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**Journal Writing in Mathematics: Exploring the Connections between Math Journals and
the Completion of Homework Assignments**

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Math in the Middle Institute Partnership
Action Research Project Report

in partial fulfillment of the MA Degree
Department of Teaching, Learning, and Teacher Education
University of Nebraska-Lincoln
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Journal Writing in Mathematics: Exploring the Connections between Math Journals and the Completion of Homework Assignments

Abstract

In this action research study of sixth grade mathematics, I investigate how the use of written journals facilitates the learning of mathematics for my students. I explore furthermore whether or not these writing journals support students to complete their homework. My analysis reveals that while students do not access their journals daily, when students have the opportunity to write more about one specific problem--such as finding the relationship between the area of two different sized rectangles – they, are nevertheless, more likely to explain their thoughts in-depth and go beyond the traditional basic steps to arrive at a solution. This suggests the value of integrating journal writing in a math curriculum as it can facilitate classroom discussion from the students' written work.

Introduction

I am beginning to realize there has always been something missing from my teaching of mathematics. I have always had good intentions starting off the school year but never seemed to be able to implement them. For example, I always wanted to use “habits of mind” problems consistently in my practice. These problems involve critical thinking to promote the use of various problem-solving strategies and the access of prior knowledge. I have integrated these problems into my classroom, but I have used them only randomly throughout the school year or as supplementary closure to a unit of study. In thinking about this problem, I have realized I need to implement something new into my curriculum. This is why I want to explore the use of math journaling in my current teaching.

Throughout my teaching career, I have witnessed large numbers of students failing to turn in their homework. This leads me to believe one of two things: either they do not care about their performance and the final outcome (e.g., a grade) or they do not understand the independent, out-of-class learning tasks before they leave my classroom for the day and then struggle. Homework should really be a learning tool in which students have a chance utilize the knowledge they have learned in the classroom and apply it to various problems and assessment. That is, homework should be about learning and enhancing their knowledge, not confusing busy work that they come to neglect. This is *my* problem, not theirs.

This leads me to look deeper into how I can encourage students to complete their homework assignments, using writing journals as a resource for their learning. As of this writing, 6 out of my 22 students are consistently missing 5 or more homework assignments. This frustration I have with inconsistent homework completion has led me to experiment with journal writing into my classroom to see what I can do to help this ongoing problem.

Originally my focus had been to look at the relationship between homework completion and test success. However this problem seemed to be too broad and simplistic. I needed to narrow it down to a specific part of homework completion that allows me to look more thoughtfully at students' efforts. In doing this, I have decided to use math journaling as one specific part of my math teaching. Therefore, my current problem of practice involves homework completion rates as I implement math journals and whether or not this relates to a student's learning of mathematics. I want to see what will happen to the students' homework completion rates as I implement math journaling into my class.

This problem of practice not only relates to the National Council of Teachers of Mathematics (NCTM) Principles of Learning that states that students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge. More specifically, it relates to the "Representation" standard (NCTM, 2000) which says the students should be able to create and use representations to organize, record, and communicate mathematical ideas. If students are able to show me through their journaling what they understand the mathematics I am teaching them, will they be more likely to do well on their homework and feel more comfortable in completing the assignments? And does this advance their mathematical learning? This problem of practice relates to the Principles of Teaching and Learning because in order for students to be successful in my classroom they must experience effective instruction through challenges and support and be able to learn mathematics through understanding.

As I searched for an area of focus for this research project, I took into account several factors in making my decision. First, mathematics journaling involves my own teaching and learning. I first had to implement the journals to ensure that all students complete them

effectively. Then, throughout the school year I needed to monitor these journals through my teaching and also learning of how to have students effectively journal. Second, I believed journaling was within my locus of control. I could implement these journals into my curriculum without disrupting my current teaching methods. Third, homework completion through mathematics journaling was something I felt passionate about and lastly, it is something I definitely wanted to change in my teaching. It seemed safe to assume that my journaling would not only change my current teaching and learning but also improve it. I was also thinking about (at least in the beginning) assigning journal entries as homework assignments to motivate students to complete them.

In generating knowledge of this topic from my own classroom, I also looked to those teachers currently using mathematics journals and found out strategies they used to implement them. I asked them whether or not journals have been a success in their classroom and if it has made a difference in homework completion. I am lucky to have twelve sixth grade mathematics teachers in my building to whom I can go to ask questions or share information with. Also, being that I am the sixth grade mathematics liaison at my middle school, I am in close contact with all of the other sixth grade teachers, which gave me the opportunity to collaborate ideas with my colleagues.

