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RAP (Reasoning and Proof) Journals: I Am Here

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Action Research Project Report

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Department of Mathematics
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RAP (Reasoning and Proof) Journals: I Am Here

Abstract

In this action research study of my classroom of 5th grade mathematics, I investigated writing in a journal as formative assessment. I also investigated how elementary age students would be able to utilize the National Council of Teachers of Mathematics (NCTM) process standard reasoning and proof. Using the Houghton Mifflin (2005) textbook and curriculum I discovered that writing reasons and proof as a formative assessment in a mathematics journal is a good way to teach mathematics. Having students solve math problems during the closure portion of each math lesson does a good job of holding students accountable for the math objectives and lets the teacher know who understood the mathematical objective each day. By using a reasoning and proof journal, students are able to demonstrate their understanding of mathematical concepts in words and numbers. Each student has the opportunity to explore and develop a conceptual understanding for each math objective while they write in their RAP (reasoning and proof) journal. As a result of this research, I plan to report my findings and share all the data to my Math in the Middle colleagues. I plan to use a RAP journal with a new group of students when I teach math next year. I hope to continue to develop these RAP journals further into the future. I hope to pioneer an effective strategy to reach students in the area of mathematics response to intervention (RTI).

I. Introduction:

I believe a relationship exists between the use of a mathematics instructional curriculum that emphasizes the students' ability to write reasoning and proof journals for daily math concepts and the students' ability to retain those concepts. In other words, I think that having students write in a reasoning and proof (RAP) journal will do something to their retention of math concepts. In this action research project I share all the qualitative data I collected for my classroom of fifth-graders.

I came to select this topic because I wanted to increase the retention of math concepts in my students for summative assessments. In the past three years of my teaching career, I have been frustrated by the fact that my students have developed retention of math concepts for only a short period of time. I thought the majority of my students could perform well on a formative assessment, but when it came to the summative assessment my students' scores would decrease. What could I do to bolster my students' retention? How could I impact those summative assessment scores? What could I change in the way I teach to benefit my students' math scores?

In order to boost my students' summative assessment scores I would have to use formative assessment in a manner that is frequent and meaningful. After attending a leadership development seminar for the school improvement process, I learned that in order for formative assessment to be effective it must be done at least twice a week. Research indicated that students' summative test scores increased dramatically when the teacher was formatively assessing twice a week. Due to this research, I decided to start having my students write in their RAP journals twice a week. Later in the year, I would increase the amount of times my students were writing in their RAP journals to every lesson. The data I show in this paper was collected after every math lesson.

When should I ask students to write in their math journal? I read some literature that explained how to use journals at the beginning of a math lesson. I did not want to use the math journal as an anticipatory set, so I decided to focus my attention on the closure of the lesson. I could not find any quality studies done in the literature I read about using journals this way, but this is the part of my teaching I wanted to improve. I creatively designed a formative assessment target for my students. My creative formative assessment method would incorporate a math journal and the National Council of Teachers of Mathematics (NCTM) process standard reasoning and proof. A lot of the literature I read focused on the NCTM process strand communication, but I wanted to do something different than what already existed.

The next thing I did was specifically teach my students what the formative assessment target looked like. The target my students were trying to hit involved them writing complete sentence reasons and number proofs for two to three problems at the end of each math lesson. At the beginning of my project I allowed the students to see the answers to the problems and then I started to leave the math journal problems blank. Students were strongly encouraged to make up their own characters and use a story format for their journal writing. This story format included a lead or attention getter, the body or math computation work and explanation, and a conclusion or satisfying ending. I did not give my students a checklist to follow, but I was thinking about using one in order for the students to meet my expectation.

The ideal students would begin their RAP journal with a creative attention getter and end it with a satisfying ending. These ideal classroom students would explain how to find the answer to the problem by using transition words to explain their reasons, and then demonstrate the correct mathematical computation work with numbers for what they had just written. Then the ideal students would write more using descriptive details in their reasons, and use numbers again

to prove what they just wrote. Students did not have to write the reasons first, they could work with the numbers and then write the complete sentence reasons for how they just got their answer. This writing of reasons using words, and proofs using numbers would continue until the students achieved the correct answer. The ideal students would convince themselves and others (in a whole or guided math setting) that their answer is correct with complete sentence reasons and organized numbers and operations.

The lessons that I teach come from a pacing chart the Lincoln Public Schools District gives to fifth grade teachers. This pacing chart tells the teacher which lessons to teach and which lessons to skip over. All the lessons are supported by a textbook. I would not let my students use the Houghton Mifflin (2005) textbook that my district issues all fifth-grade teachers. I would use the homework worksheets that match this textbook and I would also follow the district mandated pacing chart. Each school year I create my own unique curriculum by hand-selecting rigorous problems to use during each math lesson. These hand-selected problems were the ones that my students wrote correct reasons and proofs for in their RAP journals.

In the past I have used homework worksheets to let me know who understood the previous day's lesson. Checking these homework worksheets every night was very laborious and I was looking to change this part of my teaching. Instead of using the homework worksheets to tell me who understood the previous day's lesson, I used the RAP journal as an individualized formative assessment. Closure to a lesson is very powerful and giving students a worksheet to do is not the most effective way to check to see if they understood the lesson objective. I wanted the closure part of my lesson to be the RAP journal and not a worksheet. Instead of grading papers each night, I read what my students wrote in their RAP journals, wrote back to them, and then began the next day's lesson with oral communication about the correct answers to the RAP

journal problems. I even read some of the best journals from the previous day's lesson out loud for the entire class to hear. I called the journals I read out loud top five journals, because I originally planned to only pick the five best of the previous day's RAP journals. I feel passionate about this method of teaching because it connects the previous day's problem to the next day's lesson. This is another area in my instruction I wanted to improve. The transition between each day's lesson seems more smooth and seamless using RAP journals. This is an area I would like to change or improve because each lesson in the past has seemed separate from each other. The only lessons that have not seemed separate from each other have been the lessons about mean, median, and mode (Houghton Mifflin, 2005, chapter 8). Students have done very well on this chapter test because the lessons connect so well with each other. I would like to create smooth transitions between all lessons (similar to the mean, median, mode chapter) in each chapter and see what happens to my students test scores.

I have required my students to write in a math journal before, but have failed to stick with the journals for an entire year. As soon as students' journals began to fill up I did not go buy more paper and the idea quickly faded out of my focus. All of these changes are within my locus of control. Specifically, I can take time each day at the end of my lesson to let the students write for closure. I can also force myself to read each student's math journal each night in order to give each student feedback and document who understood the lesson.

I would like to have better closure in my classroom and this would be a great opportunity to let me know whether or not my students understand the concepts I teach. Requiring students to write in a math journal as formative assessment would be an excellent way for students to be held accountable for their learning. The RAP journals will also provide multiple exposures to the lesson objectives each day. I believe having to write in a RAP journal will create better attention

among students during the guided practice portion of a lesson. Students will be forced to take responsibility and ownership during the lesson. If they do not, they will not be able to solve the problems at the end of the lesson.

Writing in a math journal is cross-curricular. Will writing in a math journal help my students become better writers? The end of the year fifth grade writing prompt is personal essay. A personal essay focuses on writing three reasons for having an opinion. Focusing on the NCTM process standard reasoning and proof should help my students gain a deeper understanding for their end of the year writing prompt.

II. Problem Statement:

With the addition of specific, measurable, attainable, results-oriented, and time-bound (SMART) goals, teachers are looking for ways to measure whether or not their students are learning the objectives they teach. Since my district has a test-packed curriculum, writing in a math journal would be a test-free way to measure student learning and hold students accountable on a daily basis for each objective taught. RAP journals will be an easy way to provide formative assessment before, during, and after teaching the lesson. Before the lesson, the teacher must prepare thoughtful RAP journal problems that the students will solve. During the lesson, the teacher must walk around and monitor the students as they solve the problems. After the lesson, the teacher must check the students' work and record how each student did on the problems. This is high-quality formative assessment because it is occurring before, during, and after the instruction.

This action research is worth knowing about because formative assessment is becoming such a buzz word for teachers. What formative assessment do teachers use? This is becoming a reflection question for teachers because the power placed on high-quality formative assessments.

How do teachers use formative assessment data? This is becoming another reflection question for teachers because teachers are being held more accountable to show how they use formative assessment before, during, and after their lesson planning. Again, it all goes back to providing quality formative assessments in a classroom because this is what research indicates is going to boost students' summative assessment scores. Teachers are being scrutinized for how they use the information they obtain from formative assessments to guide their future lessons. If teachers' formative assessment data tells them that students understand the concept then they can move forward, but when the opposite is true they had better provide more time and additional support for the students to learn. Using the math journal information I describe in this paper could really help teachers understand the value of having their students write reasons and proof journals as a high-quality formative assessment. Of course, this is opposed to having students complete those drill and kill worksheets for formative assessment; such as what would be done in a more traditional math classroom.

How do teachers increase student retention in mathematics? Being able to know how to teach to increase student retention is a very important topic for any teacher. Student chapter test scores indicate retention, and this is what I take a deep look at in my action research project. This is actually the original purpose for why I started conducting research. Providing sound instruction that boosts a student's retention is the reason a teacher even teaches a lesson.

Do teachers believe that all students can learn? Anthony Muhammad discussed the answer to this question (and many others) at the annual Lincoln Public Schools multicultural institute this year (2008). When retention goes down, then so do test scores. When test scores go down, then so does a believing teacher's self worth. When a believing teacher's self worth goes down, then so does the longevity of this person's career. This downward spiral is very avoidable

as long as the teacher can provide instruction in a way that increases student retention. When retention goes up, then test scores increase, the person's self-worth goes up, and the believing teacher begins to walk in their glory. Every believing teacher wants the latter to occur.

Connecting mathematics instruction to the NCTM process standards is very important because this type of instruction benefits students deeply. This action research project connects to each of the NCTM Principles and Standards. Specifically, it heavily focuses on the process standards communication, reasoning and proof, and representation. If a student can provide reasons and proof for an answer then this answer will lead to the other three process standards I just mentioned. Reasoning and proof provides justification and leads to students making conjectures. The principles heavily in focus during this action research project are teaching, learning, assessment, and equity. Assessment and equity are the primary principles. Equity means high expectations and strong support for all students. The form of assessment I am suggesting is a daily way to know if your students have obtained your learning objective. It is a written type of formative assessment. This type of assessment is not a test, and fewer tests are needed in a curriculum. Another reason why the formative assessment is high-quality is because it is individualized for each student in the classroom. Teachers are constantly trying to improve their methods for providing high-quality feedback to students and this is one way to offer this. This is also a way to provide individualized instruction for each student in your math classroom without taking a lot of time to create specialized lesson plans for each type of learner.

Progress monitoring is becoming something that teachers are starting to do more of in order to allow students the opportunity to know where they are in their learning. Making students graphs and allowing them the opportunity to see their RAP journal scores rise or fall allows them to take more responsibility and thus achieve more. Middle school teachers in my district give

progress reports to their students before they issue report cards to let students know where they stand in the area of a grade for each subject. How effective are those progress reports? The progress monitoring is effective because it lets students know where they are at along the way, but it is ultimately up to the individuals to use this information to help them improve their status (test score, attitude, or behavior) in the classroom. Telling students where they stand in the area of progress made is very important to start doing. Letting students see a graph of each math journal they have written (in each chapter) will provide each student in the class with high-quality formative assessment data. This will allow all students the opportunity to know where they stand before taking a summative assessment. Showing students their progress over the course of a chapter could lead to confidence or failure for each child.

III. Literature Review

Introduction:

Are all students learning what a teacher wants them to learn for high-stakes testing? How does a teacher determine who is slipping through the cracks? What type of support can a teacher provide for the students in their classroom who do not qualify for special education/resource teacher support? “RAP Journals: I am Here!” is the topic of my research paper and hopefully an answer to all three of these questions. It is an exploration into the mathematical learning terrain by examining the effectiveness of a teacher created vehicle. The teacher created vehicle is a scheme like the classic Power-I offense of the Nebraska Cornhuskers. The Power-I offense is built on three main components—the quarterback, the running back, and lead blocking. This research project is also built on three major components or themes. The three major themes found in various literature are writing mathematics journals, mathematical reasoning and proof (NCTM process standard), and mathematical formative assessment.

When I began journaling about these three major themes an idea sprang forth, creating a vehicle by which I hope to successfully navigate the mathematical learning terrain. The teacher created vehicle is a reasoning and proof mathematics journal used at the end of a lesson to provide the teacher with formative assessment documentation on each student in the classroom. This holds each child accountable for each lesson I teach. One major theme that I could not find in much of the literature is response to intervention (RTI). RTI is a major gap in the literature related to my problem of practice. I hope that my research project provides insight, ideas, and information about how to provide RTI in an elementary mathematics classroom.

Writing Mathematics Journals:

Clarke, Waywood, and Stevens (1993) discuss one mode of mathematical communication—that of student journal writing in mathematics. They discuss their findings and observations of a study of four years' use of journal writing in mathematics involving approximately 500 students in grades 7 through 11 in a particular Victorian secondary school. Clarke, Waywood, and Stevens (1993) say, "In 1986 journal writing in mathematics was introduced as an experiment by several teachers in their classes" (p. 237). A little over 20 years ago the first journals were used in a mathematics classroom! Students wrote mathematics journals to communicate "what we did", "what we learned", and to explain/ask "examples and questions" about various mathematical concepts. These researchers said by keeping a math journal a student will be expected by the teacher to formulate, clarify, and relate mathematical concepts to their prior knowledge or thinking. Students will also (hopefully) gain an appreciation for how mathematics speaks about the world. Three key areas of communication expressed in the literature I read focused on the way students describe what they learned, summarize key concepts in teacher instruction, and identify appropriate examples and questions in a lesson.

There is a lot of information out there in the area of writing mathematics journals. One piece of literature I read focused on math journals at the beginning of class. Miller, (1992) called these impromptu journals. Miller had a purpose of examining the benefits of teachers who used impromptu writing prompts in first and second year algebra classes. Three teachers from a large metropolitan high school in southern Louisiana volunteered to participate in the study. Two of the teachers taught algebra 1, while the remaining teacher taught algebra 2. All three classes included students from a great range of mathematical abilities. The majority of this research examined the type of journal writing the students performed. Miller and England (1989) even created categories for student journals based on the type of writing they read in each child's journal. The students writing was actually grouped in general categories which were described in better detail by Miller & England (1989). The focus of the categories was one question or concept, and whenever possible, was placed into a meaningful context.

