxonomy.

"Level V Synthesis Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions."(Barton , 1977)
(Barton, 1977)

Question One: Predict Which Is More.(Predict) Control Group One got 14/15 correct or 93 %. Control Group Two got 18/24 correct or 75%.Science Lab books got 17/25 correct or 68%. The graphs are misleading due to the difference in numbers of the classes. Science lab books with 76% actually did worse than the Control Group One with 93% and Control Group Two with 75%, possible because of confusing the question with the "

I wonder questions used in the science lab notebooks." Students made "predictions" based on what they thought might happen, versus the control groups that actually looked at what was in the bag of jelly beans. Even though this level was not part of the original research question, there is no data to support that science lab books were more effective in increasing this Level V Synthesis based question.

"Level 1 Knowledge: Exhibit memory of previously-learned material by recalling facts, terms, basic concepts, and answers**."** (Barton, 1977)

Question Two: Count the color. (Numerator) Control Group One got 15/15 correct or 100%. Control Group Two got 19/24 correct or 79.1%.Science Lab books got 24/25 correct or 96%. The graphs are misleading due to the difference in numbers of the classes. Even though the Science Lab Books with 96% did better than Control Group Two with 79%, there is no data to support that science lab books were more effective in increasing this Level 1 Knowledge based question as Control Group One got 100% correct.

"Level 1 Knowledge: Exhibit memory of previously-learned material by recalling facts, terms, basic concepts, and answers**."** (Barton, 1977)

Question Three: How Many Altogether.(Denominator)Control Group One got 15/15 correct or 100%. Control Group Two got 15/24 correct or 62.5%.Science Lab books got 24/25 correct or 96%. The graphs are misleading due to the difference in numbers of the classes. Even though the Science Lab Books with 96% did better than the Control Group Two with 62.5%, there is no data to support that science lab books were more effective in increasing this Level 1 Knowledge based question as Control Group One got 100% correct.

Level 111Application: Solve problems to new situations by applying acquired knowledge, facts, techniques, and rules in a different way." (Barton1997)

Question Four: Circle another way.(Fractions)How Many Altogether. (Denominator)Control Group One got 2/15 correct or 13%. Control Group Two got 0/24 correct or 0%.Science Lab books got 20/25 correct or 80%. This graph reflects the percentages accurately. The data supports that the Science Lab Books with 80% were more effective in increasing this Level III Application based question then Control Group One with 13% or Control Group Two 0 %.

Level 1I Comprehension. Demonstrate understanding of facts and ideas by organizing,comparing, translating, interpreting, giving descriptions, and stating main ideas." (Barton, 1977)

Question Five : Graph.(Red) Control Group One got 15/15 correct or 100 %. Control Group Two got 12/24 correct or 91%.Science Lab books got 21/25 correct or 84%. The graphs are misleading due to the difference in numbers of the classes. Science lab books with 84% actually did worse than the Control Group One with 100% and Control Group

Two with 91%, possibly as students had not yet mastered this skill as well as the other two control groups had. There is no data to support that science lab books were more effective in increasing this Level II Comprehension based question.

"Level 1I Comprehension. Demonstrate understanding of facts and ideas by organizing,comparing, translating, interpreting, giving descriptions, and stating main ideas." (Barton, 1977)

Question Six : Graph.(orange) Control Group One got 15/15 correct or 100 %. Control Group Two got 23/24 correct or 95%.Science Lab books got 21/25 correct or 80%. The graphs are misleading due to the difference in numbers of the classes. Science lab books with 80% actually did worse than the Control Group One with 100% and Control Group Two with 95%, possibly as students had not yet mastered this skill as well as the other two control groups had.There is no data to support that science lab books were more effective in increasing this Level II Comprehension based question.

"Level 1I Comprehension. Demonstrate understanding of facts and ideas by organizing,comparing, translating, interpreting, giving descriptions, and stating main ideas." (Barton, 1977)

Question Seven : Graph.(purple/.blue) Control Group One got 13/15 correct or 86%. Control Group Two got 23/24correct or 95%. Science Lab books got 22/25 correct or 88%. The graphs are misleading due to the difference in numbers of the classes. Although Science lab books did better with 88% than Control Group One with 86%, Control Group Two with 95% did the best, possibly due to the varying nature of students ability and kindergartners lack of ability to be careful and stay focussed when doing paper and pencil tasks. There is no data to support that science lab books were more effective in increasing this Level IIComprehension based question.

