

THE IMPLEMENTATION OF MATHEMATICS JOURNALS IN THE SCIENCE
CLASSROOM TO RAISE STUDENT ACHIEVEMENT IN SCIENCE CLASSES

by

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A professional paper submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2012

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July 2012

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INTRODUCTION AND BACKGROUND

Project Background

Teaching Experience & Classroom Environment

For the past 27 years I have been teaching middle school science in Palm Beach County, Florida. The last year has been at Tradewinds Middle School in Lake Worth, Florida as an eighth grade science teacher. I teach a variety of levels, including two regular eighth grade science classes, three advanced eighth grade science classes and one high school credit Honors Earth Science class. Tradewinds is a suburban public school consisting of 1199 students making up the sixth, seventh and eighth grades. The student population is culturally diverse including 25% White, 35% Black, 36% Hispanic and 4% other students. Tradewinds Middle School is a Title I school meaning there is a large amount of students receiving free or reduced lunch. The percentage of students at Tradewinds receiving free or reduced lunch is 72%. Many students come from low income households. I also have many students whose primary language is not English.

One of the teaching strategies that is often used in my classroom is cooperative group work particularly during laboratory work. Students typically sit in groups of four to complete lab assignments and to write lab reports. One of the problems that I noticed was that students were having difficulty collecting and analyzing data and working with numbers in general. Things as easy as averaging numbers and as difficult as constructing graphs to illustrate their data were causing my students' grades to suffer. Students often raise their hands and ask questions about how to do basic math that I know they have been taught in their math classes. This problem has been very frustrating for me. I am

having to re-teach math skills, with which I know they are familiar but for some reason they are unable to transfer this knowledge to their science class. I feel this frustration is also felt by the students as they are confused by simple math concepts which cause their grades to be lower than expected. Math and science go hand in hand and I want my students to have confidence in using skills they have learned in math class to complete their science lab work. When I grade their lab reports many points are missed on simple math concepts. I also feel there is a lack of comprehension on the student's part as to the purpose of the lab and what it is that I want my students to learn by completing the lab. They constantly complain about having to include math on their lab reports, such as data tables or graphs. I would also like to save the time used to re-teach math concepts on other science concepts.

In my eighth grade science classes, my goal is to teach critical thinking skills and science processing skills over memorization of facts. The inability to complete the lab report to their satisfaction causes a high frustration level for many students. Students are not used to solving problems as a group and often try to hide their work from others in the group instead of solving problems together and sharing ideas on how to solve problems. Many factors affect student success in the science classroom and lack of communication seems to be near the top of the list.

Focus Question

Concern about student achievement on lab reports and assessments and the lack of confidence in their abilities to collect and analyze data has led to my primary focus question for my action research project: Why do students have difficulty using

skills taught in math class in science class? Also, I would like to investigate the following subquestions to improve my teaching methods: Will student grades improve through communication using math journals to reflect on problem solving? Would communication with me and their peers about where they are having difficulty solving problems improve using math journals? Would students feel more confident using their math skills in the science classroom to complete lab reports after using the math journals?

CONCEPTUAL FRAMEWORK

Two subject areas that have always been intertwined are the study of mathematics and science-both use numbers to express relationships. While mathematics may be considered a discipline that can exist in purest form, more specifically, in a framework that does not require interaction with other disciplines, science without mathematics is unthinkable. It has been said that mathematics is the language of science (Appling, 1994). A goal of both the National Council of Teachers of Mathematics and the National Science Education Standards is to teach students how to communicate with numbers. The goal of my action research project is to increase student achievement on lab reports which use data collection and analysis to increase their understanding and communication of this data and to communicate it to others using graphs or other visuals.

Journal writing can be a valuable technique to develop and enhance mathematical thinking and communication skills. A math journal is one of the best ways to introduce writing into a math lesson. It helps students stretch their thinking and make sense of problems that can sometimes leave them confused or frustrated. According to Burns (1995), writing has two major benefits. It supports students' learning because, in order to

get their ideas on paper, they must organize, clarify and reflect on their thinking. Writing also benefits teachers because students' journals are invaluable assessment resources. Their writing is a window into what they understand, how they approach ideas, what misconceptions they harbor, and how they feel about what they are discovering. How a teacher uses journals depends on her purposes, preferences, and the particular age and needs of her students. Reading student journals gives the instructor an overview of how the class responded to particular lessons and helps them to evaluate the effectiveness of their instructional choices.

When students have to reflect on their methods of problem solving the math no longer becomes a step by step task whereby the individual follows their teacher's step by step instructions on a worksheet but becomes a record of the experience of solving the problem. When a student writes about problem solving strategies, it helps to clarify strategies. Burns (1995) states that it can also be helpful to have students write not only about math concepts or problems, but instead on some aspect of student learning processes. For example, you might ask students to write about what was their most and least favorite lab and why. Or have them write about what makes a good lab partner or how well they worked with their lab group. Writing in a math journal isn't meant to produce a product suitable for publication, but rather to provide a way for students to reflect on their own learning and to explore, extend, and cement their ideas about the mathematics they study(Burns, 2004). Reflective writing can be inserted into the body of a lab report to enable students to revisit the information acquired in the lesson (Gooding & Metz, 2012).