As I looked to using writing journals, I found myself setting several goals on how I wanted to facilitate them in the classroom. First, I would see student collaboration of journals and discussion of what should be included in the journals. Second, I would witness students willing to take their journals home to help with their homework. This way parents who are not familiar with the topic could help their child. Third, I would have students cutting and pasting their work either individually or as a group into their journals so in the end they would look more

like a portfolio instead of a notebook containing notes. My goal was to make these journals usable for the students as a resource for their learning not merely an assessment tool.

An Inquiry Problem

Homework is something with which all teachers seem to struggle. The NCTM Principle of Learning states that students must learn mathematics with understanding. I have found in my classroom that many students need homework as a tool for understanding to support what they have learned in class and use it on their independent work. I have long wondered whether or not another resource such as the written journals would help my students to apply their understanding of mathematics in a different and more creative way. It has been engraved in many educators' heads to assign worksheets and bookwork each day for homework without thinking to have students extend their thinking and write about what they have learned. I have struggled to find a balance in the assignments I assigned each day—worksheets, bookwork, and story problems. I have tried assigning story problems from the book and a worksheet or solely worksheets including a few story problems. I always have roughly 25% of students who will complete the assignments no matter what is assigned and then those who rarely complete them.

I want students to be able to see a connection between the work we do in class and independent work they do at home. I also want them to see purpose in their homework, that it not be looked at as a punishment. I am intrigued to see if written journals could provide this balance which I am striving to find in my classroom. Furthermore, I want to find out if the level of work I am receiving from the students will begin to increase in terms of their written work and overall understanding of the objectives.

What Research Says

My focus on this literature review is to examine the findings of written journals in the classroom and the impact they had in the area of homework completion. I found several reoccurring themes that came about as I read relevant articles. I carefully reviewed four areas in this literature review: journal prompts proven successful and unsuccessful in the mathematics classroom, the use of journaling to promote deeper mathematical thinking, the importance of student reflection and self-assessment for a student's understanding of mathematics, and problem solving through the use of mathematics journals.

Much research has been done on the use of mathematics journals. However, my research project is not only on mathematics journals but also the effect they have on homework completion. The reoccurring themes I found in my research did not focus solely on homework but instead how to effectively integrate mathematics journaling into the classroom which I hope will in turn improve the homework completion rate. Since I was unable to find research containing the correlation between mathematics journaling and homework, my research will fill a gap in the literature research. In the following sections I will explain in more detail each of these themes and how they relate to my research project.

Journal Prompts

The *Principles and Standards for School Mathematics* state that teachers should play a major role in “selecting and using worthwhile mathematical tasks that allow significant communication to occur” (NCTM, 2000, p. 270). Research suggests that one of these ways is through the use of “journal prompts.” These are simply idea starters for students to begin writing. In the area of mathematics, this may include a problem for the students to write about and eventually solve. Researchers Aspinwall and Aspinwall (2003) focused on one fifth-grade

classroom of twenty-three students in Murfreesboro, Tennessee. Students were asked to journal from a variety of journal prompts. At the beginning of the year, students experienced different writing prompts and scored in four different categories: algorithms and computation, limited understanding, utilitarian value, and conceptual understanding. This research found that when asked to write from the prompt given “What is Math?” 13 of the 23 students gave an explanation which was described as Algorithm/Computation (Procedural) (Aspinwall & Aspinwall, 2003). Students have long been encouraged to simply walk through the steps of solving a problem instead of facilitating their own understanding which I have found only hinders a student’s true understanding of mathematics.

In this research project, I look at my efforts to encourage students to apply their learning to problems in their writing journals to facilitate a more conceptual understanding. This application was also researched by Aspinwall and Aspinwall (2003). They state, “The overall vision of mathematics that these students have is narrow, suggesting that their previous learning experiences in mathematics emphasized the mastery of techniques and skills. An emphasis on concepts will help these students broaden their understanding and problem-solving abilities” (p. 352). Instead of students being able to master certain techniques they learned through a type of “drill and kill” method, they need a conceptual understanding of how they went about solving the problems. Aspinwall and Aspinwall go on to say, “Open-ended prompts give teachers valuable insight into students’ perceptions and knowledge, information that is essential for planning effective instruction” (p. 353). These type of writing prompts challenge students to “think outside of the box” and explain their thinking of mathematical problems.