Other research takes a look at how journals benefit students' mathematical communication (NCTM process standard). According to Clarke, Waywood, and Stephens (1993) "Communication is at the heart of classroom experiences which stimulate learning" (p. 235). This quotation means that in order to stimulate learning, students must have classroom experiences that focus on communication. Classroom experiences that focus on communication arouse and awaken learning.

"Classroom environments that place particular communication demands on students can facilitate the construction and sharing of mathematical meaning and promote student reflection on the nature of the mathematical meanings they are required to communicate" (Clarke, Waywood, & Stephens, 1993, p.235). Journals put communication demands on students and require them to communicate. This communication is a sharing of mathematical meaning and it

promotes reflection inside of students' minds. Writing combined with the NCTM process standard communication, is the focal point of most mathematical journal research. Teachers featured in research articles have their students write in journals to boost their abilities to communicate various mathematics concepts. Since communication is such an important and heavily-researched NCTM process standard I wanted to focus on another important NCTM process standard, reasoning and proof.

The dialogue written in a mathematics journal is very important. The literature I read said students need internal dialogue in order to reflect on what the teacher is teaching in a lesson. Students learn by internalizing a teacher's instruction. Engaging students in constructive dialogue also helps them learn mathematics. Both of these are relayed in the literature I read. The intentions of my study will see how this occurs in a reasoning and proof journal.

The internal dialogue in the studies I read were written at the beginning of the class period to help the students think of what they learned in the previous day's lesson. The journals were used as an anticipatory set. The constructive dialogue in the math journals were between the teacher and each student during or after the teacher read each mathematics journal. Constructive dialogue was sometimes given orally by the teacher to the students while they were writing their journal, or other times through writing to each student after the teacher read the students' journals. The focus of constructive dialogue by the teacher was meant to aid the students in their ability to write quality math journals about various mathematics concepts and to obviously help each child retain the math concepts the teacher was teaching.

While most research examines the process standard communication, my research pushes students to write reasons and give numerical proofs at the end of instruction as a way to formatively assess various mathematical concepts. Stated like a true mathematician—reasoning

and proof is conveyed in the form of communication, while communication is not necessarily in the form of reasoning and proof. Will exposure to reasoning and proof in the elementary cause my students to be more comfortable with this process standard in middle and high school? It would be great to fast-forward time and talk to my students' geometry teachers in high school and see if my students become good geometric proof writers. While asking these teachers about my students proof writing ability is not possible, this is something that I explored throughout my research project. After examining qualitative data from my research project I know and understand how 5th grade students express reasoning and proof.

Reasoning and Proof (NCTM process standard)

NCTM (2000) states, "Reasoning and proof should be a consistent part of students' mathematical experience in prekindergarten through grade 12" (p. 56). In other words, students should be reasoning and proving concepts consistently or daily in order to gain mathematical experience in each grade level from when they begin to when they end school. How do teachers in the elementary do this? How is this even measured? I would like to survey classroom teachers and ask them how they consistently monitor the reasoning and proof of their prekindergarten to fifth grade students. In my research project I will not be able to interview teachers, but I still wonder how they would respond when asked about reasoning and proof. I do not know what I would say to this statement and am excited to find out how students will respond to reasoning and proof journals. I am assuming that reasoning and proof is not a consistent part of students' mathematical experience prekindergarten through grade 12. In my research project I make writing reasoning and proof journals a consistent closure to each lesson and see what happens.

What does a reason and proof look like? Hersch (1993) said that a proof is something that mathematics teachers and students have been watching and doing for 10 or 20 years. Hersch

asked the ideal mathematicians and students of philosophy, “What is a proof?” and came up with three root meanings of the English word prove. The three root meanings are test, try out, determine the true state of affairs, an argument that convinces qualified judges, and a sequence of transformations of formal sentences, carried out according to the rules of predicate calculus. The third of these is not applicable to my research study, but I would like to discuss the first two meanings of the English word “prove” in greater detail.

When thinking about the first root meaning to test, try out, determine the true state of affairs, Hersch (1993) goes on to say that when a mathematician submits his work to the critical eyes of his colleagues, it is being tested or proved. When people’s colleagues test their work they prove what they are claiming to be true or not true. This is the same for a student. When students write proofs they are testing, trying out, and determining the true state of affairs of a mathematical situation. In my fifth grade classroom this testing will be done in a similar way. The proof that each student submits will be examined by the critical eyes of the teacher and sometimes their colleagues (in this case the colleagues are peers). Each journal entry my students write will be tested and tried out with numbers, words, conceptualization, and computation.

According to Hersch (1993), “In mathematical practice, in the real life of living mathematicians, proof is convincing argument, as judged by qualified judges” (p. 389). In other words, a proof is a complete sentence or paragraph that explains an answer and convinces someone who is qualified that this answer is correct. It is important not to leave off the part about convincing someone who is qualified. Convincing the qualified is much more difficult to do than one thinks. It is like convincing Lee Corso that Darren McFadden is going to win the Heisman trophy in the 2007 college football season. Lee Corso is qualified in the area of college football and in order to convince him you must share a complete, factually, persuasive argument.

Convincing the unqualified would be like convincing my wife, who has no idea who Darren McFadden is. In my research, my students must present a convincing argument in their math journal and I will be the qualified judge. Since I've passed 5th grade, have high expectations, and have my Master's degree in math I am very qualified. What is the high expectation of a teacher about a reason and proof?

First of all, the expectation will be different in the elementary compared to the high school. The literature I read focused heavily on expectations in a high school geometry classroom. Theorems and formal proofs were discussed in every article I read discussing proofs. The type of proof that I believe elementary students should be faced with is more informal. According to Hersch (1993), "All real-life proofs are to some degree informal. A piece of formal argument—a calculation—is meaningful only as part of an informal proof, to complete or to verify informal reasoning" (p. 391). In other words, a part of every proof has to have a calculation. This calculation I believe to be foundational to proof writing. In the elementary, students should be given a foundation for their future proof writing. Since the foundation is built in the computation standard, then the majority of the proofs my students will write will be based on calculations and why they are correct. What about reasoning and proof in the elementary grade levels for the other content standards in mathematics (besides geometry)? This is a tremendous gap between my problem of practice and the literature.

Should students just write proofs for geometry or should they write them for all other content standards? I could not find any literature about writing proofs for other content standards besides geometry, but I believe a teacher's expectations differ for each mathematical content standard. This means that the expectation would be different in number sense when compared to problem solving or computation, etc. The consistent parts of reasoning and proof for various

mathematics concepts are as follows. In my study the expectation of the teacher is that at the end of a lesson each student will creatively write in their math journal thoughts that express both reasoning and proof. Reasons would be expressed in complete sentences and would be answers to why a student chose a specific operation to solve a mathematical problem. The proof part would be number work. The number work would prove the reasons that were written in complete sentences. Remember this reasoning and proof will be read by a qualified judge and categorized using a descriptor chart/scale. This descriptor chart/scale is a rubric that categorizes each journal. Then each category of journal is logged on the teacher running record document for the type of RAP journal each student wrote in each chapter.

Epp (2003) did a study on the difficulties students experience in mathematics courses requiring them to write proofs. In the late 1970's, she started teaching a course to provide background for students who would go on to take advanced undergraduate courses in mathematics and computer science. Her initial thoughts were that the students did poorly in the advanced courses because they moved too quickly. But as she taught the course, her students' difficulties were much more profound than she had imagined. "Often their efforts consisted of little more than a few disconnected calculations and imprecisely or incorrectly used words and phrases that did not even advance the substance of their cases" (Epp, 2003, p. 886). Epp discovered that students did not have the ability to connect their calculations with accurate words and phrases. The use of precise number calculations and complete sentence reasoning would advance the substance of a mathematical case and Epp found that students struggled doing this in upper level mathematics courses. Epp states that in a similar study by Senk (1985) that only 30 percent of a sample of students who took a one-year high school geometry course emphasizing traditional two-column proofs achieved a 75 percent mastery level. These results were widely

interpreted to indicate a failure of traditional methods and a need for developing an understanding of geometric relationships through exploration.

“Perhaps students at the postsecondary level find proof so difficult because their only experience in writing proofs has been in a high school geometry course, so they have limited perspective” (Moore, 1994, p. 56). Moore is thinking about why high school students struggle writing proofs in a different way than the previous authors I have mentioned. He states that high school students have a difficult time writing proofs because they have a limited perspective due to their short experience actually writing proofs. How will teachers get rid of the limited perspective students have writing proofs? I believe the first way that this will be done is to get the students writing proofs in all the content standards, not just geometry. I wonder if this creates a dislike for geometry by students because they are expected to metaphorically par a hole when they’ve never picked up a golf club. For most people in life this would be a very difficult task, but there are some who could accomplish this task with a limited amount of practice strokes. Will exposure to reasoning and proof in the elementary school help make proof writing easier in the high school geometry courses?

Tiger Woods started golfing when he was three. Now look at how his abilities have grown. It seems that the more people practice doing something, the better at it they get. Would this be true also for reasoning and proof? My research project may metaphorically create a certain amount of Tiger Woods’ in the mathematical world. Students need more experience writing proofs before they get into high school geometry. Studying and exploring this gap in proof writing from the high school to the elementary school is a worthwhile endeavor.

The second way to get students more comfortable with proofs is by expecting them to justify their results.

Being able to reason is essential to understanding mathematics. By developing ideas, exploring phenomena, justifying results, and using mathematical conjectures in all content areas and—with different expectations of sophistication—at all grade levels, students should see and expect that mathematics makes sense (NCTM, 2000, p. 56).

This quotation is important because it speaks about justifying results in all the content standard areas. It also speaks about how teachers should have different levels of expectations depending on the age or grade level of the student. Justifying results in all content standard areas is another gap in elementary students' understanding of the curriculum and how teachers teach the curriculum.

Proof writing should not only be limited to geometry. Martin and Harel (1989) asked 101 preservice elementary teachers enrolled in a sophomore-level mathematics course to judge the mathematical correctness of inductive and deductive proofs for that grade level. While Martin and Harel found out much about inductive and deductive proofs, these researchers stated that the classroom teachers' understanding of what constitutes mathematical proof is important, even though the teachers do not directly teach that topic. This is very important to know because I will not be the one teaching my students geometric proofs, but I can help them gain a better understanding of what constitutes a quality mathematical proof. Students should justify their results in all mathematical content standards. Reasoning and proof is simply justification of results, or an answer, for any mathematical problem. The reasoning that my students will do in their journals will be justifications for various mathematical concepts—mainly calculations.

How will students justify and what does their reasoning and proof look like? Students will justify mathematical concepts with written reasons in the form of complete sentences and proofs with numerical operations. The reasons will most of the time be informal calculations that

are sophisticated for a fifth grader, but nothing like the formal proofs done in an upper-level geometry course. The proof part of the journal will present a convincing argument to the teacher (qualified judge) that the student knows how to calculate the mathematical situation/problem. For example, if students write reasons that state they must add the two numbers 89 and 32 because that will give the total number of items sold for a problem, then the next thing they will do is show the computation work with numbers ($89 + 32 = 121$). The justified reasons will tell a step-by-step proof of how to obtain the correct answer to the mathematical problem. For every written reason there should be a mathematical number proof. This should continue until the students think they have arrived at the correct answer—thus justifying their results from the beginning to the end of the problem enough to convince a qualified judge and peers.

In summary, Hersch (1993) explains that the purpose of a proof is to convince and explain. He states that there are two opposing views on the role of proof in teaching. One view he calls absolutism and the other is humanism. The absolutist view is, “Without complete, correct proof, there is no mathematics” (p 396). This means that mathematics could not exist without complete correct proofs. The humanist view is, “Proof is complete explanation. It should be given when complete explanation is more appropriate than incomplete explanation or no explanation. . . mathematics is ours, our tool and plaything, to use and enjoy as we see fit” (p 397). This means that proof is a way of fully explaining something and it must occur when complete explanation is more appropriate than incomplete explanation or none at all. The most important part of the quotation is the mathematics of a proof belongs to the user and they are free to use the mathematics as they see fit. The mathematics proof journals my students write will be more humanistic than absolutistic because my students will use mathematics as a tool and plaything. They will prove as they see fit and hopefully enjoy their complete explanations of

various mathematical concepts. The mathematics journals my students write will be less absolutistic because my students will be playing with proofs and breaking them apart in their own ways in order for them to own and understand the learning objectives.

Mathematical Formative Assessment

In order to summarize this emerging theme I must first give a working definition of what formative assessment is and how it differs from summative assessment. Scriven (1967) first used the term 'formative evaluation' in connection with the curriculum and teaching (Scriven, 1967), but it was Bloom et al. (1971) who first used the term in its current meaning. The definition of a summative evaluation test is one given at the end of a unit for the purpose of grading or certifying students, or for evaluating the effectiveness of a curriculum. The formative evaluation was the other type of test that involves the student, teacher, and curriculum maker. This type of assessment is useful because it lets all three parties involved know what was learned and where the instruction needs to be intensified or monitored more closely.

I was given clarity between the two of these by my assistant principal. He said formative assessment is the health check that people go to the doctor for to make sure they are in good health, while the summative assessment is the autopsy that they do not want to go to a doctor for. The formative assessments are daily checks for understanding and the summative assessments are high-stakes standardized state testing. Knowing what instruction and where to intensify it in a lesson plan, are crucial questions that formative assessment provides answers to for a teacher, student, and curriculum maker so they don't receive bad news at the summative assessment time. This has become a big part of what my school district is doing because of the school improvement process and professional learning communities.

Fuchs and Fuchs (1986) state that when a teacher provides two assessments per week the students have a percentile gain of 30 points. When Fuchs and Fuchs state two assessments they are referring to formative assessments. What this means is that when two formative assessments are given in a week the students gain an additional 30 points on a summative assessment. This is an eye opening fact! After hearing this I was compelled to use my reasoning and proof journals at least two times per week.

The purpose of my formative assessment reasoning and proof journals are not for grading. Literature states that formative assessments are not for grading, but instead for checking to make sure a student's progress is being monitored. The journals are meant for my students to internalize the lesson and for the teacher to plan future lessons to meet students where their learning is lacking. Internal dialogue is very important. Giving students the opportunity to write about a mathematics concept as closure also shares responsibility for what was taught in the lesson. Formative assessment data should be shared with students and curriculum makers. The results of a formative assessment are seen by the teacher each time the students write in the journal and lesson plans are modified for the next day's instruction based on students' understanding determined by the journal.