Over the years many studies have shown that there is a disconnect between skills students learn in a mathematics classroom and the skills that they display in their science classes. Beauford (2009) claims that in science class, students perceived that the mathematical shortcuts and formulas manipulated for efficiency produced something new, not related to the step-by-step strategies they were seeing in mathematics classes. Data gathering and analysis in science class is the cornerstone of learning science, but students are rarely asked to gather data in a mathematics textbook although it has been called for by the *Principles and Standards for School Mathematics* (NCTM, 2000). Students are asked in math class to solve problems assigned by the teacher on a worksheet and are rarely asked to apply these skills to the solving of a real life application. In science classes, students are often asked to collect data during an experiment or observation of natural phenomena as encouraged in the *National Science Education Standards* (NRC, 1996) and then analyze it to draw a conclusion or to construct a graph.

Fogarty (1991) states that disciplines--the “subjects” we teach—are artificial constructs that serve effectively as organizers and reservoirs of human knowledge. Most people, however, learn in quite different ways. Three key understandings seem critical here:

- We learn by connecting new information to familiar information, which is almost always organized by individuals, not neatly in a discipline.
- For almost everyone, learning is social. It requires watching and interacting with others.

- Relevance is critical for most learners. We need to see something useful in new information before we expend the energy to integrate new information with existing knowledge.

All three of these key understandings could be addressed through the use of mathematics journals. Writing down their thoughts and ideas about solving a problem and then sharing it with other members of their lab group or the teacher may cause revelations to occur. Fogarty (1991) has identified ten models of integration, several of which could be implemented through mathematics journaling. The Threaded Model calls for teachers to incorporate into their teaching strategies techniques such as inquiry and self-reflection. The teacher may ask the student to discuss in their journal such questions as, “What thinking skills did you use and find most helpful in solving the problem? The Connected Methodology focuses on the details, subtleties, and interconnections within an individual discipline. The instructor might assist students with connecting one day’s work or ideas to the next. Nested Integration takes advantage of natural combinations such as a measurement lab which requires students to collect and analyze data and then communicate their data via a graph. Students could also use their journals as a place to brainstorm ideas for problem solving. These strategies could be used at the beginning of class as bell-ringers or at the end of class as exit slips. The idea being to incorporate journaling into everyday thought processes.

Helping students learn more about science and technology and become more skilled at problem solving and analysis has been the goal of recent educational efforts. New technologies have generated increased and varied application of scientifically based materials in the world of work, thereby increasing the importance of science and math

knowledge and skills for workers (Lankard, 1993). Some of the following strategies have been suggested to accomplish this goal:

1. Collaboration of math and science teachers so each is familiar with the curriculum of the other.
2. Math and science courses must use the tools of the trade as much as possible
3. Students should keep journals detailing areas of difficulty and areas of success.
4. Staff must be well trained and have the opportunity to work with materials in industry or laboratory settings.
5. Using community experts to help students and staff alike.
6. Using technology to help students learn to communicate through the use of graphs, charts, thematic maps, etc.

Kline (1972) repeatedly stressed the need to teach the applications and usefulness of mathematics rather than expecting students to enjoy it for its own sake. Also, he urged that mathematics concentrate on solving problems posed in other fields rather than building structures of interest only to other mathematicians. Kline (1972) called mathematics a “part of man’s efforts to understand and master his world”. As a science teacher this quote speaks to me as I try to understand and share with my students how physicists and astronomers explain the workings of the universe through mathematics. Journaling involves having students record their thoughts and understandings and helps them construct meaning between what they learn in mathematics classes and their lab work in science classes.

At this time, most schools segregate their curriculum, math in one room, science in another, with no interaction between the teachers and separate curriculum that does not support what is being done in either classroom. Cross-curricular activities are often thrown in the back of the textbook as an afterthought. A lack of time for planning seems to be the main reason curriculum is not integrated. Despite enthusiasm for the idea of integration, teachers lack the time needed to make thoughtful connections in the curriculum. The lack of evidence for improved student understanding or a saving of time hampers efforts to integrate content areas. Lack of information and professional development about different types of integration also hinders the process. A fully integrated curriculum combines disciplines in a synergistic manner that makes the knowledge of one subject inseparable from that of another subject. Science labs inherently integrate math and science, from measuring, to collecting and analyzing data, to graphing and communicating the results.

If the teachers of mathematics use scientific examples and methods, understanding in both disciplines will be enhanced and when the science program at the school is coordinated with the mathematics program, then the students' use and understanding of both mathematics and science are improved (Mason, 2004). Becoming "graphicate" is becoming an important part of everyday knowledge, equal in status to being literate and numerate. The National Council of Teachers of Mathematics has acknowledged writing as an important component of math instruction. The Council's *Principles and Standards for School Mathematics* (2000) states that "written communication should be nurtured" (p.62) and that math instruction should enable all students to

- Organize and consolidate their mathematical thinking through communication
- Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- Analyze and evaluate the mathematical thinking and strategies of others.
- Use the language of mathematics to express mathematical ideas precisely, (p.60).