McIntosh (2001) explored the use of learning logs and how to effectively implement them into a middle school classroom. In these learning logs, the authors provide journal prompts

which “force students to go beyond a surface-level examination of their thinking and problem solving. Students do not merely execute the steps to arrive at an answer; they explain their thinking during the step” (p. 556). According to his research, these type of writing prompts give students the opportunity to think through problems, formulate explanations, try out new vocabulary or notation, experiment with forms of argumentation, justify conjectures, critique justifications, and reflect on their own understanding and on the ideas of others (p. 556). Students have learned that if they follow specific steps to solve the problem they usually come up with the correct answer. However, McIntosh asks, what are they really learning from this procedural teaching?

Baxter, Woodward, Olson, and Robyns (2002) worked with a group of middle school mathematics teachers, a high school English teacher, and educational researchers to construct the three phases students need to be exposed to when writing in mathematics. Phase 1 of this project includes “Writing about Attitudes and Feelings” where students are asked to describe their feelings about mathematics. In Phase 2, students are asked to focus their writing on more familiar mathematical ideas which they say gives them more confidence and skill in writing. Then in Phase 3 students are asked to write about “More Advanced Mathematical Concepts” which is followed by “discussions on examining patterns, evaluating conjectures, and constructing mathematical arguments” (p. 55). Building upon these phases allows students to feel comfortable in their writing and begin to think about mathematics in a new way.

In each of these articles the authors all noted the importance of providing students with a more in-depth understanding of mathematics. Although it seems there are many different ways to promote this in a classroom, one aspect holds true in that you must prompt students to develop this thinking. Baxter, et al. (2002) believe that by installing phases into writing in mathematics,

students will become more comfortable in doing so. McIntosh and Draper (2001) used more open-ended writing prompts through a log each day. I incorporated both of these aspects into a daily writing journal in my classroom where students not only wrote about math but also their feelings towards math.

Mathematical Thinking

Not only have researchers found that open-ended journal prompts create effective learning opportunities but that these journals prompts also can create deeper mathematical thinking. Pape, Bell, and Yetkin (2003) designed a teaching experiment involving the collaboration of a seventh-grade math teacher and university researcher in which the researchers focus on “strategies designed to support students developing sense of agency and skill in controlling their own learning” (p. 182). This experiment started out as a two-year professional development program for middle school math teachers until two of the authors became involved in each other’s research which led to their collaboration. The researchers found that:

Too often students are provided straightforward models of solving problems rather than the complicated and strategic thinking inherent in mathematical behavior and they instilled in students that the belief that although arriving at an answer is important, the processes involved are equally important (p. 180).

Instead of teachers standing up in front of the classroom and telling students whether or not the answer they have given is wrong or right, the students need to be more involved with their own learning. I experience this in my own classroom when students assume that when they do not know the answer, someone will be there to tell them what it should be. Instead of just giving students an answer when they are struggling to find one, teachers need to probe them to come up with the correct answer by themselves.

McIntosh and Draper (2001) suggest that “teachers should not accept partial, ill-conceived, no-effort answers” (p.556). Although students are not always fond of writing their thoughts about math and providing steps on how they found the solution, this research suggests that journal writing can be beneficial in providing students with a richer and more in-depth understanding of the mathematics they are learning. By only accepting answers that provide more explanation and evidence of a student’s learning, the expectations can be set for future writing assignments.

Each of the authors in this section began an experiment by writing in a mathematics classroom. Pape, Bell, and Yetkin (2003) experimented with journal prompts through a professional development and McIntosh and Draper (2001) wrote about their experience with learning logs in a middle school classroom to increase deeper understanding for students. Both articles described the importance of student explanation in solving problems and it was evident in the students’ understanding.

Student Reflection and Self-Assessment

Not only can richer and deeper understanding of mathematics occur in journal writing, but it can provide students with an opportunity to reflect and assess their own learning. Fried and Amit (2003) studied two eighth-grade math classrooms on their use of classroom notebooks through videotaped lessons, student and teacher interviews, and photocopied student work. This research stated that “journals must be the place for truly uninhibited reflection and that as a tool for assessment, ought to serve only self-assessment” (p. 107). The authors believe journals should be utilized as a place for students to develop their thinking without fear of formal assessment.

Anderson and Little (2004), both fourth-grade mathematics and science teachers from suburban school districts, examined their own math classrooms to write an article on improving mathematics writing in the classroom where they suggest a two-step assessment process for students' reflection and assessment: "Prior to submitting a completed problem, the students first evaluate their own work by using a rubric. Once they believed that their work would receive a four on the scale, we conferenced with them individually about their performance" (p. 472). By having students revise their written work they are given the opportunity to think through the problems several times and make improvements to their initial work.