All the literature I read about journals had this point about modifying lessons based on formative assessment data in common. Teachers from the literature asked how instructional practices could be changed to enhance learning. Even though they did not say formative assessment, the researchers (Miller and England, 1989) discussed how the teachers who used mathematics journals used them as a type of formative assessment. Formative assessment lets the teacher know where and what to intensify or monitor in the next day's instruction. By using formative assessment data, lesson plans and instruction are adjusted accordingly, and students'

progress is affected in positive ways. This was obviously something that I wanted to use my reasoning and proof journals to do.

Creating good news at the time of summative assessments is the main reason why formative assessment has become such a buzz word. My district has said that setting S.M.A.R.T. (Specific Measurable Attainable Results-oriented Time-bound) goals that are driven from a previous year's data collected and matched with student achievement in the current year will provide a teacher with accurate formative assessment information on each student. These accurate formative assessments will improve high stakes test scores and this is a major objective for me.

Why does formative assessment work? Part of the reason that formative assessment works appears to be due to an increase in students' "mindfulness" (Bangert-Drowns et al., 1991). When Bangert-Drowns et al, (1991) use the term "mindfulness" they are referring to the student's ability to care about what is being taught. A student who is mindful actually cares enough to think about what is being taught by a teacher. It is like the mother who tells the older child to be mindful of his or her little brother or sister. This mother is asking the child to care about the younger sibling the same as the teacher is asking the student to care about what is taught in the lesson.

Another reason why formative assessment works is due to an increase in a student's long-term retention (Nuthall & Alton-Lee, 1995). A teacher's main job is to impact each child's long term retention. Formative assessment provides multiple exposures of concepts and this increases the retention in a long-term manner.

Black and William (2003) trace the development of the King's Formative Assessment Program from its origins in diagnostic testing in the 1970s, through the graded assessment

movement in the 1980s, to the present day. Black and William describe how they worked with teachers to develop formative practice in classrooms. Black and William state, “The three research reviews offered strong evidence that improving the quality of formative assessment would raise standards of achievement in each country in which it had been studied” (p.629). This means that the quality of formative assessments will impact the standards of achievement in a country. If the quality of formative assessments is high then the standards of achievement will go up, while the opposite is true for low quality formative assessment. My research project is done to improve the quality of formative assessment so the standard of achievement will rise. Improving the quality of formative assessment is a direct connection to my problem of practice. I believe that teachers need to know more ways, or alternatives, to provide quality formative assessment. Could writing reasoning and proof journals provide quality formative assessment?

Response to Intervention (RTI)

Response to Intervention, (RTI) is a brand new department in the elementary schools that serve students who are achieving below grade level, but who do not qualify for special education services. The main objective of RTI is not to identify students for special education services, but rather to help all students achieve at a proficient level. The RTI students are the ones who may otherwise slip through the cracks at a given grade level in a specific subject area for a specific concept. RTI focuses on maximizing instruction and thus narrowing the achievement gap. Also, RTI has tiers or specific levels of intervention. The tiers are all individualized based on the needs of the student. One student may need more minutes than another so the frequency and intensity of RTI may differ depending on the diagnostic assessment score of the student. The end goal of RTI is that the students involved can meet district expectations, get back into the regular classroom, and perform well on summative assessments.

Where did RTI come from? It came from the failing ability-achievement discrepancy that is part of Individuals with Disabilities Act (IDEA 2004). Doctorate-holding authors from the Nebraska Department of Education at the University of Nebraska (Daly, Glover, & McCurdy, 2006) state, “RTI is intended to improve upon many of the problems associated with the ability-achievement discrepancy model which has dominated eligibility practices for over a quarter of a century” (p. 1). The ability-achievement model has been called a “wait to fail” model because schools had to wait until a student’s problems became so severe that it caused the child to fail. A discrepancy would then appear in test scores and services could finally be provided. RTI was created due to the need for prevention and early intervention. “When schools use RTI, students receive interventions as soon as a need is identified” (Daly, Glover, McCurdy, p. 3). What this means is that the student is not allowed to fail. As soon as a student begins to achieve below district grade level expectations the school will provide interventions in order to help them achieve success. I am curious to see if my reasoning and proof journals will provide early intervention data about each math concepts in the fifth grade curriculum.

RTI is something that our district has started doing in the area of language arts. Implementation occurred this year in kindergarten through grade five across our entire district. Mathematics RTI is an unknown world for curriculum makers and teachers because right now the focus is only in language arts. This is a tremendous gap in literature and curriculum development all across the nation. The research I conducted pioneered a new frontier like that of the settlers who traveled the Oregon Trail. Are reasoning and proof journals a good RTI? RTI in mathematics was something I explored while doing this research.

Conclusion:

Will writing reasoning and proof journals as a formative assessment improve high-stakes test scores? Are these journals a good way to provide RTI in mathematics? Will journals provide quality formative assessment? What does an elementary proof look like and do for a future middle school student? These, along with many other questions I had not yet thought of, were explored. I read the literature that exists and probed the gaps. I am now ready to show you what exists in the unknown—similar to what Lewis and Clark did when they returned from their exploration of the Louisiana Purchase. The emerging themes of mathematics journal writing, NCTM process standard reasoning and proof, formative assessment, and RTI have acted as my Sacagawea (guide) and the following is what the mathematical terrain specifically looked like. I have logged 10 weeks of entries in my teacher journal and wrote three memos that act as maps along the way. Like every explorer—riches were sought, and I have returned with a story that is worth more than gold.

IV. Purpose Statement:

The purpose of my study was to collect data, change my teaching in some way, and find things that can benefit all students. At first I was just looking for ways to help my students' test scores go up and boost their retention. I do not like reteaching after students fail a test, so I was looking for a teaching strategy that would help all my students pass their math tests. I also wanted my students to retain more math concepts, so that when it was time to take the summative assessments at the end of the year, they would not have forgotten everything. I wanted my students to pay attention and be excited while learning the math objectives. I also wanted my students to be able to go up to the marker board and communicate orally how to solve a math problem. I was also looking for other things, but I did not know what they were.

During my study I was constantly looking for things to pop out of the data. I kept coming back to an article I read over the summer by Deborah Ball that said to keep your eyes and ears close to the ground as you navigate through the mathematical terrain. I also kept thinking about what I said in my literature review about my teacher created vehicle. This teacher created vehicle would help me see and understand things I did not know were there. Along the way I knew if I wrote very detailed and specific teacher journals then I would develop clarity. I was hoping to be able to find ways to teach students how to develop a conceptual understanding. I knew that if my students were developing a conceptual understanding, then their retention would increase and test scores would go up. Overall, I just wanted to know what I could do as a teacher to help my students learn how to develop a conceptual understanding.

Besides helping my students, I wanted to help my colleagues. I was really hoping that when my study was over that I could be a leader in my school district. I would enjoy leading a staff development workshop for teachers in my district to learn how to boost their students test scores and increase retention using NCTM reasoning and proof math journals as a formative assessment. I was hoping to be a pioneer for RTI in elementary mathematics since there is such a tremendous gap in the literature I reviewed and curriculum development in my district. Understanding how to use formative assessment in mathematics using a math journal was another thing I wanted to find out how to do because as I said in the previous section my district needs a curriculum with fewer tests.

I am seeking to understand the importance of reasoning and proof in the elementary classroom. What does reasoning and proof look like in fifth grade? How will students respond to writing in a math journal at the end of a lesson? I was seeking to understand how to effectively use reasoning and proof writing in math journals as formative assessment of students before a

math test. I was also trying to find out how these journals will impact the way students communicate math concepts. Is writing in a math journal to explain a math concept a high-quality way to formatively assess a student?

The first research question focuses on my students' test scores. How does each student's test score change after writing in a RAP journal? The second research question focuses on formative assessment and math RTI. How can RAP journals be used as formative assessment and math RTI? The third research question focuses on mathematical communication. How will a student's ability to communicate mathematical concepts change after he or she writes in a RAP journal? The fourth research question focuses on how I change instructionally as a teacher. How does my teaching change when I have students write in RAP journal?

V. Method:

I began collecting data on January 28, 2008, and I stopped collecting data on May 2, 2008. Prior to this, I followed all the preresearch guidelines for one completing a graduate level project. Going into this action research project I knew the more data I collected the more I would be able to find out. I also thought that the more specific I was, the more I could understand. Thinking about these two things forced me to collect data each night and then journal about what I collected each week.

Before conducting my action research project I decided on the following data collection methods. I used three data collection methods for each research question. The frequency of my data collection was different based on the method of collection. My most frequent way of gathering data was reading and categorizing my students' RAP journals after they wrote in them.

The big pieces of data in my findings came from my students' RAP journals. I really focused my data on the type of RAP journal each student was writing each lesson. I analyzed

every student RAP journal each night the students wrote in them. I used the rubrics I created to categorize the type of RAP journal each student wrote. I categorized my students RAP journals in two different ways. The first way I categorized the type of RAP journal was according to the students' writing styles (Appendix A). The second way I categorized the type of RAP journal was according to the students' ability to tell reasons and proof for the math objective (Appendix B). I documented the type of journal each student wrote on a running record document (Appendix C). I analyzed this running record document before and after each chapter test. I also lumped this data and put it into tables for the types of journals each student wrote.

I wrote in my teacher journal each week about the type of RAP journals my students were writing. I dated each of my teacher journals so they are organized chronologically because this is the way I taught all the lessons. I paid close attention to who was writing what type of RAP journal and if anyone's RAP journal habits were changing. Each week I spent from 20 to 60 minutes writing in my teacher journal about my action research questions. I wrote each of my teacher journals using a template of questions at the end of each week (Appendix D). I tried to make myself finish my teacher journal each Friday before leaving school, but this sometimes did not occur. If I did not finish my teacher journal on Friday, then I wrote it over the weekend and printed it out before Monday of the next week. This teacher journal (February 1, 2008 until May 2, 2008) helped me really see what was happening during my project. Also, the teacher journal helped my project evolve while I was collecting data. My teacher journal allowed me the opportunity to make changes to my project each week. Using this teacher journal to reflect I began to group my students into tables according to how they wrote in their RAP journal and categories began to form just like they did for Miller and England (1989).

After each chapter test I documented my students' scores. I gave chapters 12 through 18 chapter tests during this time period. My students answered a quick survey before and after taking each chapter test. The survey before the test asked the students five questions (Appendix E), while the survey after the test asked the students 7 questions (Appendix F). My students filled out other surveys at the beginning, middle, and end of my action research project (Appendix G). The first surveys were collected on January 28, 2008, and the last were collected on May 2, 2008. The middle of the project surveys were the most valuable data I collected and these were collected for every student on March 19, 2008.

The last way I gathered data was by interviewing my students (Appendix H). Every Wednesday from February 20 until March 19 I interviewed groups of my students. I ended up interviewing 19 out of 23 students. I only interviewed three to four students at a time. I had these groups of students come into my classroom and I tape-recorded our interviews over lunch from 12:05-12:35. No interview went past 12:35 and the interview usually got started around 12:10. These interviews proved to be very valuable because they addressed questions about the purpose of the RAP journals, the reasons and proof parts of the RAP journals, the top five journals, and the wrong journals.

On February 8, I felt tension in the area of my lower-ability students. I said in my teacher journal that I want to give the lower-ability students more support in addition to the RAP journal. This is an area of tension because the teacher part of me will not let a child in my classroom fail, but the researcher part of me says "stick to the agenda and see if the child fails." On February 15, I wrote something very similar to this again in my teacher journal, so the tension continued. On February 22, I again wrote something similar, but it was specific to an individual lower-ability student who was struggling. I have carefully documented this tension each week (Appendix I).

This entire project has been difficult because I don't just teach math. I teach all the subjects, so balancing Language Arts and Social Studies blocks with my research project is complex. I also have multiple other responsibilities in leadership roles at my school. I am on our school improvement leadership team, teach an after school club through the CLC one day a week, co-lead our student leadership team, and have recently been interviewing candidates for a new fifth grade teaching position at my school. There is always something; I do things before and after school four out of five days a week.

There were a couple of weeks that I stopped collecting data. These two weeks were right in a row. The weeks of March 24 through 28 and March 31 through April 4 I stopped collecting data. I stopped collecting data March 24 through March 28 because this week was spring break. The second week I did not collect any data was March 31 through April 4 because I had my class reviewing for the Metropolitan Achievement Test (MAT). My students spent one week reviewing for the MAT using a resource book required by my district called *Test Best*. After using the *Test Best* resource my students took the MAT the following week (April 6 through 10). The following week was April 6 through 10, and over these dates I continued to collect data for my action research project. My students took the MAT in the morning and then I taught them math in the afternoon.

I wrote three analytic memos during the time I was collecting data. All of the data I collected focused on answering my research questions. I looked for patterns in the data I collected and these became assertions I made about what my data was actually telling me.

VI. Findings:

Looking back to the beginning of my research project makes me feel like such a rookie, because of the growth I know I have made. This research project started out so simple, and over

the course of a couple months it evolved into something very complex. To show the ways my project evolved is difficult. Over the course of my research I had some major changes in the way I taught the lessons. Here is what the average math lesson looked like in the beginning and how it changed over the months of data collection.

At the beginning of each day my students entered the classroom, went to their desk, and began solving math problems. Some of the students had their names next to a problem on the marker board. This meant that the students had to show their work on the marker board and present the problem orally. Students at the marker board were sometimes in groups of two or three, but they always had the option to work alone. The students used red, blue, green, and black colored markers to color code all their work performed at the marker board. After each group was done working then the students took turns explaining how they got their answers. The problems that they were working out were homework problems from the previous day. The students who were not explaining how to solve a problem sat at their desks and listened to the students at the marker board orally communicate the answer. If the students at the marker board made a mistake, then the students at their desks would give the presenter “thumbs down” or the students would raise their hand in order to be called on to fix the error. I also participated in the “thumbs up” or “thumbs down” when the students presented an incorrect or correct answer at the marker board. If the students at the marker board were unable to locate the mistake then they picked someone with their thumbs down to come up and help fix their problem. When someone fixed a mistake he or she would get a point on the tally board beside his or her name. These points were worth prizes, if a student got 5 points then he or she would get a prize (prizes included a smencil—smelly pencil, or a sour jolly rancher). Sometimes the students at the marker board made mistakes on purpose.