To the young mind, everything is individual, stands by itself. By and by, it finds how to join two things, and see in them one nature; then three, then three thousand; and so, tyrannized over by its own unifying instinct, it goes on tying things together, diminishing anomalies, discovering roots running underground, whereby contrary and remote things cohere and flower out from one stem. The American Scholar," In Emerson: Essays and Lectures, ed. Joel Port (1983).

METHODOLOGY0

My capstone project addresses the use of math journals in science class to improve student attitudes and communication and therefore student achievement. Will student confidence and comfort levels improve through discussion of where their difficulties lie? Will an understanding of where their problem-solving difficulties lie enable them to develop new strategies to solve those problems. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Participants

This action research project took place at Tradewinds Middle School in Palm Beach County, Florida. Palm Beach County has a population of just over a million people and is located on the East coast of South Florida. Palm Beach County and Tradewinds Middle School are extremely diverse, both economically and culturally. Palm Beach County is home to many millionaires and alongside their mansions reside immigrants from the poorest countries in the world. Our school is a Title I school with 72% of our students receiving free or reduced lunch. Two classes of students were used in this study. Both classes consist of 22 advanced eighth grade students. One group was asked to keep the math journals and the other group was used as the control group using my usual methods of teaching labs. The combined student population of the two classrooms is 44. Table 1 provides some basic demographics for the two classes.

Table 1
Demographics by Class

Class Period	# of Students	Male	Female	Caucasian	Latino	African-American	Asian-American
2 nd	22	11	11	13	6	2	1
3 rd	22	13	9	3	14	4	1

Intervention

My capstone project spanned several basic chemistry units that occurred between January and April. The chemistry units enabled students to complete several labs on such topics as acids and bases, physical and chemical change, exothermic and endothermic reactions, and balancing chemical equations. These labs gave students a variety of problem solving situations to experience. Data collection, the analyzing of data, and the graphing of data were the science processing skills I most wanted to concentrate on in the student math journals.

Math journals were used in the science classroom to help students communicate where their difficulties lie while collecting and analyzing data during science labs. Test taking tips related to problem solving were also included in the journal and discussed in class. My students were able to reflect on their frustrations and “talk” through the steps of problem solving. The journals gave students who were unable to articulate their questions and difficulties orally, for whatever reason, a place to write them down where they could then be addressed. Questions for students to reflect upon were assigned by the teacher to lead them in the right direction before they began the assigned lab. After reading the students’ thoughts about where their difficulties lie, I addressed these specific problems before the lab began.

My triangulation matrix included a student attitude and confidence survey, student interviews and student journals, and student scores on lab reports and assessments. Teacher observations were also recorded as the project progressed. The data sources I used are summarized in Table 2 below.

Table 2
Triangulation Matrix

Focus Question	Data Source 1	Data source 2	Data Source 3
<i>Primary Question:</i>			
1. Why do students have difficulty using skills taught in math class in science class?	Pre-attitude and Confidence survey	Journal writing and student interviews	Lab Report scores
<i>Secondary Questions:</i>			
2. Would communication about where they are having difficulty solving problems improve using journals?	Journal writing	Student post-interview	Instructor observation
3. Will students feel more confident using their math skills in science class to complete lab reports?	Post-attitude and confidence survey	Student interviews	Teacher observations
4. Will student grades improve through communication using math journals to reflect on problem solving?	Teacher observations	Lab Report scores	Assessment scores

Assuming that students know the math skills needed to do the lab successfully has become a thing of the past in my classroom. The journal itself was not graded but as students became more confident in their problem solving skills I expected their lab report and assessment grades to improve. I conducted the survey at the beginning of the study and at the end to see if their feelings changed after I implemented my learning strategies. Collecting student scores on lab reports and assessments was the third part of my data collection. I used my interventions with my period two students and compared the results with my period three students who did not receive the interventions. In my classroom,

data collection and analysis is the largest part of the lab report grade and I was hoping these scores would improve while raising the confidence levels of my students in their problem solving abilities.

I first assessed students' feelings and opinions about how comfortable they are using their math skills to complete science labs. I did this using a student attitude and confidence survey (Appendix A). This data collection instrument will allow me to determine which journal prompts may be beneficial to my students. The journal prompts will be given as a bell-ringer activity during the first five to ten minutes of class. After completing several of these assignments I will assign math problem solving strategies, such as Guess and Check, Finding a Pattern, Using a Formula, Estimating Unknown Quantities, and many others. These strategies were discussed in students' journals. Journals were used to record short, informal, exploratory thoughts or ideas. Reading my students' journals let me know where their difficulties lie and what direction to go in while giving instruction. Many of these strategies are already used in science labs but students have no idea where to begin to solve problems. I believe that student comprehension about what they are actually learning by doing labs is very limited. They follow the directions to do the lab but sleepwalk through analyzing the data and drawing a conclusion. I am interested in having students write a paragraph explaining how they solved a problem and then explain it to other students in the class. We know that students who teach the material to others understand and retain information at a deeper level than those who simply memorize it.