The importance of student reflection and self assessment can be seen throughout both of the articles mentioned above. Although, there is a wide variation in self assessment and reflection as students move from elementary school to middle school. In the first article written by Fried and Amit (2003), two eighth grade classrooms were analyzed through videotaped lessons and interviews whereas in Anderson and Little's (2004) article fourth grade students were solely observed without the use of interviews. Having sixth grade students, I now realize what my expectations should be in the area of student reflection and self-assessment and the importance of interviewing students to find out their thoughts about using writing journals.

Problem Solving

Many of the writing prompts I explored in the literature I reviewed will also promote higher level problem solving in the mathematics classroom. I have struggled with ways to implement deeper problem solving in my classroom and research suggests that math journals can relate mathematics to students' everyday lives. Albert (2000), a professor at Boston College, and Antos, a fifth grade teacher, teamed up to write an article about a journal writing project implemented in a fifth-grade classroom. Each day a few students would take home composition

books to write about math outside the classroom. Albert and Antos (2000) state, “When children make connections between the real world and mathematical concepts, mathematics becomes relevant to them. As mathematics becomes relevant, students become more motivated to learn and more interested in the learning process” (p. 526). Students continually want to know the relevance of math to their everyday lives and journals can give them this insight. If students understand the importance of mathematics and how it relates to their own lives, they will be more likely to engage in classroom activities.

Having a large population of students within the special education program in my class this year, I want to make sure and implement a journaling experience beneficial to all students’ learning. This led to me to a research study conducted by Montague and Applegate’s (2000) where 54 middle school students ranging from learning disabled all the way up to gifted were given six word problems which involved one, two, or three steps. They found that “students with learning disabilities perceive problems as more difficult than do their more successful peers but do not spend more time solving problems” (p. 215). Effective journaling must require that students spend adequate time solving problems and in my own classroom experience I have found that students who need more time to solve problems do not usually take the extra time.

Another challenge faced when implementing writing journals is having students more involved with their own learning. Anderson and Little (2004) stated:

Students must learn to reason through situations and develop a problem-solving system that is successful for them. Being able to effectively communicate their solutions and defend their reasoning are life skills that student need not only in school but also beyond the classroom walls throughout their lives (p. 469).

In order for students to effectively communicate their solutions in mathematics, they must also have an understanding about how they came up with a particular answer. Communication through writing journals can not only benefit a student's learning at the time of the solution but can also serve as a reflection when solving similar problems in the future.

There are many ways to go about promoting problem solving in a classroom. Albert and Antos (2000) implemented a project which gave students the opportunity to write about math outside the classroom. Montague and Applegate (2000) studied problems solving by having students from a variety of learning levels solve word problems. Each of these research articles provided me with an insight into how I wanted to promote effective problem solving in my own classroom. Also, Montague and Applegate (2000) showed that students with learning disabilities need to take more time answering problems which I planned to emphasize with all of my students regardless of their learning levels.

Big Ideas

Current research has found that writing in the mathematics classroom is beneficial to a student's understanding of key concepts. According to Baxter, Woodward, Olson, and Robyn (2002), "The purpose of writing in mathematics class is to provide students with opportunities to explain their thinking about mathematical ideas and reexamine their thoughts by reviewing their writing" (p. 52). In order for students to truly understand mathematics, they need to be able to express their understanding in the form of writing. Journal writing is one way that promotes this critical step in the learning of mathematics.

Writing prompts play an important role in the integration of journals into a math classroom. Teachers must be particular in the prompts chosen and allow students to learn from their mistakes through self assessment and reflection. Students must be taught how to write in

mathematics and what expectations they should follow. Writing is learned and it is up to the teacher to model this from the beginning. Lietke and Sales (2001) designed a writing project where a class of seventh-grade students completed a self-assessment checklist at the beginning and the end of the 1997-1998 school year. In this project, a variety of writing tasks were integrated into the regular math curriculum and by the end of the school year many students had changed their negative stance on writing in the math classroom.

Lietke and Sales (2001) state that “Aside from presenting relevant and motivating tasks, the teacher needs to exercise skill and thoughtfulness to foster students’ development of mathematical reasoning and metacognitive awareness” (p. 350). From these articles I have learned valuable information in how I want to implement writing journals into my math classroom. I not only hope to challenge students to explain their thinking process when problem solving but also to share their struggles and successes through whole and small group discussions.

Several of these articles I reviewed used math journals as merely a self-reflection for students. In contrast, I want journals to be a resource for students when completing their homework. I also want the journals to reflect the type of daily homework assignments I assign and in turn, hope to see an improvement in their completion. Students will also be asked to revise their writing journals with a rough and final draft for each prompt given. Through the research articles I have reviewed I now have a better understanding of what a writing journal should look like in my classroom.