The students at the marker board made mistakes for two reasons. The first reason was that they wanted to give away points on the tally board. The second reason was that they wanted to show a common mistake in order to see who was paying attention. This kept the audience focused while they were explaining the problem. I walked around the classroom and stood next to different students' desks during the explanations of the homework problems. I always made sure everyone in the audience had good eye contact on the presenters. I do not let a group present at the marker board until everyone in the audience is giving the presenters their best eye contact. I even had the students presenting tell me how many students they were waiting for before they began their presentation. My main concern was to find out who was or was not paying attention. If students were not paying attention then I squatted down next to them in order for those individuals to become focused on what was being communicated at the marker board. This would be perfect if I only knew what my students were thinking about in their heads. Solving and orally presenting the selected homework problems from the previous day took 10-20 minutes.

After the students orally communicated the reasons and proof I made a couple of comments about each problem. I made sure to highlight the really powerful statements or computation that each presenter or audience member said or did using that student's name. Then I read the top five journals from the previous night. Doing this took me approximately 15 minutes. Finally, the students solved one or more of the problems from the marker board in their RAP journal as closure. In the beginning all the answers to the RAP journal problems were on the marker board because the problems were just solved by selected students. I stopped giving my students the answers to the RAP journal problems after one week of research. During week two I began leaving two problems on the far right side of the marker board blank. These two to

three problems were reserved strictly for the students to solve during RAP journal time at the closure to the lesson. This took them 15-20 minutes.

One challenge that I quickly faced was that I was not allowing myself enough time to teach a new lesson. I had to decrease something in order to allow time for a new lesson objective to be taught. I could not decrease anything at the beginning of the lesson or at the end so I knew it had to be the way I was structuring the middle of my math instruction.

First, I decreased the amount of problems my students had to solve at the beginning of class. I only put three problems from the previous day's lesson on the marker board instead of six or seven. These three problems would later be the exact same problems that my students wrote about in their RAP journals from the previous day. This meant that my students were no longer able to select any problem to solve in their RAP journal. Every student now had to solve the same three problems. I would later make the first two problems the same for everyone and the last problem could be a problem with their choice of numbers that fit the lesson's concept. Sometimes I let students come to the board and explain a new math concept, but most of the time I would conceptually explain how to do the math in the next lesson objective. If there was more than one way to solve the problem then I would ask my students if they knew of another way to get the same answer. If my students did not know another approach then I would write any other approach I knew. This would take me 10-20 minutes depending on the lesson objective and whether or not my students were showing me that they understood how to do the math. Students or the teacher explained how to solve problems on the marker board. After solving the previous day's RAP journal problem I read the Top 5 Journals from the previous day. The two or three problems that each student wrote about were blank at the end of the previous day's lesson. This was new because I had always in the past let my students write about a problem that had just

been solved on the board. The third problem that students solved in their RAP journals was for the students who needed a challenge. This third problem was one that the students could make up their own numbers for and solve. Later my teaching evolved into what it looked like at the end of my research project.

At the end of my research project I started off each lesson with the previous day's RAP journal problems. The first day of the week I had three boys solve the previous day's RAP journal problems. The next day I had three girls solve the RAP journal problems. The students that solved the previous day's RAP journal problems were picked based on what they wrote in their RAP journals about the problems. I tried my best each day to select one student who struggled on the RAP journal problems and two that understood. This took the first 10 minutes. After the RAP journal problems were discussed then I read the top five journals out loud to the entire class and pointed to the reasons or proof the presenters showed on the marker board. This took 10-15 minutes. Next I taught the new day's lesson in 10-20 minutes. I showed all my work on the marker board for two to four problems for a new math objective. I always tried to connect this new math objective back to the previous day's RAP journal problems. The problems I solved were from the new day's homework. While I was solving the problems I wrote reasons for my work in the reason box on the marker board beside the new day's RAP journal problems. I also wrote new vocabulary words with student given definitions in this reason box. I would explain how to solve the new day's lesson orally and then write the words that I said out loud in the reason box so my students could remember exactly what I said and how to solve the new day's RAP journal problems. Some of my students started writing in their RAP journals right away while I was talking about the new day's lesson, so I had to ask them to please wait to solve the RAP journal problems during the time allotted at the end of the lesson. After this my students

solved two to three blank problems in their RAP journals and worked on homework until it was time to switch for reading. Students did this for 15-25 minutes depending on how long everything else took.

My instruction changed and evolved from the beginning to the end of my research. By the end of my research my students knew the expectations and were in a solid routine. If teachers decide to teach the way I was, then here are some points to understand and consider.

First of all, the teacher is able to hold each student accountable and provide multiple exposures to learning a math concept for each lesson. The first way I held students accountable for each lesson was by reading and writing to each child in their RAP journal. I wrote about how I did this in my teacher journals and I also documented each student's type of RAP journal on my running record document for each math chapter. Besides documenting the type of RAP journal I also kept track of who got the problems in the RAP journals correct or incorrect. Students who got the problems incorrect in their RAP journal got a longer response written by me in their RAP journal. Students who got the problems correct in their RAP journals received encouraging words and sometimes top five journals if they were among the best in reasons and proof. Here are some specific things I wrote in my teacher journals.

On February 1, 2008, I wrote the following in my teacher journal about the focus of my replies to each student.

I would lump the focus of the replies back to each student into two categories. The first category would be for the students who wrote a RAP+, Dialogue journal. My replies to these students were all positive and encouraging. I gave specific praise to all of these students about the reasons and number proofs they wrote. The second category would be for the students who wrote very little in their RAP journal. These are the

Recount/Response, only Proof journals. My replies to these students attempted to motivate them to write better reasons. My responses also told the students what they forgot to say when solving the problem. For example: I made the comment, "Simplest form" because the student forgot to check to see if the fraction was in simplest form.

On February 8, 2008, I wrote the following in my teacher journal about students who miss problems and students who write top five journals.

Since a bunch of students had wrong answers this time (today) I really focused on showing students the correct work and explaining why they were wrong. One big area that I focused on was double digit multiplying. A couple students forgot how to multiply double digit numbers so that was one thing that I explained (I explained this to the students in writing and numbers in their RAP journals). The journals with correct work that were top 5 journals I just wrote encouragement. For example: great RAP or excellent reasons and proof.

On February 15, 2008, I wrote this in my teacher journal about students who miss problems in their RAP journals.

Maybe next week I could write in each student's wrong journal that they need to see me at the back table during RAP journal writing time?

The following week I did not follow through with this idea. I have never made students come to the back table for missing a problem in their RAP journal. Since I never did this I asked my students during interviews what I should do to those who get the problems incorrect in their RAP journal to make sure that they understand the correct answer. During my first student interview on February 20, 2008, Kandy said,

I think Mr. Schwanke should have a little group of people who consistently get it wrong and meet with them to make sure that they get the correct answer.

On March 19, 2008, Sandy said something very similar,

I think Mr. Schwanke should put them all in a group and those guys should do the problem together.

It seems that students support the idea that I did not follow through with. Team teaching with a resource teacher would be an ideal approach to instruction. This is a prime example of math RTI because students who are not learning are given more time and support by a teacher to understand the learning objective, while students who are proficient are doing enrichment activities for the same concepts. The proficient students gain valuable depth, while the strugglers gain the essential learning.

On February 22, 2008 I wrote this in my teacher journal about students who get top five journals.

I try to communicate my laughter at various journals by writing funny or ha, ha.

The second way I hold students accountable for each lesson is by putting the previous day's RAP journal problems on the marker board. On March 14, 2008 I wrote,

The first thing we did each day is look at the journal problems from the previous day. The RAP journals are becoming something I do after each lesson. Originally, I was only going to have students write in them (the RAP journal) two or three times a week. Now the only times we haven't written in the RAP journals were on review and test days. My students have written in their RAP journal as closure to every lesson in chapters 13, 14, and 15. The students even wrote two times for some of the lessons in chapter 15. (Triangles and Congruence) If you were observing my class you would have seen the

following. Students orally communicated the answers to the RAP journal problems using markers on the marker board. Then the new lesson was taught.

The third way I hold students accountable for each lesson is by helping each student during RAP journal time. In March I began to document who I am helping during RAP journal time. I began doing the following in my teacher journal and running record on March 18, 2008. I put a small “H” next to each student’s name that I helped on that day (I picked the letter “H” because it is the first letter in the word help). I have continued to do this so that I can remember who I helped and who I did not help. Students who I help are being held accountable because I am talking to them about each RAP journal problem. This is a one-on-one conference, similar to the way I teach writing.

Three types of students have seemed to emerge: the self-accountable, the teacher-accountable, and the independent. Students who I help because they raise their hand or walk up to me to seek me out I call self-accountable. They are self-accountable because they hold themselves accountable to learn the concepts in each lesson. Other students I call teacher-accountable. I seek this type of student out because I know without my support they will not attempt to complete the RAP journal problems. These students tend to lack discipline, drive, or motivation. I stop by and chat with these students to help them get their RAP journals started. Sometimes I even write down the RAP journal problems in the students’ journals for them, so they copy the numbers or draw the pictures correctly. Teacher-accountable students need the teacher to hold them accountable so they learn the lesson. The last type of student is the independent worker. These students are independent learners and never look to me for help. They write down the RAP journal problems and never ask me a question. They come up with

their own type of ideas and solutions for the RAP journal problems. The independent learners tend to be my gifted students in the classroom, but not always.

Now take a closer look at how I help my students during RAP journal time. After teaching a whole group lesson, I am able to give one-on-one support to consistent strugglers during RAP journal writing time. A pattern exists in my data that leads me to believe that using RAP journals is a good way for the teacher to provide one-on-one support for certain types of students.

Providing one-on-one support is very helpful when teaching a student named Curt. My teacher notepad indicates that everyday I have my students write in their RAP journals I go talk to Curt to check if he is on-task. Motivation is a big issue with this student because he constantly puts his head down on the desk during the guided practice portion of a new lesson. I always check to make sure he is writing in his journal before going to my struggling students. Sometimes I even write the problem in his RAP journal to help him get started. Other times I draw the pictures for him in his RAP journal because he always tries to only write the answer and show as little work as possible. Students like Curt need the one-on-one support the RAP journal time provides a teacher.

More evidence comes from the running record sheet I log each time my students write in their RAP journal. I have noted that additional support has been given to Sherry, Shannon, and Katie during RAP journal time. I have written reasons and proof in each of these students RAP journals to help them understand the mathematical process for certain lessons. These are all teacher-accountable types of students who often try to be successful.

Even more evidence for one-on-one conferencing comes from my teacher journal (February 22, 2008). I wrote about working with Betty, Shannon, and Sherry. I wrote about how

these students were “hung up” during a lesson about how to know which way to move the decimal and how many places to move it. I said the following statement in my teacher journal,

After working with them one-on-one they seemed to have the light bulb go on.

I talked to Sherry about zeroes in the quotient and she would have missed every problem in her journal if I would not have met with her. I wrote in my teacher journal on February 22, 2008,

It seems that while my students are writing in their (RAP) journals then I am free to walk around and help students one-on-one like a writing conference. This is a great example of how to provide math RTI after I am done with whole group math instruction.

The last assertion I make about how a teacher must teach is focused on expectations. Students need clear expectations for what to do after they are done writing in their RAP journals. This is an essential finding in my action research.

Data from my midproject interview brought the following information to my attention about the amount of time my students use to write in their RAP journals. A question on this survey asked my students how long they take to write in their RAP journals. I give approximately 20 minutes each day for my students to write in their RAP journals. Some days I give less than 20 minutes, while other days I give more. The following table shows how many minutes my students said they wrote in their RAP journals each day.

Amount of time students spend writing in their RAP journals:			
Amount of Time	Frequency	Total number of Students Interviewed	Percentage
5 minutes or less	5	23	22%
10 minutes or less	11	23	48%
15 minutes or less	17	23	74%
20 minutes or less	*21	23	*91%
20 minutes or more	2	23	9%

The majority of my students (91%) take less than 20 minutes to write in their RAP journals. This creates a problem if they have nothing to do after they are done journaling. If my students have nothing to do after writing in their RAP journal then they tend to distract each other and a quiet study environment is not achieved. More structure is essential in order to help the students not distract each other.

In my teacher journal on March 7, 2008 I wrote,

My students have been distracting to each other lately during RAP journal time. I moved Herb's seat on Friday because he didn't finish his RAP journal on Thursday. He was the only student in class to write an incomplete journal and I felt it was important to let him know that this was unacceptable. The reason he didn't finish his RAP journal was because he was talking to Larry and Albert. I will be reviewing expectations for what to do after each student writes in their RAP journal next week and creating a list of what to do after writing in your RAP journal with my students.

On March 14, 2008 I wrote,

We made the expectation list on Monday together as a whole class and I posted it at the front of the room. The students have really done a nice job of meeting the expectations we created at the beginning of the week. The students have been more on task during the RAP journal time. Students have not been distracting each other during RAP journal time because they have been choosing things to do from the list we created. Moving Herb's desk really made him focus. He was one of only three students to get a correct answer in his RAP journal the very next day during RAP journal time.

I wrote the following at the end of my teacher journal on March 14, 2008.

Students need clear expectations after they have completed their RAP journal. I have noticed that the list we made has been a firm law that students must follow. This is much needed if you decide to teach this way.

This list of things to do after writing in the RAP journal is a procedure that all students have created and must follow. Letting students help create this list was very important because it allowed the students to take ownership. Holding students accountable to this expectation is the teacher's main job each time the students finish writing in their RAP journals. If students are trying to do something that is not on the list then all the teacher has to say is the students' names and that they need to find something to do on the list. This is a simple way to redirect bad behavior and focus it on what is acceptable.

My second research question asks how RAP journals can be used as formative assessment and math RTI. Do RAP journals allow the teacher an opportunity to provide a helpful intervention? How can RAP journals monitor a students' progress and allow the teacher foresight?

My first assertion for this research question is about students who make mistakes in their RAP journals. Students who make mistakes in their RAP journals need more support in order to be successful on that particular math objective. Students who miss the RAP journal problems are approaching proficiency, while the students who do not miss the RAP journal problems are approaching advanced. Students who do not make mistakes in their RAP journals need enrichment activities to extend their learning on that particular math objective.