The third phase of my project consisted of collecting student lab report grades and assessment grades to see if student grades had improved over time. I compared the

grades of the class using the interventions to the grades of the control class to see if the class using the interventions showed any signs of improved achievement. Both of these classes completed the same labs and solved the same problems. I also feel that looking at my students' grades in their math classes may provide me with additional information.

At the end of the intervention, I used my students' journals to modify the pre-attitude and confidence survey and the interview questions (Appendix D) to collect additional data from my students to determine if my interventions were successful in helping students feel more confident in their problem solving skills.

DATA AND ANALYSIS

To try to answer my focus questions several forms of data were collected throughout the third and into the fourth quarter of classes. I used both quantitative and qualitative data to draw my conclusions. I will compare the quantitative data, such as lab report and assessment scores of my intervention group with another very similar group of students who completed the same labs and assessments as the intervention group to determine if an increase in student achievement took place.

Student difficulties using math skills in science class

My first claim is that my students are having difficulty computing simple math problems such as averaging numbers or changing a fraction into a percent while working on a lab report. These skills are taught every year in middle school math classes but for some reason my students are unable to use them to complete their lab reports. The main evidence to support this claim comes from my students' lab reports. While grading them I became concerned because most of the points lost were due to simple computational

errors and their inability to record and graph the data collected during the lab. I have also taught these skills in my science class and review them before we begin the lab exercise. Students often write comments on their lab reports like “I don’t know” or “I don’t understand”, or “why do we have to do math in science class?” Many of my students leave blank spaces on their papers without even making an effort to complete the math sections. Even though students work in cooperative groups of three or four students and are encouraged to work together to problem solve they are reluctant to do so. This may be because they are not used to working in cooperative groups and have not been properly trained to do so. Some are reluctant to share answers with students that do not contribute to the group effort while others spend their class time discussing irrelevant issues such as the basketball game that was on last night.

My pre-student attitude and confidence surveys (Appendix A) did not strongly back up my claim that my students were having difficulty using their math skills in science class but did indicate that students are unsure of themselves as most replied neutrally, neither agreeing or disagreeing.. I first grouped student answers by gender to see if there were any differences but did not see a correlation between gender and mathematics difficulties. Boys and girls almost equally disagreed that mathematics made them feel uneasy and confused although several fell in the neutral category which does not back or refute my claim, although I wonder if this neutrality indicates indifference or confusion. Four students did agree that math was their most dreaded subject while on the other side, six students agreed that they enjoyed working on a difficult problem. Thirteen students agreed that they could solve a complex problem by breaking it down into smaller steps. Only six students agreed that communicating with others helped them with their

attitude towards mathematics. On the post-student attitude and confidence survey there were fewer neutral answers and more students answered agree or disagree which seems to indicate a small increase in communication. Whereas neutrality gives me nothing to work with when teaching my students, a disagree or an agree response gives me a direction to work towards.

To add additional support for this claim I also chose three girls and three boys from my second period intervention class that I felt would discuss their difficulties with me and answer my interview questions honestly (Appendix B). These students were reluctant to admit any difficulties they may have been having in my class. Over and over I heard, "I'm not having any difficulties, I can do this stuff. I am wondering if the fact that all of these students are in Honors Algebra or Honors Geometry has anything to do with their denial. I believe embarrassment over missing basic skills may be a factor. When I asked, "Are you comfortable with the math skills you have to complete assignments in science class" one of the girls answered, "No, because I have enough math to do in math class and I don't want to mix science and math together. Science is a thousand times better without math!" Another girl in my class stated, "Even though the math done in science is a lot simpler than the math done in my algebra class, I find that doing math annoys me". The third female student that I interviewed said, "No, I'm not comfortable to tell you the truth, I really don't know why. But I think it's because it doesn't look the same as in math class. It looks more "scientific" than mathematical". These types of statements tend to make me believe that in the past my students were taught math and science totally separately and they do not see the relationship between the two and that science has been for them just the memorizing of facts.

The males that I interviewed had some slightly different comments than the females. The first boy I interviewed said, "I feel I am comfortable because I do well in math class. If I miss something it may be because I am going too fast." The next boy replied, I feel comfortable because I am in geometry and the skills I have learned so far help me." The last boy I interviewed stated, "Yes, I am comfortable with my math skills for science class because math and science are very similar." These answers seem to indicate that the males have more confidence in their abilities while the girls will admit to having difficulties.

When asked "Where do you think your difficulties lie in using math skills to complete lab reports", all six students either shrugged their shoulders or said, "I don't know." For many of my students, eighth grade has been the first year they have ever been involved in doing science labs and they have never been introduced to the math skills needed to be successful in science class. These results indicate to me that many students are struggling to incorporate math into their science classes and my hope is that the results of my action research project will enable me to effectively adjust my teaching methods to better meet my students' needs.

