TLC: Teachers **L**earning and **C**ollaborating

Improving student achievement in grade 5 science through teacher collaboration

An Action Research Project
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Table of Contents

TLC: Teachers **L**earning and **C**ollaborating
Improving student achievement in grade 5 science
Through teacher collaboration

Will teachers who collaborate with a science resource teacher in the use of hands-on science activities, increase their students' understanding of science content knowledge?

Are students getting more science (frequency) because of teacher collaboration? Will increasing hands-on science frequency improve student science content knowledge?

RATIONALE:

When asked why elementary teachers do not put as much effort into teaching science as other subject areas, many issues are brought forward. Many classroom teachers and pre-service teachers express anxiety over teaching science (Collins, Joeston, Metzgar, Shepherd & Thompson, 2002). Eighty percent of the teachers surveyed felt they were not properly trained in the area of science education and 70% felt they lacked the science content knowledge to teach science even on the elementary level. Similarly, 70% of the teachers surveyed found the Florida Sunshine State Science Standards confusing. Unfortunately, for many years, teachers felt that due to scheduling conflicts and expectations to perform in other areas such as math and language arts, pressure was put on them to "move science to the back burner." Now, with the inclusion of science on the grade 5 Science Florida Comprehensive Assessment Test (FCAT), teachers are feeling even greater pressure to teach science to their students. In May 2007, in the State of Florida,

FCAT in addition to individual assessment science scores will be used to grade the success of schools.

Hands-on science instruction has been demonstrated to be one of the most effective methods of teaching science principles. This researcher asserts that students who participate in hands-on science activities that aligned with the state standards will be prepared for success. Students learn best through doing or through hands-on instruction (Stohr-Hunt, 1996). This is why many students have failed to grasp science content knowledge simply by reading it in a textbook (Meyer, et al, 1986). Each student learns differently depending on their learning modality. Teachers may feel they have succeeded by having students read a textbook from cover to cover, but I believe these teachers have not been truly effective with all their students. Studies have also shown that students with learning disabilities comprehend concepts better when presented in a hands-on manner as many of them are unable to read the information out of a book for they lack the reading comprehension skills. This is why it is crucial that teachers infuse hands-on science activities to better serve the needs of their entire learning community (Goor & Sterling, 1998).

BACKGROUND/CONTEXT:

The 1,795 students at Jack D. Gordon Elementary come from middle class families. The school population is 23% white non-Hispanic, 7% black non-Hispanic, 64% Hispanic, and 5% Asian/Multinational. The student body is made up of 11% exceptional education students, 5% of which are classified as gifted and 6% attend

classes for learning disabilities. Relatively few students transfer in or out during the school year. Additionally, one fifth-grade class has been set up as a “COMET” lab. These students have qualified for participation in this program due to poor academic performance, behavior problems and poor attendance. These students have been targeted because of their potential for dropping out of school; they are considered at-risk students. Not only is the class size smaller, but instead of attending county mandated Spanish classes, they take part in activities that will teach them trades and other skills such as secretarial skills, cosmetics, tile laying, and electronics. The faculty is made up of 56 teachers, 44% hold masters degrees and 10% hold specialist degrees, and there are four National Board Certified Teachers.

The students in grades 2-5 have been exposed to science in a unique way. The school has a fully equipped science laboratory. In addition to being taught science by their classroom teacher, they attend a science lab class for one hour every other week. As the science resource teacher, I operate the science lab where all students participate in hands-on science activities. I see between 120 and 150 students per day on average. Each time they are in the lab, students follow the scientific method, record and analyze data, and draw conclusions.

Through ***TLC*** (Teachers Learning and Collaborating), teachers worked with the science resource teacher to collaborate on activities to increase students’ science content knowledge using varied techniques of instruction that included the use of technology via laserdisc players and computer software. This study involved the fifth-grade faculty in nine collaborative training sessions over the course of the year.

In May 2003, teachers spent an entire day reviewing and mapping the Sunshine State Standards based on the calendar and correlating with the science textbook. Standards not represented in the book were matched with supplemental activities that were placed in a binder for their use in the upcoming school year. After spending the day correlating the textbook, all of the teachers noticed that the state adopted textbook did not adequately address the state science standards.