The first piece of evidence comes from my teacher journals. Each week in my teacher journal I noted that the next day's lesson was based on the needs of the students who missed problems in the RAP journals. This is something I noted in my literature review. Teachers in the

literature I read spoke about how their math journals allowed them to plan future lessons to meet the students' needs. In order to meet my students' needs I began each lesson with the previous day's RAP journal problems. Three students would communicate the correct answers to the RAP journal problems and then I would read the top five journals and share common mistakes. If my students made a mistake in the previous day's RAP journal they could correct their mistake by listening to me or by watching their peers communicate the correct answers to the RAP journal problems on the marker board orally.

The second piece of evidence comes from my running record log and data after chapter 13 test scores. Because of what I found from this data I have been supporting Curt, Sherry, Katie, and Shannon. The reason I target these students is because they wrote the most incorrect journals and had chapter 13 test redoes. These are the first students I go and chat with during RAP journal time because they struggle and need more one-on-one support.

The third piece of evidence comes from my teacher journals (mainly teacher journal February 22, 2008). Sherry, Katie, and Curt did not have as many incorrect journals during chapter 14. Sherry and Katie still had test redoes, but their scores were not as low as they were on the chapter 13 test. I supported these students and helped them successfully write their RAP journal answers throughout the week. I noted in my teacher journal that throughout the week Amy, Sherry, Shannon, and Betty always raised their hand and asked for help during the RAP journal time. Nearly every day of my action research project these same four students raise their hand and ask me to look at their RAP journal as they write it them.

In the following table, Sherry, Betty, Katie, and Curt are all in the column, "2 or fewer out of 5 RAP Journals." The four students from the above piece of evidence are in the far right column because they solved two or fewer RAP journals correct during the chapter 18 lessons. I

kept track of these students in my teacher journal and noticed that I kept helping them until the last chapter of my research project. A striking piece of evidence comes from the data I collected from the chapter 18 test and my running record log. During this chapter I noticed the following about the type of RAP journals the students were writing.

Before I show the table let me explain a little bit about what I did. Before the math test review I put all my students' names on the marker board. I wanted to just put the names of the students who were writing lower-quality journals, but I needed to include everyone to be equitable. I also needed to celebrate those students who are meeting or exceeding my expectations. The students who are on the left side of the table are my role models, while the students on the right side are the ones I want to motivate, so they are aware of their lack of progress. I put each student's name under a heading that indicated how many journals each student had solved correct in this chapter. I always want to focus on what the students can do, rather than what they can not do, so that is why I put the amount of journals correct on the marker board. Here is what the table looked like on the marker board (I have included each students test score beside their name).

Number of Correct RAP Journals Written in Chapter 18:							
5 out of 5 RAP Journals		4 out of 5 RAP Journals		3 out of 5 RAP Journals		2 or fewer out of 5 RAP Journals	
Larry	100%	Miley	90%	Sandy	1 Redo	Curt	85%
Amy	95%	Kandy	100%	Sam	90%	Andy	100%
Ashley	100%	Herb	85%	Travis	100%	Taft	100%
		Albert	90%			Sherry	90%
		Dilbert	95%			Betty	90%
		Buddy	100%			Katie	90%
						Lola	1 Redo
						Tonya	1 Redo
						Mandy	1 Redo
						Adam	2 Redo
						Shannon	3 Redo
						Ally	3 Redo

Then I explained to my students that everyone who was in the heading “2 or fewer out of 5 RAP Journals correct” were in serious jeopardy of getting a redo on the chapter 18 math test. I said the following statement to my students.

My research indicates that anyone who got more than 3 RAP journals correct in this chapter will not get a math test redo. The students who got two or fewer RAP Journals correct in this chapter will get at least a one page math test redo.

Then I went on to explain this same thought using different words because I have to say things from multiple approaches at least three times to my students in order for the thought to really sink in. The consistent words I used each time were, “my research indicates” that the people on the two or fewer side of the table will have a math test redo and the people on the opposite side of the table will not get a math test redo. I kept talking and explained to my students that I did not want this to be true. I also expressed my concern for the high amount of students (12 students) on the two or fewer correct RAP journals side of the table. There have never been this many students on this side of the table.

There are some reasons for such a high amount of students on the right side of the table. The reasons are that the students were absent, did not turn in their RAP journal, got teacher help, or got a RAP journal problem incorrect when I checked them. I told the entire class that I wanted them to “prove my research wrong.” I said the way to do this was work extra hard on the math test review today. The striking part of the data, is how hard the students worked on the math review and how some of their scores provided a counterexample to the pattern I had detected in my data.

I noted in my teacher notepad that everyone seemed to work hard on the math test review. Sherry was a student who really stuck out as doing a very nice job on the math test

review. No one stuck out as doing a poor job on the math test review. The next day I gave the math test for chapter 18. Of the 12 students who were under the heading “2 or fewer out of 5 correct”, six of these students got a redo on the test and six of these students passed the test. The students, who I have been helping consistently since chapter 13, all passed the test, except one. Sherry, Curt, Katie, and Betty all passed the test. Shannon did not pass the test and I have been helping her a lot. This just goes to show that teacher support for a long period of time can bolster achievement. Also sharing with students their progress can allow them an opportunity to buckle down and get serious before a test. Progress was shared to each student and the students whom I have been helping took off and soared on the test.

There is something else worth noting about the students who got the most redo pages. The students who got the most redo pages on the test were the students who also got the fewest amount of RAP Journals correct during the lessons. Another assertion emerges—the students who get the fewest RAP journals correct in a chapter will be the least successful on the chapter test. The students who are least successful during the RAP journal time have the most math test redo pages. I speak more about this assertion when I arrive at my next research question. This assertion is supported by a lot of other data I gathered in future math chapters. Before I move forward to the next research question I want to take a look at the top five journalists. The top five journalists are the opposite type of journals as the incorrect journals. The following assertion emerged from the data I collected at the very beginning of my research project.

A top five journal is the best of the best journal for that day. A top five journal has amazing reasons and proof (RAP) for the problem(s) being solved. I came up with the name top five journal because I thought I would only read the top five journals out loud the next day. I decided to give this award to more than just five journals, but kept the name. During an interview

with my students I asked them if I should give the top five journal award only to the five best journals. Of the 19 students interviewed, they all agreed that the top five journal award should be given to more than just the five best journals.

Students who consistently write top five journals do not have to be re-taught any lesson on a math test. The word consistently needs to be stressed because there were students who wrote a few top five journals who did poorly on a test. The students who consistently write top five journals tell completely how to solve the problem using NCTM process standard reasoning and proof. The students who consistently write complete sentence reasons about how to solve a problem in their RAP journal always get the highest score on a test and never have to be re-taught any test objectives.

After reading my students' RAP journals in chapter 12 I noticed that Ashley, Larry, Dilbert, Kandy, Miley, Sandy, Sam, Buddy, and Tonya all wrote consistent top five journals about how to multiply and divide fractions. None of these students had to be re-taught any of the objectives on the chapter 12 test—Multiplying and Dividing Fractions. If I look back even further, I can see these same students consistently wrote top five journals in Chapter 11. None of these students had to be re-taught an objective on the chapter 11 test—Adding and Subtracting Decimals. I could not count the amount of times each of these students wrote a top five journal for chapters 11 or 12 because I was not documenting each student's journal type each night, but I can for chapter 13. Here is how many top five journals were written during chapter 13. This also brings me to my next research question about how students' test scores change after writing in a RAP journal.

My third research question asks how students' test scores are impacted by what they write in a RAP journal. I took a deep look at all the types of RAP journals my students wrote

during each chapter and compare it to the score they received on the same test. The type of RAP journal students consistently write during a chapter allow the teacher the ability to predict who will do well or poor on a chapter test. The following assertion emerged from the data collected and analyzed about the top five journals.

Chapter 13 Test Scores and Number of Top 5 Journals:					
Student Names	Number of Top 5 Journals	Total Number of Journals Written Correctly During the Chapter	Total Number of Journals Written Incorrectly, Incompletely, or Absent During the Chapter	Percentage of Journals Written that were Top 5 Journals	Score on Test
Dilbert	4	4	0	100%	100%
Kandy	4	4	0	100%	82%
Ashley	4	4	0	100%	94%
Sam	4	4	0	100%	94%
Amy	2	2	2	50%	88%
Miley	3	3	1	75%	82%
Mandy	2	2	2	50%	82%
Larry	2	3	1	50%	88%
Buddy	2	3	1	50%	100%
Andy	2	2	2	50%	76%

These ten students wrote top five journals at least two out of four times this week. All of the other students in the classroom wrote fewer than 50% of their journals as top five journals. Receiving the top five journal award at least 50% of the time is fairly consistent. I would say that receiving the top five journal award more than 50% of the time is the consistency I am really expecting. None of these ten students had to be re-taught any of the objectives on the test. All of their test scores were over 76% and two of the students aced the test.

What about the students who had to be re-taught objectives? What kind of RAP journals did they write before these chapter tests? I previously asserted,

The students who get the fewest RAP Journals correct in a chapter will be the least successful on a math test.

Here is specific evidence for each student who had a redo on the chapter 12 test. Katie had a redo on her chapter 12 test and at least one of her RAP journals during this chapter was incomplete. This means that she did not finish explaining how to solve the problems I asked her to write about. She was absent the second time we wrote in our RAP journals for this chapter. Betty's chapter twelve RAP journal writing was good, but very brief with the reasons. She did get a top five journal one day, but her reasons were scattered and not organized in a structured way. One top five journal is not consistent. She had a redo on the chapter 12 test. Sherry also had a redo on the chapter 12 test and she wrote one top five journal. She was absent when we wrote in our journals for the second time. I actually pulled her in during morning breakfast to review with her before the school day of the test and she seemed to understand how to solve the problems. She missed 6 out of 12 questions—failing miserably and showing little retention. Andy had the fourth redo and his journals were very unstructured and lacked reasons. He did not write a top five journal during the chapter lessons. Shannon had the last redo in chapter 12. Her chapter 12 journals were good and bad. She wrote one top five journal and her second journal had a huge mistake. I took an entire page of her journal to explain the correct reasoning and proof to get the answer, but how do I know she actually read it? The chapter 13 data revealed more evidence to support my assertion in the table below.

Six students solved problems incorrectly, incompletely, or not at all (because they were absent) in their RAP journal three out of four times (75%) this week. Out of these six students, three of them had to be re-taught objectives on the chapter 13 test. Did these three out of six students actually read what I wrote to them in their RAP journal? How did half of these six students pass the test? I need to rethink the idea about top five journals always leading to good scores because my students proved that they could pass the test and even do very well on the test,

even if they do not write top five journals. In the table below Travis proved that he could ace the test without writing even one top five journal. Sandy and Curt also proved that they could get a 94% on the test and miss three out of four RAP journals. My assertion about the top five journals is now evolving into the following assertion below the table.

Chapter 13 Test Scores and types of RAP journals:					
Student Names	Number of Top 5 Journals	Total Number of Journals Written Correctly During the Chapter	Total Number of Journals Written Incorrectly, Incompletely, or Absent During the Chapter	Percentage of Journals Written Incorrectly, Incompletely, or Absent	Score on Test
Katie	0	1	3	75%	4 Page Redo
Shannon	1	1	3	75%	3 Page Redo
Sherry	1	1	3	75%	1 Page Redo
Curt	1	1	3	75%	94%
Travis	0	1	3	75%	100%
Sandy	1	1	3	75%	94%
Herb	1	2	2	50%	94%
Betty	1	2	2	50%	88%
Amy	2	2	2	50%	88%
Mandy	2	2	2	50%	82%
Tonya	1	2	2	50%	82%

Students who never get a RAP journal problem incorrect will not get a test redo. In other words, students who get their RAP journal problems correct also get the test problems correct.

The following evidence will shine more light on this assertion.

The first piece of evidence comes from the chapter 13 RAP journal and test data collected and lumped. According to the table below, nine (there were 22 students in my classroom) students solved all the problems in their RAP journals correct for the entire week. These nine students never got a RAP journal problem wrong, but some of these nine students were absent or failed to turn in their RAP journal for at least one lesson. Sandy only turned in one RAP journal all week because she was absent two days and failed to turn in her journal one day. The rest of

the students in the classroom (13 students) had at least one incorrect RAP journal during the lessons. Of these nine students, none of them had a redo for the chapter 13 test. Three of the nine scored a 100% on the chapter test. There were only four perfect scores on this chapter test, so that means one student got a 100% on the chapter test, but did not get every RAP journal correct for the entire week. The exception is Travis, who is a gifted student. He learns from his mistakes and rarely makes them twice.

Chapter 13 Test Scores and Types of RAP Journals					
Student Names	Number of Top Five Journals	Total Number of Correct RAP Journals	Total Number of incorrect RAP journals	Percentage of correct RAP journals	Test Score
Dilbert	4	4	0	100%	100%
Sam	4	4	0	100%	94%
Kandy	4	4	0	100%	82%
Buddy	2	3	0	75%	100%
Andy	2	4	0	100%	76%
Miley	3	3	0	75%	82%
Adam	1	3	0	75%	100%
Albert	0	4	0	100%	88%
Sandy	1	1	0	25%	94%

The second piece of evidence comes from the chapter 14 RAP journal and test data. According to the lumped data, 12 students solved all the problems in their RAP journals correct for the entire week. These 12 students had no incorrect journals, but they did have some incomplete or absent RAP journals. Eight of the twelve students solved all their RAP journals correct, while four of the twelve students had a few journals that were incomplete or absent. Of these 12 students, only one of them had a test redo, but I did help her on two of her RAP journals throughout the week (without my support writing the correct mathematical process in those two RAP journals she would have missed a problem and not been a part of this group of students). The student that I helped was Sherry. I will say more about this after I show the data in the table.

Seven of these twelve students scored a 100% on the chapter test. There were only seven perfect scores on the test, so that means no one got a 100% outside of this group of students.