My second claim is that students cannot collect data and create a data table in which to record it. This claim was also backed up by student lab reports, student journal entries and one of my interview questions which asked, "Do you work with your lab group to collect and record data or do you complete this on your own?" Even though students commonly work with sets of data in math class they are not able to take the data collected during a science lab and record it on a data table.

The first piece of evidence to back up my claim was student lab reports. When

grading my students' lab reports it was evident that data collection and recording was a problem because the majority of lab reports were incomplete or done incorrectly. My students do not seem to grasp the idea that a data table and a graph are two different ways to display the same information. I always begin the school year teaching my students how to write a lab report and students are given data tables which are completely labeled and all they have to do is fill in the numbers. Later in the year I would ask my students to create their own data tables.

One of the questions on my student interview also provided some evidence toward this claim. When I asked, "Do you work with your lab group to collect and analyze data or do you complete that part of your lab report as an individual?" One student stated that it was the student's responsibility to collect and graph data on their own. Another student replied, "I don't know what to do on the labs' data tables." The following quote from one of my students sums up the confusion of the class quite well when he states, "I work with my lab group to collect and analyze data because then we have everyone's opinion of what happened and we can make better observations and conclusions." Middle school students tend to let one person in the group do all of the work while the others just copy, instead of everyone in the group contributing to the final product. Middle school students are also reluctant to let others know that they don't know what they are doing so they continue doing things incorrectly instead of working together to figure out the correct way to complete a task.

The third piece of data that supports my claim would be my students' journal entries on data recording. Several times during the intervention period I gave my students a short set of data and asked them to construct a data table in their journals. This was a

bell-ringer type of assignment which we went over together a few minutes into the period. Many of my students were unable to do this and I observed a high level of frustration as they began to talk to one another to ask how to do the assignment and some of them even got out of their seats to try to get the answer from a friend. These behaviors occurred even though I had asked that students do this on their own like it was a test question. After spending a couple of minutes going over the problem I asked the students to write a short paragraph explaining where their difficulty was in solving the problem. Later on when I read their answers I was surprised that most of them wrote absolutely nothing about their difficulties. Four of my students wrote that it was easy for them and they had no difficulties, although when I checked their work three out of four were incorrect. I also had several students who wrote, “I don’t know what a data table is.”

Using journals improved student communication with their teacher and peers.

Using journals improved student communication with their teacher and their peers by allowing the students to reflect on where their difficulties might lie. At the beginning of my project I assigned each student a composition book to use as a journal. By reading the student reflections I learned information that was helpful when planning my lessons. One student wrote in his journal that math did not “look the same” in science class as it did in math class. Another told me that doing math in science class is “annoying”. Neither one of these student perceptions would have entered my mind before reading them in my students’ journals.

Before journaling students could only raise their hands to ask questions in front of the entire class, often just making the statement “I don’t get it?” , instead of asking a question related to solving the problem. Journaling increased their comfort zone by

making them less afraid to be wrong and to ask others in their lab group for assistance in solving the problem instead of asking their teacher for the correct answer thereby making them more self-confident. They could also work on their problem solving skills without fear of being graded. These results did not occur right away but took several weeks of practice. The student journals provided evidence for the above statements as student entries became longer and contained more information as time went on. As students reflected on their learning they began to understand that there is a process involved in learning and that when you understand how you learn you can make adjustments.

The second source of evidence to back this claim was my post-intervention student interviews (Appendix D). After my intervention I re-interviewed the same six students with slightly altered questions to determine if their attitudes and confidence levels had changed. When I asked, “Do you feel more comfortable using your math skills in science class after reflecting on your difficulties?”, four out of the six students felt their comfort level had improved making comments like “I have a place to write down my thoughts to get them straight” and “writing in my journal makes me think about how I solve a problem”. The other two students felt that writing in a journal was extra work and didn’t really help them communicate their difficulties. One student stated that they had a lot of work to do and the journal held them back and wasted time. Three students did feel that the journal was an important place for the teacher to find out what students are thinking about. I heartily agree that journaling was very productive from the standpoint that it took me inside my students’ minds and allowed me to better understand where my students’ difficulties lie. The entire class shared with me that they had never kept any

kind of a journal in any of their prior class. This revelation has inspired me to keep some kind of journaling activity a part of my curriculum in the future.

I also made several observations which supported my claim that students felt more confident. My students seemed more comfortable communicating and sharing ideas with their lab partners when they had their journals in front of them because they had a place to jot those ideas down as they discussed them. One of my students described their journal as a place to organize their thoughts. They did not seem as reluctant to throw ideas out to the group. I also felt like I received more information when students took time to reflect and not just yell out “I don’t get it!” I need students to be able to verbalize a specific question or to explain to me what they don’t get instead of becoming frustrated and giving up. Writing in their journals forces students to do this. I also observed students pointing at their journals when arguing a point with a lab partner. Although two students felt that writing in the journals was not helpful to them it has provided them with another technique in their repertoire of learning strategies. My hope is that as student confidence rises they will write in their journals as needed without teacher intervention.