The 45 minute collaborative sessions introduced teachers to science concepts and activities that they could use with their own students. In the sessions that followed, teachers began by reviewing science FCAT field test scores and then analyzing the scores and noting gaps in achievement across the board related to specific standards.

A 65-question pretest that included multiple choice and short response questions correlated to the Sunshine State Standards was administered to students. These questions were the item specifications for the FCAT science field test. Following the administration of the test, the data was analyzed to show where the gaps in understanding were and the data were used to map out a sequence for instruction.

Additionally, teachers participated in workshops where activities helped them to gain an understanding of the various strands of the Sunshine State Standards. Teachers found out what students did in the lab with the science teacher in order to elaborate in their own classroom.

During subsequent sessions, teachers were instructed on the use of a laserdisc player and the *Windows on Science* series to supplement their science program. After this session, many teachers started using the laserdisc player in their

classrooms for the first time as well as signing up for open lab times to use it in the science lab. All 10 teachers involved requested their own laserdisc player. A district wide e-mail was sent by the media specialist to all schools requesting that they donate laserdisc players that were not being used. As a result, enough players have been acquired for all 10 fifth-grade teachers to have their own. Additional laserdiscs were ordered for the classroom teachers to support science instruction.

At the end of the school year, teachers met to review the curriculum put forth at the end of the last school year and made revisions to cover more of the standards in a more user friendly manner. At the end of the study, students were administered an FCAT type science post test and the data was analyzed noting gains.

Finally, teachers were also encouraged to bring hands-on science into their classroom with a “green slip” program. Teachers who wished to teach using hands-on science experiments in their classes filled out a green slip requesting materials. Those materials were delivered to the teachers’ classrooms to support their teaching of science.

REVIEW OF THE LITERATURE:

When elementary students have the opportunity to participate in hands-on science on a regular basis, both student content knowledge and excitement about the subject being taught both increase (Gillingham, 1993). Furthermore, it has been found that students who engaged in hands-on science activities frequently scored significantly higher on standardized tests of science achievement than students who did not (Stohr-Hunt, 1996).

Unfortunately, elementary teachers often dislike science and lack confidence in their ability to teach it (Palmer, 2002); many lack both content knowledge and teaching skills (King, Shumow, & Lietz, 2001). In addition to the pressure to meet external standards, lack of content knowledge, discomfort with the method and general anxiety all function as obstacles to teaching hands-on science (Lee & Houseal, 2003). Such deficits seem well founded as there is evidence that many teachers who believe they are using "hands-on," inquiry based methods are, in fact, not (King, Shumow, & Lietz, 2001). Worse still, one study found that the culture of student elementary teachers, that is their values, assumptions, beliefs, personality profile and behavior taken as a whole, was the complete antithesis of the culture of science. Naturally, therefore, the student teachers' anxiety and frustration in teaching science lead to resistance to inquiry learning (Specter & Strong, 2001).

The challenge, then, is to influence the attitudes of elementary science teachers and simultaneously build the skill sets necessary to teach science effectively. External validation and experience with inquiry-based science instruction are both factors affecting the attitudes of teachers and may increase their interest in teaching science (Palmer, 2002; Cavallo, Miller, & Saunders, 2002). Teachers who participate in hands-on science workshops showed a greater comfort level teaching science as well as an increase in the frequency of hands-on instruction (Gillingham, 1993). Further, teachers who have been exposed to actual research during their teacher preparation have been found to be more likely to actually use open inquiry methods with their students (Windschitl, 2003).

Teachers in the field have less opportunity to engage in research projects than preservice teachers in training, however comparable opportunities can be fabricated. Teachers working collaboratively can share their own expertise with each other (Yure et al, 1995). Donivan also shows that effective hands-on science programs can be established when teachers use collaboration, in-service workshops, shared leadership, planning, and peer coaching to bring science to their students (1993). Simply collaborating with experts in the field to plan science lessons has been found to effectively increase the self-confidence of teachers (Van Zee, Lay, & Roberts, 2003). In one study, researchers provided instruction and assistance in lesson planning for teachers of a summer science camp. They found that "the opportunity for immediate application of their own learning with children in the camp was a valuable part of the program "(Naizer, Bell, West, & Chambers, 2003)."