My Inquiry’s Purpose

This action research project explores the connection between the use of writing journals and completion of homework. I wanted to see if by implementing the use of journals into my

classroom and building a resource for learning increase the completion rate of homework and ultimately support students' learning. I examined the features of:

1. The quality of students' reasoning represent in their written journals.
2. The quality of written and oral homework presentations.
3. The quantity of homework assignments turned in on time.
4. The quality of homework assignments.

I sought to answer the research questions:

1. How does the use of written journals facilitate a student's learning of mathematics?
2. In what ways can I effectively use journals in my classroom to motivate students to complete their homework?
3. What happens to my teaching when I try to incorporate writing journals into the classroom?

Method

I began data collection on January 22, 2008 and ended on April 27, 2008. I implemented various research sources throughout these months, including teacher journals, interviews, student writing journals, and the record of homework assignments and test scores. With the implementation of the written journals I provided students with nine writing prompts (Appendix D) and stapled them into students' journals. Each student was given a journal in the form of a composition notebook at the beginning of the semester. I gave the writing prompts every other week and these were then scored with a rubric and copied for further investigation. Before giving the first writing prompt to the students, we discussed the expectations and a copy of the scoring rubric (Appendix E) was given with the aligned scores. Students were also asked to journal their

thoughts about the prompts every three weeks from a list of questions I asked them (Appendix C) and these were also copied.

I kept two separate teacher journals throughout the semester on my own thoughts of the process. In the journal which I will call my “observation journal,” allowed me to record observations of students working on math journals and the effectiveness of the journals and the other was a “teacher journal,” which I used throughout the entire project. In this journal I wrote about frustrations and successes I had each week and things I wanted to change about the instruction opportunities or levels of discussions I wanted to obtain. I also conducted individual and group interviews throughout this research project which were divided into three different categories. First, I interviewed students individually to ask about journaling and their perceptions of its effects on completion of homework assignments. Second, I conducted another set of individual interviews in which I ask them to demonstrate their mathematical understanding by working through math problems similar to those in their journals. Finally, I split my class into three separate groups (6-7 students in each group) and interviewed them about what impact the journals have on their understanding of mathematics.

The final data source was the tracking of homework assignments turned in on time with 80% of problems correct and the scores of quizzes and tests throughout the project. Throughout the semester I input these grades in my grade book and after each chapter in the curriculum I printed them out and analyzed the data for each category. This data collection was much easier to collect due to the fact that I have always kept record of this information. However, I did write the quizzes for each week which was time consuming some weeks. I felt it was important for the quizzes to align with the discussions we had in class and material we were covering not only in the curriculum but also in the journal entries.

Although I seemed to continually be playing “catch-up” with my data collection, I gathered all of the data I had planned to collect throughout the semester. The students were very cooperative in helping me to collect the data I needed and were more than willing to come in at lunch or after school for the individual and group interviews. In fact, I had that several students were asking me if they could stay in and complete an interview. Overall, the data collection went fairly smoothly and I enjoyed learning more about my students and the way they perceived writing journals.

Findings

Upon completion of my data collection, I was able to sit down and analyze the information I had collected through interviews, journals, and various student work. In this section I will explain what I found and the assertions I can make based on this data. This part of my paper is divided into three sections centered on my research questions.

The use of written journals to facilitate a student’s learning of mathematics:

At the beginning of the semester, students began to enjoy getting a new journal assignment and when given the opportunity to explain their thoughts they took the time to really think about the problem they were solving. They would work on solving the problem independently for around five minutes and then work with their table groups for another five minutes. After having a chance to solve the problem, we would discuss the journal as a whole group. This gave the students who were still confused about the problem the opportunity to ask questions on how to solve it.

Many students were willing to answer the questions other students had and volunteered to share their solutions with the class. When I interviewed them individually about what impact the journals had on their understanding of mathematics, students offered comments on how they

believed the journals helped them in the classroom. Kaylee¹ remarked, “It trains you and your mind to think about how or other ways to solve a problem not just to add, subtract, divide, or multiply. It teaches you to think in other ways to solve one (problem).” Mandy similarly believed, “Some of us don’t like story problems so the journal teaches us and helps us get better at them.” Finally, Robert explained, “it teaches you how to explain your answer rather than just writing.” All of these comments supported my idea that the work students were doing in the journals was helping the students to solve problems in their everyday work in the classroom.

I soon realized that many students wanted to share their answers with the class because I had students coming up to me directly after I gave the journal assignment asking if they could present their answers to the class. I was impressed at the level of discussion that occurred after the assignments were given and the students had the opportunity to work on them. I wrote about a group discussion that occurred that same day this in my teacher journal. This really helped me to see the impact the writing journals were having on the students’ understanding and the level of discussion that was going on.