Students will feel more confident using their math skills in science class.

The most compelling evidence to support this claim is teacher observation. When completing lab reports my students were struggling to collect and record data. There were so many questions I had trouble circulating around the room to answer them. They turned in incomplete lab reports which I later found out was not because they did not want to complete them but because they did not know how to complete them. After spending time reflecting on their difficulties students seem more confident and are able to complete their lab reports without asking so many questions. The majority of the lab reports are

now turned in completed, which helps to improve student grades. More of my students feel confident to step up and be the group leader. One of the jobs of the group leader is to make sure everyone understands what they are doing and that they are contributing to the group. I have also noticed more debate among my students which I believe is due to feeling more confident about their abilities. They constantly run to me to show me their work which they did not do previously.

My students also chose answers on the post student survey which showed an increase in confidence. The number of students agreeing that they liked listening to others when trying to decide which problem solving method to use rose by three and the number of students that make a plan before solving a problem rose by five. All but one student claimed that communicating with other students helped them have a better attitude towards math and that they now ask their teammates for help when solving problems. Many now also claimed that they enjoy working on a difficult problem and figuring out how to solve the problem. Instead of just memorizing facts my students are learning how to work together to problem solve. I enjoy seeing all of my students contributing to the final product instead of sitting in their lab group with a confused expression on their faces.

The last piece of evidence for the above claim was my post-study student interview (Appendix D). Question number three asked if their feelings had changed about their willingness to work with others to complete lab reports. Five students reported that their feelings about being part of a lab group had not changed although they could not articulate why that might be the case. The remainder of my students felt that their feelings about group problem solving had changed in a positive way. They reported feelings such

as “We are more likely to come up with the right answer” and “I have someone to help me if I get stuck”. These statements indicate to me a higher confidence level about completing lab work correctly.

Student grades will improve through improved communication via journaling.

To prove the claim that my students’ grades will improve through math journaling I tracked my students’ lab and test scores using the Tradewinds Middle School Progress Tracking Chart (Appendix C). I recorded my students’ grades beginning in January and running through April. I separately averaged the lab scores and the test scores for the third quarter and the fourth quarter and compared the averages from my second period intervention class to my third period class that did not receive the interventions. Both classes exhibited an improvement of a few percentage points in both the lab report and assessment categories. The average lab scores of the intervention class improved by seven percentage points, moving from 70% to 77%. The average lab scores of the class that did not receive the interventions improved by eight percentage points, moving from 62% to 70%. The difference of one percentage point between the two classes is so small that it is statistically insignificant. I was surprised by the consistency of the averages with and without the interventions. My journal intervention did not seem to affect student learning as both classes showed a similar improvement which was probably due to my usual teaching methods. The change in assessment scores was even smaller. The intervention class showed an average increase of two percentage points and the class that did not receive the interventions improved by one percentage point from an average of 71% to an average of 72%. Again, this amount of change is statistically insignificant

(Figure 2). The fact that the averages were so close surprised and disappointed me.

Although I feel having students reflect in their journals was beneficial in many ways my ultimate goal of improving grades was not realized.

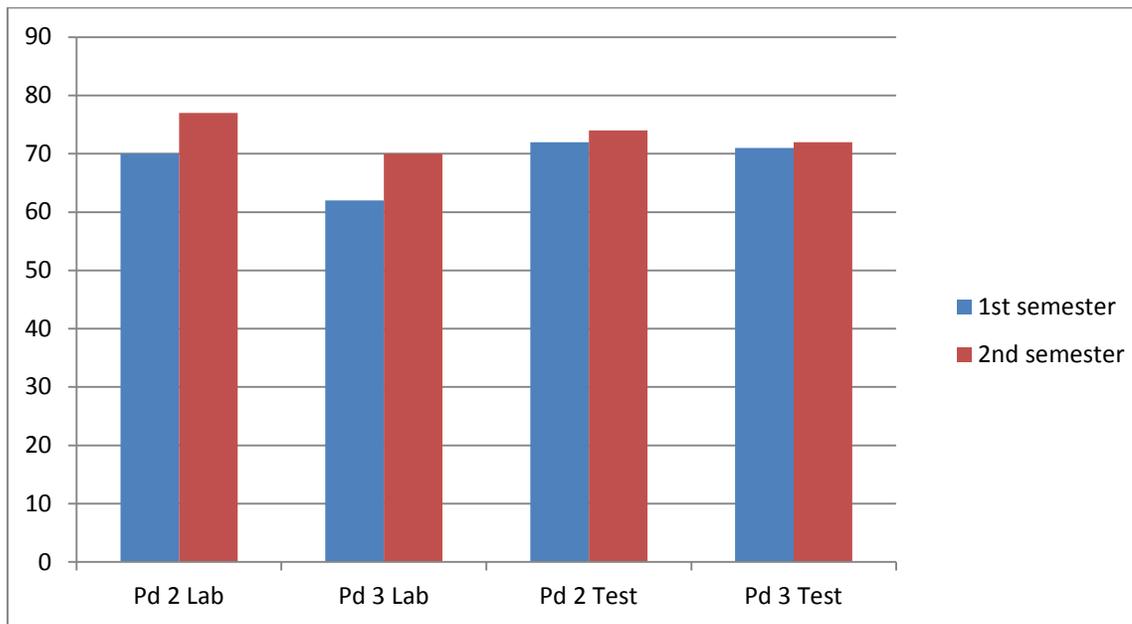


Figure 2. Average Lab Report and Test Scores, Intervention Group vs. Non-intervention Group.