TOOLS:

Several tools were used in the collection of data for this study. A **pre-post-test** was administered to all students to assess their level of science knowledge. The test was constructed using item specifications correlated to the state standards. Next, teachers were given a **science attitude survey** that clearly spelled out their apprehension in the area of teaching science. At the end of each 45-minute collaborative session, **teacher exit slips** were completed to determine if each session was effective in meeting its goals. Additionally, **teacher and student reflection essays** were analyzed to note any changes in attitudes from the previous

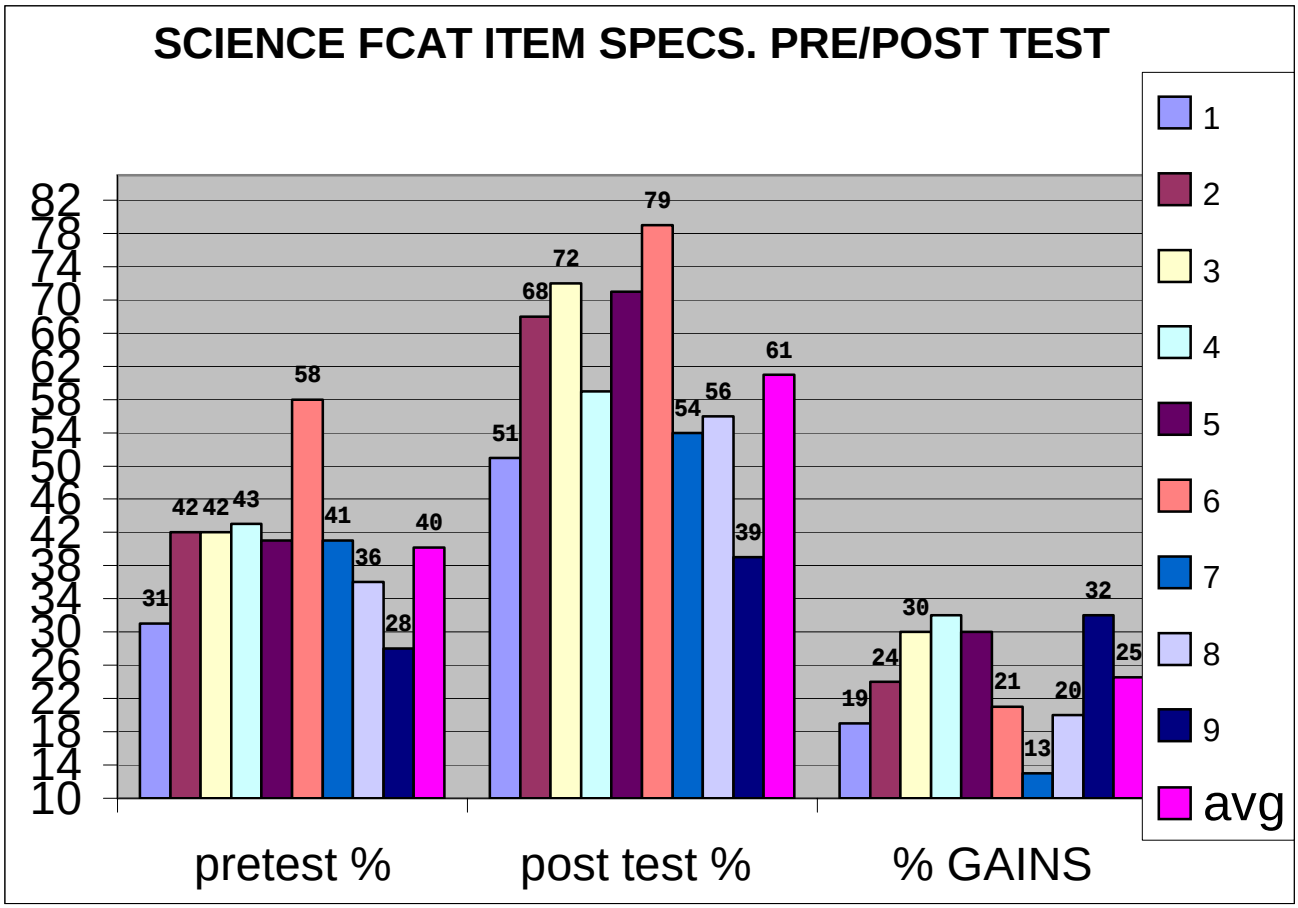
year. Finally, there was a **comparison of frequency** of hands-on science by teacher for the 2002-2003 and 2003-2004 school years.