Chapter 14 RAP Journal and Test Score Data:							
Name of Student	Number of Top 5 Journals	Total Number of Journals Written Correctly During the Chapter	Total Number of Journals Written Incorrectly, Incompletely, or Absent During the Chapter	Percentage of Journals Written Incorrectly, Incompletely, or Absent	Percentage of Journals Written Correctly	Percentage of Journals Written that were Top 5 Journals	Test Score
Dilbert	4	4	0	0%	*100%	100%	94%
Amy	4	4	0	0%	*100%	100%	94%
Buddy	4	4	0	0%	*100%	100%	100%
Ashley	4	4	0	0%	*100%	100%	100%
Miley	3	3	1	25%	75%	75%	1 Redo Page
Sandy	3	3	1	25%	*75%	75%	82%
Sam	2	2	2	50%	50%	50%	94%
Larry	2	4	0	0%	*100%	50%	100%
Adam	2	2	2	50%	50%	50%	94%
Tonya	2	3	1	25%	75%	50%	94%
Mandy	1	3	1	25%	75%	25%	88%
Herb	0	4	0	0%	*100%	0%	100%
Albert	0	4	0	0%	*100%	0%	100%
Curt	0	4	0	0%	*100%	0%	100%
Travis	0	3	1	25%	*75%	0%	100%
Kandy	0	3	1	25%	*75%	0%	94%
Sherry	0	3	1	25%	*75%	0%	2 Redo Pages
Andy	0	2	2	50%	50%	0%	88%
Betty	1	2	2	50%	50%	25%	94%
Lola	1	2	2	50%	50%	25%	3 Redo Pages
Katie	0	1	3	75%	25%	0%	1 Redo Page
Shannon	1	1	3	75%	25%	0%	2 Redo Pages

*Indicates that the student had 0 incorrect RAP journals

After analyzing this table you begin to notice that the number of top five journals does not matter as much as getting the problems correct in the RAP journal. Three students in the middle of the table (Herb, Albert, and Curt) all solved their RAP journals correctly for the entire week and scored a 100% on the math test. These students did not write any top 5 journals, but still had tremendous success on the math test. Students who get the problems correct in their RAP journals consistently are scoring significantly higher than those students who are getting the majority of their RAP journals incorrect, incomplete, or absent. Five students at the bottom of the table (Shannon, Katie, Andy, Betty, and Lola) got 50% or more of their RAP journals incorrect, incomplete, or were absent during this chapter. Of these five students, three of them had a math test redo. It is also interesting to note that Sherry received teacher help while writing her RAP journals. The only reason she did not get more RAP journals incorrect was because I assisted her while she wrote the answers in her RAP journals. Without my help she would have had a higher percentage of incorrect, incomplete, and absent RAP journals. This means that the help I provided did not aid her to retain the lessons, but only helped her get the right answers to the RAP journals. Sherry did not develop a retention for the objectives on the lessons I helped her learn. Six students consistently wrote top five journals (remember, to be consistent the student must write 75% or more of the journals as top five) during this chapter. One out of these six students actually had a math test redo. Miley got a math test redo and she only had one incorrect RAP journal during the math chapter. She is actually the first student to consistently write a top five journal, and score a redo on the chapter test. The incorrect RAP journal she wrote was for the math test objective she scored a redo on. Did she read the feedback that I wrote to her in her

RAP journal? Did she just keep solving the problems incorrect on the math test like she did in her RAP journal? How can a teacher stop this from occurring again?

The third piece of evidence comes from both of these chapter tests (chapter 13 and 14). During these chapter tests, four RAP journals were written each week (one RAP journal for each lesson taught). There were three students who had redoes on both of these tests. Take a look at the types of journals these students wrote for these lessons and understand why they scored redoes.

Students who scored a redo on both Chapter 13 and 14 and the type of RAP journal they wrote				
Student Name	Number of Incorrectly, Help, Incompletely, or Absent Journals for Chapter 13	Test Score Chapter 13	Number of Incorrectly, Help, Incompletely, or Absent Journals for Chapter 14	Test Score Chapter 14
Katie	3	2 Redo Pages	3	1 Redo Page
Shannon	3	2 Redo Pages	3	2 Redo Pages
Sherry	3	1 Redo Page	3	2 Redo Pages

These three students either received teacher help, wrote incorrect answers to the RAP journal problems, wrote an incomplete journal, or were absent on more than half (75%) of their RAP journals during each of these two tests (this means that these three students only got 1 correct RAP journal out of 4 for each entire chapter). Of these three students, they are all teacher-accountable students who require my one-on-one support during the RAP journal time. The attitude and effort of these three students has gone dramatically down due to their lack of success on a math test. How will these students break the negative cycle in which they currently find themselves?

Now I turn to my class's data during chapter 15—Geometry. This is a significantly larger chapter with six lesson objectives. My students actually wrote two RAP journals for two of the lessons (Triangles and Congruence). Students had the opportunity to write eight correct RAP

journals during this chapter. The table below presents data that is very shocking and this is where it really began to open my eyes to the power of quality formative assessment. The link between getting the RAP journals correct and scoring well on a test is very obvious in the table below.

RAP Journals and Test Score Information for Chapter 15							
Name of Student	Number of Top 5 Journals	Number of Correct Journals	Number of Wrong, Incomplete, or Absent Journals	Percentage of Top 5 Journals Written	Percentage of Correct Journals	Percentage of Journals Wrong, Incomplete, or Absent	Test Score
Larry	2	7	1	25%	87.5%	12.5%	94%
Miley	5	6	2	62.5%	75%	25%	100%
Kandy	4	6	2	50%	75%	25%	91%
Sam	3	6	2	37.5%	75%	25%	97%
Dilbert	3	6	2	37.5%	75%	25%	91%
Ashley	3	6	2	37.5%	75%	25%	91%
Andy	0	6	2	0%	75%	25%	94%
Herb	1	6	2	12.5%	75%	25%	94%
Amy	1	6	2	12.5%	75%	25%	2 Redo Pages
Betty	1	4	4	12.5%	50%	50%	94%
Mandy	0	4	4	0%	50%	50%	91%
Lola	0	4	4	0%	50%	50%	91%
Buddy	4	4	4	50%	50%	50%	94%
Curt	0	4	4	0%	50%	50%	1 Page Redo
Katie	0	4	4	0%	50%	50%	3 Page Redo
Travis	0	3	5	0%	37.5%	62.5%	97%
Sandy	1	3	5	12.5%	37.5%	62.5%	97%
Shannon	1	3	5	12.5%	37.5%	62.5%	2 Page Redo
Adam	1	3	5	12.5%	37.5%	62.5%	3 Page Redo
Taft	0	3	5	0%	37.5%	62.5%	3 Page Redo
Tonya	0	2	6	0%	25%	75%	85%
Albert	0	1	7	0%	12.5%	87.5%	2 Page Redo
Sherry	0	1	7	0%	12.5%	87.5%	4 Page Redo

First take a look at the students who wrote top 5 journals. The highest score on the test went to the student with the most top five journals. Miley scored a 100% on the test and she

wrote five out of eight top five journals. She was the only student in class to write more than 50% of her journals as top five journals. Buddy and Kandy both wrote 50% of their journals as top five and they both scored above 90% on the chapter 15 test. Ten students wrote at least one top five journal. Of these ten students three of them had a redo on the test. Seven students inconsistently wrote top five journals and still passed the test without a redo. Of the students who wrote more than two top five journals, none of them had a math test redo. This is consistent with my first assertion, but it cannot explain the fact that students who wrote zero top five journals passed the math test with no redo pages. Five students (Tonya, Travis, Mandy, Andy, and Lya) all wrote zero top five journals during the chapter and they all passed the math test without having any redo pages. Maybe there is another explanation for these students' success on the test?

The explanation comes from the columns for RAP journals written correct vs. the column for the RAP journals written incorrectly, incompletely, or absent. Nine students wrote 75% or more of their RAP journals correct during chapter 15. Only one of these nine students had a math test redo. Six students wrote 50% of their RAP journals correct during chapter 15. Two of these six students had a math test redo. Eight students wrote fewer than 50% of their RAP journals correctly during chapter 15. Five out of eight students got a redo on their chapter 15 math test because they got less than half of their RAP journals correct for this chapter. Only three of these students passed the chapter 15 test without getting a redo. The lowest number of RAP journals written correctly by an individual was one. There were two students who only got one RAP journal correct during the entire chapter and both of these students had multiple pages of the math test to redo. Tonya wrote the fewest correct journals and actually passed the test with no redo pages. How did she do it? She only had two out of eight (25%) correct journals, but she had

two days of planned absence during this chapter. She was able to bring make-up work with her while she was absent in order to learn the math objectives. Even though her correct journal number is low, she was able to complete make-up work that substituted for her RAP journal writing.

I now turn to chapter 16 and 17. This is a combined chapter test with objectives from both chapters on the test.

Number of correct RAP journals written during the chapter 16+17 and success rate on the test:		
<u>Name of student:</u>	<u>Number of Correct Journals:</u>	<u>Score on Test:</u>
Larry	6 out of 6	100%
Kandy	5 out of 6	96%
Dilbert	4 out of 6	96%
Albert	6 out of 6	92%
Travis	4 out of 6	92%
Amy	5 out of 6	1 page redo
Lola	5 out of 6	1 page redo
Ashley	5 out of 6	1 page redo
Tonya	5 out of 6	1 page redo
Taft	4 out of 6	1 page redo
Sandy	4 out of 6	2 page redo
Buddy	4 out of 6	1 page redo

These are all the students in the classroom who wrote four or more correct RAP journals during the week. All the rest of the students in my classroom wrote three or fewer correct RAP journals during the week. Each student wrote in their RAP journal a total of six times during the math chapter.

All the students who scored above 90% on the math test wrote four or more correct RAP journals during the chapter. The most journals that they wrote incorrectly was two. The student who scored a perfect score on the test also solved his RAP journal problems perfectly each day. No student got above a 90% on the test without writing at least four correct RAP journals during

the chapter lessons. Students who wrote three or fewer correct RAP journals during the week did not have a test without at least one page of redoing.

Seven students scored below 90% on the above table, but they did solve four or more correct RAP journals during the math chapter. Two was the most redo pages any student had in the above table. Only one student had two pages of redo to complete. Six students who wrote four or more correct RAP journals during the chapter had a one page redo to complete on the test.

These tables show that the more correct RAP journals written during the math chapter will lead to higher test scores and fewer test redo pages. Refer to the next table to see what happened to the students who wrote the least amount of correct RAP journals during chapter 16 and 17.

Number of correct RAP journals written during the chapter 16+17 and success rate on the test:		
<u>Name of student:</u>	<u>Number of Correct Journals:</u>	<u>Score on Test:</u>
Ally	1 out of 6	2 page redo
Adam	2 out of 6	2 page redo
Mandy	2 out of 6	2 page redo
Sherry	2 out of 6	3 page redo
Miley	2 out of 6, but she did write 5 out of 6 RAP + Journals	1 page redo

The most redo pages on the test were three pages. Sam and Sherry both had three redo pages. Sam wrote three out of six correct RAP journals during the math chapter. Sherry wrote two out of six correct RAP journals during the math chapter. All of the students listed on this table had at least one page of redoing on the math chapter test. No one on this table took the test without having to complete a redo on at least one math objective. It seems that fewer correct RAP journals written during the math chapter will lead to lower math test scores and more redo pages.

This is something I noticed on the chapter 16 and 17 math test for a specific lesson about finding the area of triangles. I noticed a total of 13 out of 23 students failed this part of the math test. This was the most students to fail any one page of a test all school year. Why did this occur? I went back and checked each student who failed and tried to see what type of RAP journal led to this poor success rate.

Students who had a redo on the math test for the area of triangles:		
<u>Incomplete Journals:</u>	<u>Wrong Journals:</u>	<u>Top 5 Journals:</u>
Mandy	Ashley.	Sam
Curt	Amy	Ashley
Betty	Taft	Miley
Adam		Tonya
Ally		
Andy		

These are the names of all 13 students who failed the objective about the area of triangles on the math chapter test. Here is what happened during the RAP journal lesson about the area of triangles. There were a total of eight incomplete journals written for this math concept. Six out of these eight students failed this concept on the math test. This means 75% of the students who wrote an incomplete RAP journal for this lesson failed this lesson objective on the math test. Only two students wrote incomplete RAP journals for this lesson and passed the test objective. Only 25% of the students who wrote an incomplete RAP journal actually passed this objective on the math test.

There were a total of four incorrect journals written for this math concept. Three out of these four students failed this concept on the math test. 75% of the students who wrote incorrect RAP journals for this lesson failed this lesson objective on the math test. Only one student who wrote an incorrect RAP journal on this lesson was able to pass this objective on a math test. Only 25% of the students who wrote an incorrect RAP journal actually passed this objective on the math test.

There were a total of seven top five journals awarded for this math concept. Four out of these seven students failed this concept on the math test. Approximately 58% of the students who wrote top five journals for this lesson failed this lesson objective on the math test. This means that three students who wrote a top five journal were able to pass this objective on a math test. Approximately 42% of the students who wrote a top five journal actually passed this objective on the math test.

I only gave my students less than 10 minutes to write in their RAP journals for this lesson. I should have had my students write in their RAP journals the next day for this math objective as I did in the geometry chapter for the two objectives involving triangles and congruence. In the geometry chapter I also ran out of time while teaching these concepts, so I had students write RAP journals about them for two days in a row. The reason I did not write about this concept again was because at the beginning of the next lesson I would let students who had great reasoning and proof communicate the correct answers orally at the marker board to the previous day's RAP journal problems. After the students were done at the marker board then I would really focus my instruction on the reasoning of why you have to multiply the base time height and then divide by two (or multiply by 0.5) to find the area of a triangle. With the entire class paying attention and listening to the students explaining the answers and then to me, everyone should have been able to correct their mistakes so they would not have a redo on the chapter test. This turned out to be a bad assumption due to the significant amount of math test redoes. Since students were not given 20 minutes to write in their RAP journal then the amount of test redoes for that math objective significantly rose.

Something else that led to a significant amount of math test redoes was giving the students the answers to the RAP journal problems. Not providing students answers to the RAP

journal problems helps the teacher know who did and did not learn the math objective being taught. When the teacher knows who can solve the RAP journal problems then he/she can prevent the struggling students from getting a math test redo and also increase their retention of the math objectives.

When I first began my research project I allowed my students to pick any problem off the marker board to solve and explain in their RAP journal. There were five to seven problems to choose from and all the problems had the correct work explaining how to get the correct answer. The correct answers were also plastered under each problem. This seemed like a good idea, but I soon decided that it was not doing my students any good. It was also leading to more math test redoes. Having the reasoning and proof already done on the marker board was starting to cause my students to be lazy thinkers. Some students were making simple computation errors, while others seemed to turn their brains off and just blatantly copy the numbers from the marker board into their RAP journal without a rational thought going through their head about what they were doing. My students began to just copy down the answer and some or all of the work. This required the students not to think and I am totally against this because it does not promote retention of the mathematical concept! The students were actually trying to fool me by copying down the problems and correct work with answers in their RAP journals like they knew what they were doing. Later in the chapter the test was very difficult for these students and this was evident because they got redoes. I did have those students who actually thought about the mathematical process that was occurring in each problem, but I was letting the ones who did not know the correct mathematical process to squeak through a crack. After I realized this, I decided not let my students write about a problem that they had the answer to in their RAP journals. I

was forced to start leaving the RAP journal problems blank so the students would have to do more thinking and less copying.