My observations while grading individual lab reports showed that students were doing a better job of completing their lab reports correctly. Data tables were more complete and most of my students were able to construct a graph displaying their data. I also observed an increase in the number of students who were successfully working cooperatively in their lab groups. Students proud of their accomplishments couldn't wait to show me their completed lab reports. There must have been other variables affecting the outcome. For example, most of my students shared with me that my class was the first time they have worked cooperatively to conduct a lab exploration. I assumed wrongly that advanced eighth graders would have some exposure to science processing skills. Due

to this lack of training I would expect to see improvement no matter what type of intervention I used.

INTERPRETATION AND CONCLUSION

My action research project has provided evidence that shows that my students do have difficulties and are often frustrated when asked to collect and analyze data while completing lab reports or taking an exam where they are asked to read a data table and answer questions. An example, which I will never forget, is when a student drew a lab table on their lab report when asked to draw a data table. They often do not see a relationship between the skills they learn in math class and the skills they need to successfully complete their lab reports. My students' inability to communicate their difficulties and frustrations with using their math skills was evidence that this is definitely something I want to continue to work on. Time for reflection and an opportunity to write in their journals was ultimately a positive experience, although getting my students comfortable with expressing themselves was a slow and painstaking process. I planned on the journal writing activities as bell-ringers and exit slips but they turned into activities that encompassed the entire period. As I got deeper into my project I realized just how large this problem is and quickly became overwhelmed with trying to find solutions to increase student understanding.

The results of this study also illustrated to me the importance of not making assumptions about what my students know and are able to do in an eighth grade advanced class. Getting to know my students at the beginning of the year as well as possible is of

the utmost importance as I need to plan my lessons meeting them where they are and then moving them forward. Proficiency for all students and enhancing scientific literacy is a lofty goal but one toward which I strive.

VALUE

The experience of working on my action research project has improved my teaching methods in several ways. I also believe it has improved student communication in my classroom. The first and most important area is reflection, both for myself and for my students. I now realize how important it is to take the time to reflect on my teaching methods as they relate to student learning. Teaching the curriculum should not be the only consideration when planning lessons. Teaching students how to learn, how to study, how to incorporate what they learn in other classes into science class and their everyday lives, and how to evaluate themselves and their learning is also important. Many of my interventions allowed me to get to know my students and their learning styles in greater detail. I also feel that their reflections in their mathematics journals helped them to get to know themselves better.

When I began asking my students to write in their journals they were very uncomfortable about expressing their difficulties and any frustrations they may have been having, but as we spent more time discussing their difficulties they became more verbal and expressive about ways to solve their problems and eliminate these difficulties. My plan for next year is to start off the first week of school using the student attitude and confidence survey to get to know my students. I would also like to continue with the journal writing but maybe expanding it to include more than mathematics. I would like

students to eventually write in their journals without prompting when they feel confused or they are having difficulties solving a problem. Maybe adding a “muddiest point” area in the journal where I could address student questions since many students in middle school are reluctant to ask questions in front of their peers. Instead of a separate mathematics journal I am planning to incorporate a reflection area in their interactive science notebooks to streamline the process of writing for my students and reading on my part.

The second area I would like to focus on for next year is showing my students that mathematics and science are related and that embracing that relationship instead of fighting it will make learning science easier and will include real-life applications for both subjects. During my action research project I shared with my students the data tables I created from their surveys. I also attempted to show them how I analyzed that data to improve my teaching, thus illustrating a real life application. My hope is that my students will begin to understand that they need to integrate all learning to solve life problems and that school is not just about memorizing facts. This will be especially difficult as the Florida Comprehensive Assessment Test which I have to administer to my eighth graders in April does not embrace the teaching of concepts which are not annually assessed on that test.

The third area I am interested in pursuing is collaborating with the math teachers that work with the same students I teach. This may prove difficult as I have no planning period and the physical layout of the school puts us miles apart. Also the math teachers are required to follow a pacing chart geared toward our state test and they are not allowed to deviate from it for special cross-curricular projects. The eighth grade math curriculum

may be something I need to look at incorporating into my curriculum. Showing the students this relationship is of the utmost importance to me as this was the basis of my action research project. I believe my project illustrated the disconnect most students have between their mathematics and science classes.

In conclusion, my project has shown me how important it is to take time for reflection both of my teaching practices and of my students' learning styles, attitudes and difficulties and to give my students the opportunity to reflect on these same things as they affect their learning. This project has brought to life for me the disconnect that teachers have with each other at the middle school level and how that disconnect is passed to their students. I truly believe that overall understanding and achievement would increase if students were more aware of how they learn and how skills learned in one class could be used to benefit their learning in another class. I truly believe that overall understanding and achievement would increase if students were more aware of how they learn and how skills learned in one class could be used to benefit their learning in another class.