DATA:

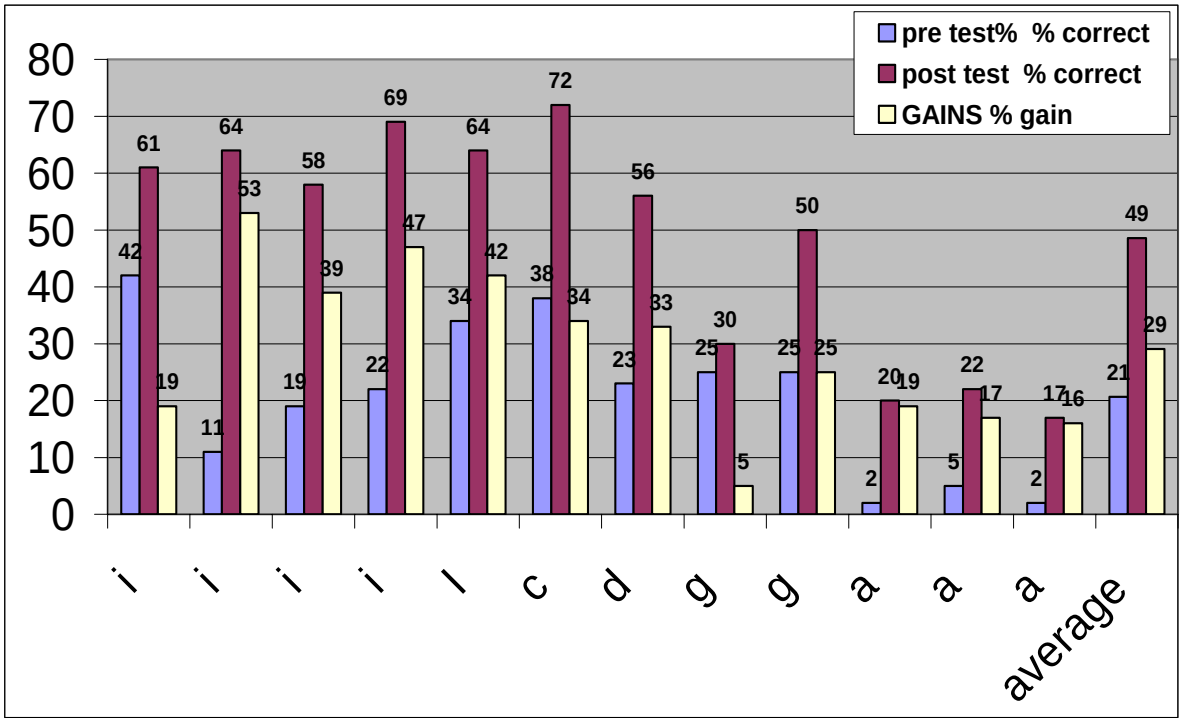
All students in the nine fifth-grade classrooms were administered a 65-question pre-post-test based on sample items provided from the FCAT. Class averages were computed, and percentage gains were computed based on these class averages. Teachers completed science attitude surveys at the beginning and at the end of the school year, and also provided reflections at the end of each training session. The use of prepared, hands-on science activities by classroom teachers were documented over two school years.

Jack D. Gordon Elementary Community School
Science Achievement Data

SCIENCE FCAT ITEM SPECS. PRE-POST-TEST



Jack D. Gordon Elementary Community School ESE
Science Achievement Data



It is also worth noting that in the year teachers increased the frequency of hands-on science in their classroom, the target school posted Science FCAT scores that surpassed the district and state levels as seen in the chart below.