"Level 1I Comprehension. Demonstrate understanding of facts and ideas by organizing,comparing, translating, interpreting, giving descriptions, and stating main ideas." (Barton, 1977)

Question Eight : Graph.(green) Control Group One got 14/15 correct or 93 %. Control Group Two got 24/24 correct or 100%.Science Lab books got 24/25 correct or 96%. The graphs are misleading due to the difference in numbers of the classes. Although Science lab books did better with 96% than Control Group One with 93%, Control Group Two with 100% did the best, possibly due to the varying nature of students ability and kindergartners lack of ability to be careful and stay focussed when doing paper and pencil tasks. There is no data to support that science lab books were more effective in increasing this Level II Comprehension based question.

The lack of kindergartners to be careful and stay focussed when doing paper and pencil tasks is also supported by the fact that the results for the last four similar questions as not one group did better consistently on all four questions.

Also graphs that presented data in terms of percentages not actual class numbers might be more effective than those used.

To answer the research question: **Data only supports that Science Lab Books were effective in the short term to helped increase Level III Application Questions, not Level I Knowledge or Level II Comprehension questions based on Bloom's Taxonomy.**

Major Insight From Research:
Looking at the samples of what students could produce in lab books and the thought processes that occurred during the research, made science lab books from my teacher's point of view an extremely valuable and exciting potential resource to use in and with kindergartners and other elementary students.

How exactly science lab books could be best implemented in various stages to avoid interference or misconceptions based on other learned skills and then monitored for progress OVER TIME would be the next step to be determined. I feel that this would need to be done before they could be successfully implemented and data could be collected to reflect their effectiveness as an excellent learning strategy of integrating science inquiry with higher order critical thinking skills.

Action Plan: The next possible research cycle would be developing a timeline for developmental growth that occurs in writing during this school year. This research revealed through teacher observations the difficulty of both presenting and evaluating the "format or structure" of a lab book all at once. In the next action research cycle, it is felt that it would be more beneficial to "orally " introduce and develop the concepts and vocabulary (predictions, wonderings, data, conclusion,etc.) used to describe the activities done in the lab books, well before the students wrote about them to avoid interference or misconceptions with other skills learned. The lab books could also then be evaluated using alternative assessments or rubric for progress and growth shown over time as indicated by Campbell and Fulton (2003).

Reaction to Action Research:

This research project provided me with insight into the different challenges that the researchers face when investigating an area of focus where relevant research and qualitative data were not readily available. I learned the importance of being flexible and constantly evaluating and modifying what one does as the research focus progresses. I also was made aware of the tremendous commitment of time and energy as well as benefits and that doing research and learning new technology like the bblog web site and excel requires over simply just trying an idea in one's class.

I found it especially rewarding that other considerations resulted from my research project. I saw an increase and recognition of the benefits of collegiate collaboration

between grades and a real excitement over the fact that kindergartners could produce science lab books that showed their ability to do science inquiry.

In addition, another consideration that resulted from my research project that I thought was extremely important was the question of how to better enable teachers who are interested in doing action research and collaborating with others to get started and involved. I understand that I was selected for participation in this project because of my national board certification and previous experience in an action research course. I included the email addresses in my timeline as I strongly feel that the support and network and encouragement to do action research I received should be made more accessible to everyone based on interest, not only to those with previous qualifications.

My reaction to the networking tools and opportunities available to me through the MURMSI project.

I feel that a "class" format might have been better than a "meeting" format because there is a tremendous amount of work and time commitment needed on top of regular working responsibilities to do research. I would suggest that more structured time and explicit support be given to action researchers so that they could feel more comfortable learning the new skills and methods of presented research that we were given the opportunity to do, like the bblog web site. I would recommend that a series of classes over a longer period of time were designed where different parts of the actual research was covered and actually logged on the blogg during each of the classes with the instructors there would be best. In this way, the use of the network would have been easier to learn and more knowledge about how to manipulate information on the web site might have been gained. As well, more time would have been desirable to learn how to better use and present information on the bblog as well as gain more familiarity with Excell and how to present data in different ways. For example, it would be beneficial to learn how to post graphs or pictures on the bblog as well as just type in text. Also I would have like to learn how to vary the order of items in the report that first come up when one sees the web page. Had I had more time, I would have liked to learn how to have my web page first open up with my introduction and research question and be read in the order that my report is written. In addition, there is a list on the side of earlier postings. I would prefer to have a way to show all items that are in there, not just some of the postings that are available in my archives list.

I definitely found it very challenging and exciting to be part of this project as it was a fabulous opportunity to come in contact with a variety of very qualified and talented colleagues and experts at the university who supported, guided my research, and continued to inspire me to find ways to challenge and motive students more. I also hope to use some of my new found experiences, knowledge and skills in the next research project I participate in and to help others engage in research.

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