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APPENDICES

APPENDIX A

STUDENT PRE AND POST ATTITUDE AND CONFIDENCE SURVEY

Appendix B-Math and Science Learning Attitudes & Interest Survey

Here are a number of statements that may or may not describe your beliefs about learning math and science. You are asked to rate each statement by selecting a number between 1 and 5 where the numbers mean the following:

1. Strongly Disagree (SD)
2. Disagree (D)
3. Neutral (N)
4. Agree (A)
5. Strongly Agree (SA)

Choose one of the above five choices that **best expresses your feelings** about the statement. If you don't understand a statement, leave it blank. If you have no strong opinion, choose 3. This survey is voluntary and will not affect your grade. All surveys are anonymous. Do not put your name on your paper.

I am _____ male _____ female

	SD	D	N	A	SA
1. Science is dull and boring.	1	2	3	4	5
2. Science is hard to understand.	1	2	3	4	5
3. Mathematics is dull and boring.	1	2	3	4	5
4. Mathematics is hard to understand.	1	2	3	4	5
5. Science and mathematics make me think.	1	2	3	4	5
6. Mathematics makes me feel uneasy and confused.	1	2	3	4	5
7. Mathematics is a solitary activity, done by individuals in isolation.	1	2	3	4	5
8. Real mathematics problems can be solved by common sense instead of the mathematical rules you learn in school.	1	2	3	4	5
9. I have never liked mathematics, and it is my most dreaded subject.	1	2	3	4	5
10. Ordinary students cannot expect to understand mathematics, they expect to memorize it and apply what they have learned mechanically and without understanding.	1	2	3	4	5

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|---|---|---|---|---|---|
| 11. I try to learn mathematics because it helps develop my mind and helps me think more clearly in general. | 1 | 2 | 3 | 4 | 5 |
| 12. I enjoy working on a difficult problem. | 1 | 2 | 3 | 4 | 5 |
| 13. I develop my own ways of solving problems. | 1 | 2 | 3 | 4 | 5 |
| 14. I use a step-by-step process to solve a problem. | 1 | 2 | 3 | 4 | 5 |
| 15. I make a plan before I start to solve a problem. | 1 | 2 | 3 | 4 | 5 |
| 16. I like listening to others when trying to decide which problem solving approach to use. | 1 | 2 | 3 | 4 | 5 |
| 17. Communicating with other students helps me have a better attitude towards mathematics. | 1 | 2 | 3 | 4 | 5 |
| 18. I like to work with others to complete lab reports. | 1 | 2 | 3 | 4 | 5 |
| 19. I try new methods to solve a problem when one does not work. | 1 | 2 | 3 | 4 | 5 |
| 20. It is important to report exactly what you observe when solving problems. | 1 | 2 | 3 | 4 | 5 |
| 21. In order to solve a complex problem, I usually break it down into smaller steps. | 1 | 2 | 3 | 4 | 5 |
| 22. When working in teams, I ask my teammates for help when I run into a problem or don't understand something. | 1 | 2 | 3 | 4 | 5 |
| 23. I can draw a valid conclusion based on evidence. | 1 | 2 | 3 | 4 | 5 |
| 24. Science and mathematics are important in everyday life. | 1 | 2 | 3 | 4 | 5 |
| 25. I'll need a good understanding of science and mathematics for my future job. | 1 | 2 | 3 | 4 | 5 |

APPENDIX B

PRE-STUDY STUDENT INTERVIEW

: Pre-Study Student Interview

1. Are you comfortable using the math skills that you have to complete lab reports in science class? Explain why or why not.

2. Where do you feel your difficulties lie in using your math skills to complete lab reports?

3. Do you work with your lab group to collect and analyze data or do you complete your lab reports as an individual? Explain.

4. What could Ms. Hammond do to make collecting and analyzing data and constructing graphs easier for you?

5. How do you think keeping a math journal will help you learn to complete your lab reports? Will it make you more comfortable using and thinking about your math skills?

APPENDIX C

TRADEWINDS MIDDLE SCHOOL PROGRESS TRACKING CHART

APPENDIX D

POST STUDY STUDENT INTERVIEW

Post- Study Student Interview

1. Do you feel more comfortable using the math skills that you have to complete lab reports after reflecting on your math difficulties in your journal?
2. Do you have more of an understanding about where your mathematics difficulties may lie after reflecting in your math journals?
3. Have your feelings changed about working with your lab group to collect and analyze data after reflecting in your math journals?
4. Have you thought of anything Ms. Hammond could do to make using math skills in science class easier for you?
5. Do you feel more comfortable discussing your difficulties with your teacher or your lab partners after using your math journals?
6. Do you think it would be beneficial to continue journaling as you begin high school?
7. Do you think Ms. Hammond should use journals with her eighth grade classes next school year?