District Average score 2003-2004	State Average score 2003-2004	School Average score 2003-2004
266	286	295

DATA ANALYSIS:

When analyzing the pre-post-test data, it is evident that the greater the frequency of hands-on science instruction, the greater the science content knowledge will be. This is most evident when you consider that the lowest

performing students in the fifth-grade population surveyed showed the greatest gains in science content knowledge. Additionally, it is important to review the data from the initial pre-test. The students in the COMET class posted the lowest average test score, which was an average of only 18 out of 64 points scored compared to the average fifth grader not in the COMET class who scored an average of 27 out of 64 points. However, on the post-test, these students scored as well as 5 out of the 10 classes tested with an average score of 35 points.

The green slip service was offered for several years leading up to this study. Even with this service available, most teachers chose not to integrate science past their textbooks in their classes. With this resource available, why didn't teachers take advantage of this service? In talking to teachers reviewing surveys, both of my assumptions were realized. Teachers did not feel comfortable teaching the content and they lacked the time to devote to the set up and implementation of science experiments. In further analysis of FCAT science field test scores, a trend was noticed. The few teachers who completed science experiments in their classes, scored significantly higher than those who had not. After participating in the eight sessions and collaborating on science instruction, teachers not only began to do more hands-on science, but were also requesting that the school purchase science specific materials to support their hands-on science as well as their use of technology to teach science.

With regard to teacher collaboration, the following represents written comments made by the teachers who participated in the study. The overwhelming theme is resurgence in confidence with respect to teaching science.

> "I have done more hands-on activities this year than last year. Next year, I plan to do more. I have implemented many new science strategies with my students as a result of participating in TLC."
>
> "I think analyzing the pre/post data will help me to guide my teaching. I can see what areas my students did poorly in as a whole and try to find more hands-on activities for next year."
>
> "One new skill I learned through TLC was the use of a laserdisc player and how to incorporate it in my science instruction. I feel this gave me more confidence in using the equipment and made me more willing to try new techniques."
>
> "I feel that the materials used in the curriculum planning session will be helpful for my science instruction. I think the guide we produced will shape my instruction. I can also use the materials as a reference point to enhance the science subject matter being taught."
>
> "The most valuable thing I gained out of these sessions was being able to collaborate with my colleagues. Having everyone share what they knew brings great information to one another."

At the end of the study, students completed an essay asking them to describe their favorite science activities and to compare the frequency of hands-on science from the previous school year. Their comments reveal clear enthusiasm for the hands-on approach:

> "Last year we only did science in the lab. This year, our teacher did experiments with us in the classroom."
>
> "I didn't used to like science because it was boring to read it in the science book. I like doing science experiments."

> "I really understand science better when we do experiments in class and in the lab. It is a lot more fun too."
>
> "I like when we get to use the Windows on Science (laserdisc) before the lesson. My favorite one was when we got to see the Killer Whale have a baby."

RESULTS/CONCLUSIONS/RECOMMENDATIONS:

After spending eight months learning science both in their regular classroom as well as in the science lab, an FCAT Science Item Specification Post-Test was administered to all fifth-grade students. When compared to the pre-test, the overall fifth grade population showed a 25% gain in science content knowledge. As stated previously, by teaching in a hands-on manner, we can better address the needs of students with varied learning modalities. Very often students attending exceptional student education classes have a great deal of difficulty in tasks that involve reading comprehension, because many of them are not reading on grade level. They experience lower success rates when teachers teach only using a textbook. After analyzing the test data, that the overall student population posted gains of 25%, the ESE students showed gains of 30%. Upon starting this project, it was assumed that the greater the frequency of hands-on science, the greater the science content knowledge that would be obtained. To better illustrate this, I took the lowest performing students in our school, the 21 students in our alternative education program, and invited them to participate in activities in the science lab weekly instead of bi-weekly like the other fifth -grade classes. Their post-test data showed that the average gains for this class of 36%. That was 11% greater gains than the average fifth-grade class. Similarly, the individual ESE students in the alternative

education class showed gains of 28%, 40%, 42%, 49%, and 51% respectively for an average gain of 42%. The students in the COMET program were also invited to spend an additional day in the science lab bi-monthly on the weeks that they were not scheduled to attend, giving them twice as much hands-on instruction as the other classes. Reviewing their test data, I believe this demonstrates clearly that the greater the frequency of hands-on science instruction, the greater the student science content knowledge will be.