Thursday included a great discussion of the first journal entry. I asked three students (Robert, Bryan, and Kaylee) to go up to the board and write down exactly what they had written in their journals. Each student provided their written work and also an explanation of the solution. I was so excited to find that all three computations were different. Although one of the student’s solutions was incorrect, they still provided an explanation and so it gave me a chance to show the students that I wasn’t just looking for a correct answer but a well thought explanation.

¹ All names are pseudonyms.

When given the opportunity to write in the journals, students are more likely to look more deeply at one math problem instead of “skimming the surface” with multiple problems. The first problem from their writing journals asked them to solve this problem and reminded students to show their work:

When 2,000 pounds of paper are recycled or reused, 16 trees are saved. How many trees are saved if 5,000 pounds of paper is recycled?

Prior to giving them this problem, I emphasized the fact that I did not simply just want them to give me an answer to the problem but also provide a clear explanation of how they solved it. I provided the students with a scoring rubric and specifically went over what I expected and how I would assess their work. First semester, I gave these directions but it still did not give me the results I wanted so I was not expecting to see any difference this time. I was greatly impressed by the journal writings I received back from journal 1. The variety of solutions and the explanations given were great. Gina provided this explanation:

The first thing I did was put down all the info. I knew like there was 5,000 pounds of paper and for every 2,000 pounds of paper 16 trees were saved. I did the problem by subtracting. I took 5,000 and subtracted 2,000 and got 3,000. I knew that I could subtract more so I took 3,000 subtract 2,000 and got 1,000. Then I thought if you recycle 4,000 you would have saved 32 trees. I went back to the 1,000 lb of paper. If you have half of 2,000 that means you have to take half of 16. Half of 16 is 8 so add 32 equals 40. So the answer is 40 trees are saved.

However, as the journals were written throughout the semester the effort, I saw at the beginning seemed to dwindle by the end. At the beginning of the semester for Journal 1, I awarded 10 of the 22 students a score of an A or B for their journal grade and for Journal 2, 11 had an A or B. In order for the students to receive an A or B on their journals they must be proficient in at least three of the four categories in the scoring rubric. I did not reward a student a proficient score if an explanation was not given. However, by Journal 7 only five students received these high scores with only two earning an A. It seemed the novelty of the journal writing had worn off and the students were not as motivated to complete the assignments as they had been at the beginning of the semester.

Students also wrote more in-depth explanations of math problems when asked to write a rough and final draft of their journals. I began asking the students to write a rough and final draft of each writing assignment by Journal 3. I would assign the journal prompt for the students to solve on the first day during the class period and ask them to come back the following day with a final draft of their work. Journal 3 asked the students this question:

I am driving to the bank and decide that I want to take out 25% of the money in my bank account to go shopping. If I had \$600 in my account before I went to the bank, how much should I take out when I get there?

Here is a rough draft of a journal entry written by Jason:

Well first you have to make it a fraction by putting 25 over 600 and then make the fraction into money by simplifying 25 and 600. Then your answer is \$24.00

Then this same student wrote this for his final draft:

Well first you need to see what 25% is out of 100. And you can think of money like 100 = \$1.00 and 25% is 25¢. Then you have to divide 4 into 100 because remember 4 quarters

= \$1.00 and your trying to find how much money to take out which would equal 150 dollars because we're trying to find how much money to take out of the bank. Then that's your answer \$150.

A much more detailed response was given when this student was asked to write a second draft of the assignment.

I interviewed a group of students on February 12 asking them about what they perceive to be the impact of journals on their understanding of mathematics. It seems that they also agreed that by writing a second draft they were able to think more in-depth about the problem. Sandy wrote:

I think they (the journals) are fun in general. When we write the stuff like multiplication, division on the first day and then we have to write about I think it gets us more involved in the problem. The first draft you just try stuff out and when we actually write about we have to think....what did we do.

And Sam wrote the next day:

They help you understand what we are doing in math and understand how to do it. They help us at how to explain the problem.

It is clear to me from these excerpts and interviews that the students found that by writing a rough and final draft of their journals they were given the opportunity to expand on the work they had done in class that day.

The Use of Written Journals to Motivate Students to Complete Their Homework:

The second research question I explored was "In what ways can I effectively use journals in my classroom to motivate students to complete their homework?" and the assertion I have

made regarding this question is that students do not access their journals to help with their every day homework assignments. For the majority of students, the only time they take their journals home is when they are part of their homework assignment. When I asked the students, “how often do you use your math journal for homework,” 21 of the 22 students said they do not use their journal for homework. Here are some comments from the students when I asked them to journal their thoughts: Sandy wrote, “No, I never use my writing journal because there is nothing usually that I can use in the notebook. I have used it but maybe sometime if I make a number line or chart I will maybe use it.” Lisa agreed, “Never because I don’t take it home with me. I only use it when we have to write in it.” Jeremy even stated, “I didn’t know I could take it home to do that.” This last comment told me that I desperately needed to make some changes in how students were using the writing journals.