The running record log I have for each student's RAP journal was not telling me very valuable information when I was giving my students the answers to the RAP journal problems. Each day when I read my students' RAP journals, I documented the RAP journal type and whether or not the RAP journal problems were solved correct. Everyone was getting the problems correct because the answers to the problems were already given. How was I to know who solved their RAP journal problems incorrectly for each specific lesson on each specific day of the week when the students were giving all the right answers? Students who miss a problem in their RAP journal did not learn the lesson that was taught for that particular day, but my running record indicated that everyone was getting the answers correct. Not everyone was learning the lessons because the test scores indicated that students were not developing retention. If the answers were given to each RAP journal problem then I would not know who really understands or does not understand the math problem because the students could just copy the answer and work from the marker board into their RAP journal without knowing why this answer is even correct.

The second piece of evidence comes from my teacher journal (February 29, 2008). For the past two weeks Katie has gotten three out of four journals wrong each week (chapter 13 and 14). I have been providing her extra support while my students have been writing in their RAP journals. The problem solving lesson was the one for which she really needed my support (lesson 14.8). Kandy has also been providing Katie support. Kandy and Katie are friends and Kandy is a strong math student. Kandy has never written an incorrect journal. Kandy worked one-on-one with Katie during RAP journal and homework time in chapter 14. Katie had her best test score

on the chapter 14 test. She only missed three problems out of 16, but she still had a one page redo. If Katie were allowed to copy the correct answers off the marker board, then I would not know how badly she is struggling to learn the math objectives. I would not have been able to give her the support she needed because she would have slipped through a crack.

The third piece of evidence comes from my teacher journal (February 8, 2008). I wrote in my journal,

I seem like I'm catching the student mistakes before the test by using RAP journal problems without the answers given. I also feel like I know what to really focus (my instruction) on before the test because I know what type of common mistakes my students make. If I gave my students the answers to their RAP journal problems, then I wouldn't be able to see any of their common mistakes because they would just copy the answers and not get the problems wrong.

The RAP journals have really guided my instruction the next day. Incorrect journals become common mistakes that I show the next day. I write the correct way to solve the RAP journal problems in the RAP journal of any student who gets the incorrect answer. Then the correct answer is communicated the next day at the beginning of the math lesson on the marker board by students. Each student is exposed to the correct mathematical process multiple times, from multiple points of view, and multiple learning styles (mainly auditory and visual).

Besides not giving the answers to the RAP journal problems, on a separate occasion I made the change to add a reason box on the marker board. When I explained how to solve a new or foreign math objective I wrote the words I communicated orally in a reason box on the marker board, so my students could refer back to it during their RAP journal writing time. I called the words I communicated orally, reasons, and put them in a box I called a reason box. This helped

students write reasons in their RAP journals and boosted mathematical communication through the avenue of writing. The addition of the reason box caused the following pattern in my data.

Students who write reasons on the top of their test get the problems correct on that page of the test. Students who have test redoes have never written reasons on their test. Students who get redoes only focus on the answer to the problem on the test.

The first piece of evidence comes from a student's test. Sam wrote a couple reasons on the top of her chapter 14 test (lesson 14.3). She did not miss a problem on this test objective. She solved four out of four problems correctly. Sandy wrote a couple reasons next to her answers on the chapter 14 test (lesson 14.3). She did not miss a problem on this test objective (four out of four correct). Both of these girls wrote reasons on their test for the same lesson and both scored perfect scores on this page of the test.

On the chapter 15 test many students wrote reasons on their test and none of them got a redo. Ashley, Miley, Buddy, Larry, Sandy, Sam, Dilbert, and Lola all wrote reasons on all or most of the pages of the test and all these students scored over a 90% on the test. Kandy used a highlighter and wrote reasons on the majority of the pages of her test and she scored over 90% on the test. Mandy wrote reasons in her own words on the majority of the pages of the test and she scored over a 90% on the test. Katie used a highlighter and gave reasons on the last page of the test about the parts of a circle. She scored a perfect score on this page. She did not write any reasons on any other page of the test and scored a redo on three out of six of those pages. The same thing happened to Shannon. She wrote amazing reasons on one page of the test about translation, rotation, and reflection. She scored a perfect score on this page of the test. She did not write any reasons on any other page of the test and scored a redo on two out of six of those pages. Students who did not write reasons on any pages of the test were more likely to get a redo.

The third piece of evidence comes from students' tests that get redoes. None of these students have ever written reasons at the top of their test. I have never had a student write reasons on a test page and get a redo on that same test page. Would writing reasons at the top of a math test help students not get redoes? I really think it will because writing reasons at the top of a test page means that the student knows the mathematical process. If a student knows the mathematical process and can state it as a reason, then the only mistake the student could make is computational.

Did writing reasons help my students? My final research question is: How will a student's ability to communicate mathematical concepts change after they write in a RAP journal? Here is a look into the type of communication that boosts mathematical retention.

Writing reasons seemed to be a big determining factor for how students test scores and retention increased or decreased. Besides students writing reasons on their tests the reason box has led to the following assertion. Putting a reason box on the marker board helped students communicate the mathematical process. The reason box is very helpful because my students can either use my words or create their own during their RAP journal writing time.

The first piece of evidence is from my teacher journal (February 15, 2008). I noted that after doing the reason box for two straight days, my students wrote 15 top five journals on the second day. This is a dramatic increase in the number of top five journals for one lesson. I do not give my students a top five journal for simply copying the reason box. If a student copies the reason box word-for-word, just as I wrote it on the marker board, then I give them a RAP- (reasoning and proof minus) journal. In order for a journal to receive the top five journal award it must be RAP+ (reasoning and proof +).

The second piece of evidence comes from my teacher journal (March 7, 2008). I noted that I did not write a reason box on the marker board for a lesson about congruence. None of my students wrote reasons to go with their RAP journal answers in this lesson. A couple of students actually asked me during the RAP journal writing time what the reasons were and I told them that I said the reasons orally today, but did not write them on the marker board. Only three students wrote a correct journal for this lesson. This is the fewest number of students all year to write a correct RAP journal. This means that 18 students wrote incorrect answers in their RAP journals (I only had 21 students at this time of the year). This is a significant increase in the number of incorrect RAP journals. I wonder how much of this can be attributed to the fact that I did not put a reason box on the marker board?

The third piece of evidence comes from Andy's RAP journal. This student has copied (word-for-word) the reason box for at least five consecutive RAP journals. Since I started putting the reason box on the board this student has been copying at least one part of what I write inside the reason box into his journal. There are other students like him, but none as extreme. Is this helping or hurting him? His math test scores indicate that this way of writing in his RAP journals is helping him. His test score on the chapter 13 test was a 76%. I was not putting a reason box on the marker board for RAP journals written during this chapter. Then I started putting the reason box on the board for chapters 14, 15, 16, and 17. Andy's test score rose to an 88% on the chapter 14 test and a 94% on the chapter 15 test. The reason box seems to be helping this student since his test scores are increasing.

This reason box is very important for another purpose. Because students who are able to tell reasons develop a conceptual understanding, and this increases their retention of mathematical objectives. Developing a conceptual understanding also helps students recognize

and state common mistakes within their learning. Students who can accurately communicate common mistakes related to a mathematics concept at the marker board or in their RAP journal can conceptually understand an objective. Getting students to develop a conceptual understanding is what I want every student to do during every math lesson.

The first piece of evidence comes from Buddy's RAP journal. Buddy always writes common mistakes in his RAP journals. I know that he conceptually understands the objectives because he never has had a math test redo. This student's test scores are all above 90%. He has not scored below a 90% on a math test this entire year.

The second piece of evidence comes from my teacher journal (February 1, 2008) and Larry's communication about multiplying mixed numbers on the marker board. Larry always communicates very well at the marker board. On one occasion, he explained a common mistake and was very convincing with what he said. He accurately communicated the common mistake and by just listening to his words you would believe what he was explaining to be correct because he did not use any voice changes or hints of being shady. Larry accurately explained the correct way to solve the problem after a few people pointed out some of what was wrong. Larry scored a 100% on the multiplying mixed number test (Chapter 12) and he was the only student to score a perfect score on this test. His ability to communicate a common mistake on this mathematical concept deepened his understanding and boosted his test score. Since Larry was the only student to achieve a perfect score on the test this proves to me he developed a conceptual understanding for this math objective.

The third piece of evidence comes from a student interview after a test and teacher journal (February 29, 2008). Lola told me that the reason she missed the problems on the test was because she only remembered the common mistake way of dividing decimals. This student

has never had a test redo until scoring four out of four incorrect problems on this particular test objective (chapter 14, lesson 14.5). Since Lola could not remember the difference between the common mistake way of solving the problem and the correct way of solving the problem this really shows me she failed to conceptually understand the objective. It also makes me wonder if common mistakes are age-appropriate for some students.

Some students tend to be more confused when a teacher shows them a common mistake. The common mistake actually does more damage to the student's understanding of the concept than just letting them work the problem. Showing the students the correct way to solve the problem is the same as reinforcing what they are supposed to do. Showing the students the incorrect way to solve the problem is supposed to reinforce the incorrect way to solve the problem, but in the mind of a ten year old these two things can easily become jumbled and accidentally reversed. Such is what happened to Lola. When I retaught this math concept to Lola in a one-on-one setting she quickly observed and fixed her mistakes, which were the same for each problem. Since Lola's mistakes were all the same, she only had to know how to fix the mistake in one problem. After fixing the mistake in one problem she could easily transfer this conceptual understanding to each other problem with differing numbers. Can some students learn from common mistakes of a math concept, while others cannot?

It would be great to get my students to write reasons in their RAP journals every day, but there are some students who refuse. Some students like writing more than others and other students like to do the computation in their heads. What type of journals do students like to write? Which is more important—the reasons or the proof? The following assertion answers those questions. Students prefer to communicate reasons and proof in their RAP journals.

The first piece of evidence comes from my teacher interviews. I conducted one interview each week between the dates of February 20 until March 19. I interviewed 19 students between these dates. When asked a question about what type of journal each student writes, 15 out of 19 students (80%) said that they prefer writing reason and proof journals as opposed to just reasons or just proof. No students preferred to write only reasons. None of the students in class write these types of journals. Four out of 19 students (20%) prefer to write just proof journals.

What students prefer to communicate in their RAP journals:			
Type of Communication	Frequency	Total Number of Students Interviewed	Percentage
Reasons and Proof	*15	19	*80%
Just Reasons	0	19	0%
Just Proof	*4	19	*20%

The second piece of evidence comes from the same lumped data. On the next question during these interviews, I asked the students to choose either reasons or proof (each student had to pick one over the other) so I could determine which form of communication the students prefer the most in their RAP journals. I found out that 12 out of 19 (63%) students prefer reasons. When students write reasons they are telling how to get the correct answer in their own words, sentences, or paragraphs. I think of the reasons as the mathematical process or conceptual understanding. Only seven out of 19 (37%) students prefer to write just the proof part of the journal. The proof part of the journal is the number work and means that the student prefers to just write the answer. I think of the proof as the computation process/understanding.

What students prefer to communicate in their RAP journals:			
Type of Communication	Frequency	Total Number of Students Interviewed	Percentage
Reasons	*12	19	*63%
Proof	*7	19	*37%

The third piece of evidence comes from my teacher journal (March 14, 2008). In this teacher journal I wrote about specific student habits. I said,

Curt and Travis are very anti-reasons. They rarely communicate any written reasons in their RAP journal. They go straight for the proof with numbers and mathematical operations. They like to quickly communicate the answer to a math problem.

I also wrote the following in the same teacher journal (March 14, 2008). I was talking about the way that some of my students communicate the reasons in their RAP journals. I wrote,

Mandy does a nice job of stating the reasons in her own language. So does student Sam, Sandy, and Betty. Amy and Lola do this occasionally.

Students that write their reasons in their own language take more ownership of what is being learned and this leads to a deeper understanding of the math objectives.

I also wrote the following in the same teacher journal (March 14, 2008). I was talking about how some students copy the reasons I write from the board into their RAP journal. I wrote,

Some students communicate the reasons the exact way I do in the reason box in their RAP journal. Andy and others simply copy the reasons down word for word as I wrote them in the reason box on the marker board.

These type of students could take ownership of what is being learned, but they could also forget everything the teacher taught because the information is not their own.

VII. Conclusions:

In my literature review Fuchs and Fuchs (1986) state that when a teacher provides two assessments per week the students have a percentile gain of 30 points. This is exactly what the RAP journal can do for students on a math chapter test. Everything the teacher and students do in the mathematics classroom is structured around the RAP journals. The RAP journal is a high-

quality way to formatively assess and it provides the students with a fun way to learn and the teacher with the knowledge to guide the next day's instruction based on the student's needs.

Black and William (2003) stated in the literature review that using quality formative assessment will result in the standards of achievement to go up. This does not happen right away for some, and it may take some time to develop.

In the beginning of my project the students were uncomfortable writing reasons in complete sentences. Students who especially struggle to write complete sentence reasons said they did not like writing before this year in a pre-survey. While a teacher's expectations are different for each math content standard, there are some consistent factors. In my literature review I wondered what my students' RAP journals would look like when I made my expectations consistent.

Here is what happened when I made the RAP journals consistent. Quality reasons were written in complete sentences and proofs used numbers with operations and checking. Some of the reasons and proof that students wrote were unstructured in their RAP journals. I have discovered there is an increased likelihood that students will have test redoes if their RAP journals are unstructured. The students who consistently wrote top five journals have very structured RAP journals. The teacher has to work hard at the beginning of the school year to teach these expectations.

As Hersch (1993) said in my literature review, the mathematics of the proof belongs to the user. This was called humanist. A bunch of my students developed their own style of RAP journals. I could pick up a couple of my student's RAP journals and know their theme for each math objective. Sam would always solve the RAP journal problems with the Hardy Boyz and Buddy would always have Pokemon characters solve his problems in a game show format. The

students who developed their own style of RAP journals were more likely to receive the top five journal award consistently.