POLICY IMPLICATIONS:

Given the opportunity for elementary teachers to collaborate with a science resource teacher, they will gain a better understanding and comfort level teaching hands-on science, thus increasing student science content knowledge. Students should be provided the opportunity whenever possible to take part in hands-on instruction to support their successful acquisition of science content knowledge. Therefore, labs should be set up in elementary settings to support hands-on instruction or equipment should be made available for teachers to use in their classrooms. Professional development must be offered to elementary teachers to give them a better understanding and comfort level of science content knowledge as well as the use of manipulatives to teach hands-on science. It is imperative that universities infuse the use of hands-on science when instructing their pre-service teachers.

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APPENDICES

APPENDIX A

Teachers: I am in the process of securing a $1,000 grant for my research project. The entire $1,000 would be split evenly between the fifth-grade teachers in the form of gift certificates to Get Smart to buy materials of your choice for your classrooms. In order to qualify for the $100, you must participate in nine 45 minute science support sessions. These sessions will provide you with hands-on activities you can use in your class as well as other science strategies. The success of this program depends on your support. Please let me know if you would be willing to participate and which of the following times would be best for you.

_____ two days a month from 7:45-8:30am
_____ two Wednesdays a month from 2:30-3:15pm

Thank you for your cooperation and dedication to your students. This survey will be used as data for of my action research project. If at all possible, please return it to me prior to December 19th. Please place a check in the column that describes how you feel about each statement. When completed, please return this survey to my mailbox. There is no need to write your name on this survey as all responses will remain anonymous.

Science Attitude Survey

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1. I find the Sunshine Standards in science to be confusing.					
2. I feel that I have a great deal of science content knowledge					
3. I feel that my teacher education training prepared me to teach elementary science					
4. I find it a hassle teaching using hands-on science					
5. I have all the materials I need to teach science in my classroom					
6. I am able to obtain the materials I need to teach science in my classroom					
7. I teach most of my science lessons by reading with my students out of our science textbook					
8. I teach hands-on science in my classroom at least twice a month					
9. I think that the science textbook does not adequately address the state science standards					
10. I think that students understand science more by participating in hands-on inquiry based science					

APPENDIX B

After reviewing your FCAT Science Post-Test, please take some time to reflect on the sessions we have spent together and complete the survey below. Your answers will assist me in processing the data for my research project and to determine the effectiveness of the collaborative time we have spent together. You do not need to put your name on this survey.

Since taking part in ***TLC*** (Teachers Learning and Collaborating), do you find yourself watching more science related television, reading more science related books, or purchasing science related materials for your classroom? Please explain.

What new teaching strategies have you used since your participation in this program?

How many more hands-on science activities do you estimate you have done this school year compared to last year?

Have you used a laserdisc with science related materials with your class this school year? Had you done so in past years? If so, did you find your use this year to be more than last year?

Do you feel that analyzing student pre-post-test data was important? Do you think it will guide your teaching next year?

What new skills did you learn through your participation in this study. Do you think it made you a better teacher or made you more confident in the area of elementary science? If so, please explain why.

How important do you think teacher collaboration is and if you were given the opportunity to take part in additional science sessions next year, would you choose to participate in a one -hour session per month?

How do you think you will use the materials created in the curriculum planning session in the upcoming school year?

What was the most valuable thing you learned through your participation in TLC? Which session(s) did you find the most valuable?

APPENDIX B

Student Name:_____ Date:_____

Dear Student,

This year, I have been collecting data as a teacher/scientist just as you collect data in the lab. I just finished grading your FCAT POST-TEST and am so proud of how WONDERFUL you did and how much you improved from the PRE-TEST. THANK YOU for all your hard work, I knew you could do it!

I have been working with your classroom teacher this year showing them new things to do with you in your class during science. Please help me to find out how successful I have been by answering the following question.

Thanks for helping me with my data collection and for all your hard work this year. You are the BEST!

Mrs. Davis

Think about your experience learning science in 5th grade (while you were not in the science lab). Reflect back on your classroom science learning experiences in 3rd and 4th grades. Did you do more experiments with your homeroom teacher this year?

write about how you learned science with your classroom teacher this year and some of the things you liked the best. Be specific and explain some of your favorite CLASSROOM science experiences as well as your favorite SCIENCE LAB experiences.