About half way through this project I realized that I was not making the journals accessible for the students to take home and use for their homework assignments. I decided to allow students to keep their journals all week long and turn them into me every Friday. Over the weekend I would copy the journal assignments for the week and look over the bookwork assignments and notes the students had completed. My hopes were that if students were able to take their journals home, they would be more likely to use the notes and information inside them to complete their homework assignments. However, this was not the case for most of the students. Some students were still not turning their homework assignments in on time. I also did not see an increase in homework grades with the help of the journals. The same students who were scoring low grades on the homework assignments before the project were for the most part continuing to score low. Here is a record of the homework assignments turned in on time with 80% of problems correct (these records are taken solely from 4th quarter): Assignment 1: 21/22,

Assignment 2: 18/22, Assignment 3: 14/22, Assignment 4: 12/22, Assignment 5: 7/22, Assignment 6: 9/22. The motivation was still not there for students to complete their homework assignments even when given the opportunity to use their writing notebooks.

Although students did not consistently complete their homework assignments, I did see one aspect of homework completion and group discussions. I found that the students were motivated to complete their homework assignments when a group discussion of the journals was expected the next day. I found over the course of the semester that students were much more involved in the group discussions when they entailed the work we did in the journals. Students who normally did not participate in the group discussions began volunteering frequently to discuss their answers. I found this the case when I wrote about it in my teacher journal on February 22:

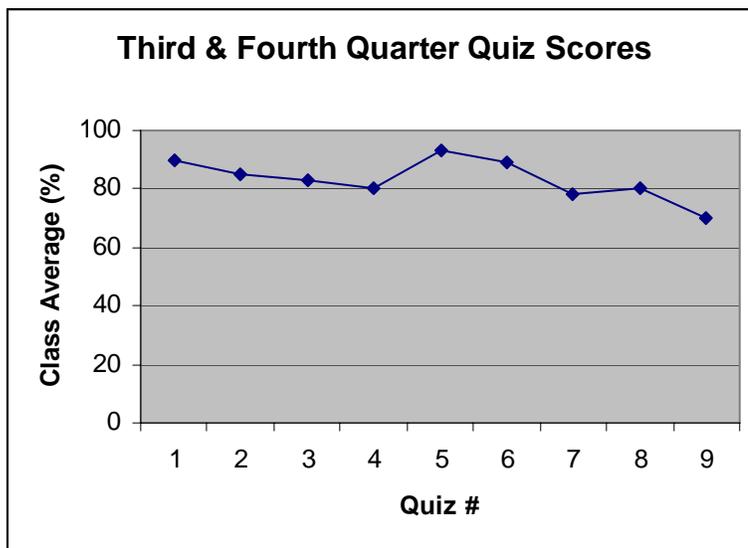
The students seem to be much more inclined to complete their homework when they know they will be discussing it the following day in class. Logan, who rarely completes his homework, came to class on Wednesday with his homework done. He also participated in the discussion and answered questions when I asked them. I think by completing his homework, he was confident in joining the discussion.

The following quantitative data comes from my grade book:

On February 11, 2008 students completed Journal #2 and were told we would discuss the journal and also the homework assignment (Worksheet 8-6) the following day. 91% (20 out of 22) students turned the homework assignment in the next day.

On February 27, 2008 students completed Journal #4 and a discussion of the homework assignment and journal followed the next day. For this particular homework assignment, 86% (19 out of 22) of the students turned in the assignment on time.

Not only have homework completion rates been higher but quiz scores have remained consistent. Each week (usually on Friday) I give the students a quiz over the material learned throughout the week. All class average percentages range from 70-93%. This tells me the students are retaining the information they are learning which is large in part to the homework assignments they are completing and the class discussions which have occurred. However, from the graph below, the class average during the fourth quarter decreased slightly.