The length of the top five journals are usually more than a page long, while the RAP journals without good reasons tend to be very short. A top five journal does not have to be over a page long, and I have awarded this honor to some journals that are only one page in length. Top five journals must have reasons in writing and proof in numbers that are structured in an organized way. Students who write structured reasons in complete sentences and even paragraphs do very well on the chapter tests. I enjoy reading these journals and the students who wrote them seem to get pleasure when I read them out loud to the entire class the next day. Reading the top five journals out loud the next day helps students retain the correct way to solve the RAP journal problems and it motivates other students to write a high-quality reason and proof journals. Reading the top five journals out loud helps students focus more of their attention on the mathematical process from the previous day's lesson. Getting students' attention on the mathematical process will help promote the writing of better reasons in complete sentences. Communicating the RAP journal problems the next day at the beginning of math class helps other students understand what they did to get the problem incorrect in their RAP journal from the previous day. Giving students multiple exposures to a problem helps them to retain a math concept.

In a heterogeneous classroom the challenge of teaching is presenting your lesson to a wide range of developmental levels. RAP journals allow the teacher the opportunity to teach a whole-group lesson and then close with the RAP journal as formative assessment that promotes the NCTM process standard reasoning and proof. Some students will value the reasons, while others the proof. Students who value the reasons are more conceptual learners. Students who

value the proof are more computational learners. The RAP journals provide the conceptual learners with the freedom to be creative and the computational learners the structure to learn the essentials.

When students do not have the answers provided to the problems they solve in their RAP journals, the teacher is able to accurately know who learned the lesson that was taught. Students who miss problems in their RAP journals do not conceptually understand the lesson that was taught. Students who consistently make mistakes in their RAP journals need extra practice. Students who never make mistakes in their RAP journals get perfect or nearly perfect scores on their tests. Students' confidence level on a test is deeply connected to their success during the week of writing in their RAP journals. Like what Brangert-Drowns et al, (1991) stated in my literature review, this makes students more "mindful" and they tend to care more about what is being taught. Students' focus and attention also rise during the guided practice portion of a lesson because they are being held accountable by the RAP journal.

Reading all students' RAP journals each night is time consuming, but worthwhile for their achievement. Reading all the RAP journals each night allowed me to modify the next day's lesson based on formative assessment data just like it did for Miller (1992). What the students write in their RAP journals either become the common mistakes that I will share, the correct journals that will lead to this student's success on a test, or the top five journals that I read out loud the next day.

Tell students who are not making progress on RAP journals their progress before giving a math test. RAP journals provide early intervention and math RTI, so share the documentation from the running record log with each student. Some students do not have the slightest idea of the progress they have made during the lessons the teacher has taught. The teacher needs to be

more proactive at showing the students their progress before giving the students a math test. A teacher can show students their progress by telling them how many RAP journals they have solved correct like I did before I gave the chapter 18 test. Another way to show students their progress is by giving them a graph of all their RAP journals during the math chapter the teacher taught. This is something I plan to do next year and see what happens. I actually created a document that I will photocopy and have students fill out next school year. This document will graph the progress that they make during each lesson (Appendix J).

I wonder if telling students that they were in jeopardy of getting a math test redo made them more motivated to focus during the math test review and then achieve a passing score on the math test? I whole-heartedly believe that me telling my students where they stood in their progress of learning really impacted how they did on the math test. Telling students their progress and sharing this progress with students before high-stakes testing definitely impacts a student's motivation and achievement. Having students perform daily formative assessments and then letting students know their progress of learning definitely will help them score better on summative assessments. This was a major gap in the literature I read and now I hope my research helps fill the void.

VII. Implications:

In my literature review I said that the intention of my study was to let students learn by internalizing the instruction. If teachers choose to teach using RAP journals I believe they will have a lot of success and test scores will go up. In order for this to occur the teacher will have to model the way to write a journal very passionately at the beginning of the school year. During the middle of the school year the teacher will have to hold those teacher-accountable students feet to the fire and make sure that these students are writing in their RAP journals each day.

Have fun with those independent learners because they really love writing in the RAP journals and this way of teaching really makes them come alive.

When students begin to write reasons in their RAP journals they have just begun a process that will lead them down the road of success. Moore (1994) states that students at the postsecondary level struggle to write proofs because they have such a limited perspective. Getting students to start reasoning and proving at an early age should eliminate and broaden the students' perspective. Students will begin to be more successful on tests with the addition of writing reasons. In my study I found that students who wrote reasons on their test never got a test redo. Students who do not write reasons on a test are more likely to have a test redo. Getting students to write reasons on a test page will help boost their test score. Getting students to embrace the writing of reasons will lead to conceptual understanding and high summative assessment scores.

Using RAP journals as a high-quality formative assessment will allow the teacher the ability to know who understood a lesson. Sharing the progress made for each student in the classroom will help each student set goals and monitor their achievement. Next year, I will make graphs for each student because then they will be aware of their progress before each chapter test. Students will learn by internalizing the instruction and making the math objectives their own. The proof belongs to the user and hopefully this practice at an early age will lead to the growth of more Tiger Woods' in the math world.

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Appendix A:

RAP Journal Descriptor Rubric Scale/Chart 1.1

Type of Journal Written:	Recount/Response	Summary	Dialogue
	<p>*1. Focus is placed heavily on the answer.</p> <p>*2. Simple computation is written in numbers in the journal.</p> <p>*3. Very little to no use of vocabulary words.</p> <p>*4. Details of the lesson are shared or written down.</p> <p>*5. Events of the lesson are listed in a random, scattered, or incomplete order.</p> <p>*6. No counterexamples are written.</p>	<p>*1. Focus is split between the mathematical process and answer.</p> <p>*2. Student copies something directly from the board. They may tell the answer in their own words or numbers in the journal.</p> <p>*3. Some vocabulary words are used in the journal.</p> <p>*4. Main ideas and some details of the lesson are shared or written down.</p> <p>*5. A simple summary of the events are listed in the correct order.</p> <p>*6. There is an attempt at a counter example.</p>	<p>*1. Focus is placed heavily on the mathematical process.</p> <p>*2. Student uses their own words and writes fresh ideas. They may use characters, an attention getter and satisfying ending. They share the answer in words and numbers in the journal.</p> <p>*3. Vocabulary words are used throughout the journal.</p> <p>*4. Main ideas and details of the lesson are shared and written down in a new personalized way.</p> <p>*5. A personal summary of the events are shared or written about in a creative manner.</p> <p>*6. A clear counterexample is written.</p>

Appendix B:

RAP Journal Descriptor Rubric Scale/Chart 1.2:

Type of Journal Written:	Reasons:	Proofs:	RAP – (Reasoning and Proof Weak)	RAP (Reasoning and Proof)	RAP + (Reasoning and Proof Strong)
	*1. Only writing is written in the RAP journal..	*1. Only Numbers are written in the RAP journal..	<p>*1. Written reasons and numerical proving is weak.</p> <p>*2. The reasons and/or proofs are limited or lacking in certain areas.</p> <p>*3. One is more dominant (either the reasoning side or the proof side).</p> <p>*4. The reasons and proofs are not linked together throughout the entire journal..</p>	<p>*1. Written reasons and numerical proving is average.</p> <p>*2. The reasons and/or proofs are just enough to meet the expectations.</p> <p>*3. Neither side is dominant. The reasoning and proving has good balance.</p> <p>*4. The reasons and proofs are linked in some place, but not throughout the entire journal.</p>	<p>*1. Written reasons and numerical proving is exemplary.</p> <p>*2. The reasons and/or proofs exceed the expectations.</p> <p>*3. Neither side is dominant. There is a numerical proof for each reason.</p> <p>*4. The reasons and proofs are linked together throughout the entire journal.</p>

Appendix C:

Running Record for each student in class:

Lesson from the textbook and date written:										
Type of journal:	R,S,D	R,P, RAP	R,S,D	R,P, RAP	R,S, D	R,P, RAP	R,S,D	R,P, RAP	R,S,D	R,P, RAP
A										
Amy										
Andy										
Lola										
Adam										
Miley										
Kandy										
Derik										
Larry										
Ashley										
Herb										
Tonya										
Albert										
Betty										
Adrianna										
Shannon										
Sandy										
Sam										
Mandy										
Buddy										
Travis										
Dilbert										

(R,S,D stands for Recount, Summary, Dialogue) (R,P,RAP stands for Reasoning, Proof, Reasoning and Proof)

Appendix D:

Teacher Journal (Blank Template):**First Part about my teaching:**

What did my teaching look like?

If you were observing my class you would have seen the following.

What were challenges?

What went well?

What did the average day look like?

How much time does the teacher spend replying back to students' RAP journals?

What was the focus of the teacher's replies to each student?

Are there any changes in what each student has been writing in their RAP journal?

What changes have I seen in my students RAP journals this week?

Second Part addressing the research questions:

Test scores data?

Formative assessment observation data?

Communication observation data?

What happens to my teaching when I let my students write RAP journals for the last 20 minutes of class 2-3 times a week?

Other questions:

Tensions I felt this week between my roles as teacher and researcher?

What surprised me this week related to my problem of practice?

What did I learn this week that will inform my teaching and/or journaling for next week?

Appendix E:

Five question survey:
(Given: Before each chapter test.)

Name: _____

Please give your honest reflection about each question.

1. Do you remember what you wrote in your RAP journal this week? If so, what math idea(s) do you recall?

2. Name one (or more) thing(s) you wrote about in your RAP journal that you predict is/are going to be on the test?

3. What score do you think you are going to get on this/these part(s) of the test? (example 4, 3, 2, or 1)

4. How confident are you that you will do well on this test?

5. How do you think writing in your RAP journal will help you on this/these part(s) of the test?

Appendix F:

Seven Question Survey
(Given: After each Chapter Test)

Name: _____

Please honestly answer each question:

1. How did you get this grade on the chapter test?

2. Did writing in your RAP journal help make your test score better? Why or why not?

3. How did writing in your RAP journal affect you on the test?

4. Did you predict one or more math test problems on the test?

5. Which type of problems did you predict would be on the test?

6. Do you think that writing better RAP journals will boost your test score? Why or why not?

Complete the following statement:

7. The number one thing the RAP journal did for me was . . .

Appendix G:

**Survey Asking Students to Reflect on what they write in a RAP journal:
(Given: Beginning, Middle, and End)**

Name: _____

Please honestly answer each question:

1. What do you think is the purpose for writing in your RAP journal?

2. On average, how much time do you spend writing in your RAP journal (each time you write)?

3. Do you like writing in your RAP journal? Why or why not?

4. What are the benefits to writing in your RAP journal?

5. What do you write in your RAP journal?

6. How successful on homework do you feel after writing in your RAP journal?

7. How successful on a test do you feel after writing in your RAP journal?

8. How confident do you feel on homework after writing in your RAP journal?

9. How confident on a test do you feel after writing in your RAP journal?

10. What do you think about when you are writing in your RAP journal?

11. What makes writing in the RAP journal easy for you? If it's hard, what makes it hard?

12. Did you enjoy writing before this year?

13. In middle school, would you like to use a RAP journal? Why or why not?

14. What do you like best about the RAP journals?

15. What do you like the least about the RAP journals?

16. If you could change one thing about the RAP journals, what would it be?

17. Is there anything else I should know about your attitude toward the RAP journals to better understand your opinion?

Appendix H:

Small Group Interview Questions:

Tell your name and what you think about the RAP journals

Purpose of the RAP Journals:

Which two of these do you think is the purpose of the RAP Journals?

_____ Helps me memorize or remember how to solve the problems

_____ Helps me practice the problems

_____ Shows me common mistakes

_____ The RAP journals are for Mr. Schwanke to know if each student understands the problems

_____ Lets me have fun while doing math

_____ Lets me use my imagination and opens my mind while solving the math

_____ Helps my test score go up

_____ Barely or does not help me at all

Which two of these applies to you? (Could be the same or a different answer.)

Is there another reason you can think of that should be added to the list?

Which one should not be on the list?

Reasons and Proof:

Why are writing reasons and proof important?

Why are reasons important to write in complete sentences?

Why is proving important to do in numbers?

Which would you rather do in your RAP journal? (Reasons, Proof, or Reasons and Proof)

Which one do you think is more important? (Reasons or Proof)

Top 5 Journaling:

Have you ever gotten a Top 5 Journal?

What motivates you to write a Top 5 Journal? (Points, Good test score, write something funny to possibly make the class laugh, etc.)

Should Mr. Schwanke keep reading the Top 5 Journals out loud? Why?

Should Mr. Schwanke only pick the five best journals to be in the Top 5 Journals? Why?

I found out that the students who consistently write Top 5 Journals never have a test redo. Why do you think this is true?

Incorrect Journaling:

Have you ever gotten a problem wrong in your RAP journal?

Why do you think students make mistakes on the problems in their RAP journals?

What should happen to students who get the wrong answer in their RAP Journal?

If you missed a problem in your RAP Journal would you be okay with this consequence?

How should the teacher check with these students to see if they understand how to get the correct answer?

I found out that students who miss problems in their RAP Journals are very likely to get a test redo. Why do you think this is true?

Appendix I:

Teacher Journal
February 8

Other questions:**Tensions I felt this week between my roles as teacher and researcher?**

I really felt tension in the area of my lower students. As a teacher I want to give additional support to students who I feel are struggling to learn the lessons. Students who consistently have test redoes are on my teacher radar. Even though these students write their journals and do their homework they are still at-risk to fail any given test, in my opinion gained from experience. So what I want to do is given these (Sherry, Katie, Amy, Shannon) four students extra support at various times of the day. The additional support I would give as a teacher would be in addition to everything that everyone else is getting. I would do this additional support during breakfast or morning plan time to help these students on a one-on-one level. As a researcher this is really messing with the data I've collected because only these four students are getting the support. Maybe these students wrote a certain type of RAP journal all week long and then they get to the test and ace it because they've been getting one-on-one support on top of the daily lesson. It seems like this would not be okay. So I feel that I can't help students one-on-one because the research would be tampered with, but I don't want these students to have another test redo.

Teacher Journal
February 15

Other questions:**Tensions I felt this week between my roles as teacher and researcher?**

My students who have test redoes need more support than just writing in their RAP journals. Would pulling them to the back table to help them write the journals help them understand how to write better reasons and proof? Will the students who need more support be more successful with the teacher or other student's help?

Teacher Journal
February 22

Other questions:**Tensions I felt this week between my roles as teacher and researcher?**

Letting Katie work with Kandy out in the hallway on problems was a tension I felt because Katie is getting more one-on-one attention on top of her journal writing. Is this fair? Will letting Katie work with another student boost her mathematical abilities?