The Impact of Writing Journals on My Teaching:

The last question I researched in this project was “What happens to my teaching when I try to incorporate writing journals into the classroom?” Using written journals in the classroom has facilitated the integration of small and large group discussions in my teaching. Written journals have allowed students to discuss the problems I give them first in a small group at their tables and then as a whole group with the entire class. At first, I found myself stepping in to help students with the problem but by the middle of fourth quarter the students were answering questions as a group and my role changed to an observer of these discussions. Not only were

students discussing the problems amongst themselves but they looked forward to what they called “debates” about the problems. While they “debated” about the problem, I was able to assess how well students understood the problems, which was a great learning experience for me as an educator. I was able to see the students’ communication skills evolving and maturing in their understanding of mathematics. I found this the case when I wrote about it in my observation journal as the students worked on journal writing #3: “It was a great sight to see four students crowded around one piece of paper discussing and debating over the answer to the problem. Never once did they get off task. I then asked Gina, Charlie, and Jeremy to talk about their discussion and they shared their findings with the class.” These types of group interactions occurred numerous times throughout the semester as the students collaborated on the journal writings.

Not only has the research project sparked more discussions in my classroom but it has also encouraged students to write more about problems they encounter in the classroom. My expectations have changed on the homework assignments—I no longer accept one or two word answers to story problems but instead expect students to write at least a sentence or two. This is evident in several excerpts from my journals which I have included below. In the first journal entry, I note specifically to the students my expectations for the problem and in turn the students gave further explanation. Similarly, in the second journal entry the students were able to use their previous work in the classroom and transfer that to another problem. Working in groups, they discussed my expectations and the result was a well written journal.

Teacher Journal #6:

I was pleasantly surprised to see that many students wrote much more for this problem we worked on today. When I gave the students the assignments, I said, “pretend this is a journal write up and know that I hold the same expectations for this problem as I do for your journals.” I also used the same rubric to score their write-ups for this problem as I

do for the journals and told this to the students ahead of time. I could see how their previous experience with journal writing had played a part in their write-ups. Most of the students wrote at least a paragraph or two on the answer to the problem. YEAH!

Teacher Journal #7:

As the students started working on the journal in groups I overheard a conversation between 2 students. I decided to listen in and observe their conversation. One student said to the other, "Do you think I have enough written?" and the other student said, "I would write a little more if you want an A." The two students discussed this further and eventually came up with a better and more in-depth solution to the problem I gave them. I realized that not only have students recognized the expectations I have for the journals but also the kind of writing they can do in math class.

It is evident that the expectations I was holding for the writing journals I began to also employ for other assignments throughout the semester. It seemed that when the students knew my expectations in regards to the rubric and were familiar with how I was grading their work, they were motivated to work harder and meet those expectations.

Conclusions

This project has allowed me to take a step back and truly understanding the learning process of my students. I realize that I still have a long way to go but I believe I have learned valuable information in how students learn mathematics. I now see students taking the time to understand specific mathematics problems and thinking more analytically about them. I no longer find myself standing up in front of the classroom and lecturing about a specific topic but instead having a discussion with the class about what they know and building upon that.

The use of written journals has helped students to think more about a problem they encounter in mathematics. I now see students analyzing the problems I give them and thinking through how they could solve them. They no longer immediately come up to me with a question about an assignment but instead discuss it with their groups and try and figure it out on their own. I believe the written journals have allowed my mathematics students to become more

independent thinkers. Most students enjoyed helping their group members if they had questions and this was rewarding to me as an educator. I also feel like I have learned a lot about myself as a teacher throughout this project. I have found a way to integrate more writing into my teaching and plan to use more journals in the future. I have set more goals for myself in the future in better integrating journals into the classroom and plan to implement them in the coming years.

Just as Aspinwall and Aspinwall (2003) found that open-ended prompts give teachers insight into students' understanding I also found that by allowing students to work on a journal writing prompt I gained stronger knowledge of how my students were performing on a variety of tasks. By the end of the semester, the students were beginning to think more "outside the box" and enjoyed the challenge of receiving the prompts periodically. Unlike Fried and Amit (2003), who believed journals must be the place for truly uninhibited reflection and only as self assessment, I found in my research that my students must be formally assessed in order to motivate them to complete the assignments.

I believe students benefited from the journal assignments and note-taking they completed. Although the quiz scores remained stable and the rate of homework completion did not change unless group discussion occurred the following day, students gained worthwhile knowledge from real-world applications of mathematics. Not only were students involved in their own learning from the journals, but they also were enthusiastic about completing the assignments. I found it very rewarding as an educator to see the students' eyes light up when I said we were going to have another journal writing assignment.

Implications

As a result of this action research project, I plan to continue to use written journals in my classroom. I plan to take several suggestions the students gave me in the group interviews and

make needed changes next year. I also plan to make the journals a more integral part of the homework assignments instead of giving students homework not in the writing journals. I want to break myself a way from using worksheets and begin to find more real-world mathematics problems related to the required curriculum objectives instead of just using the journal assignments once every other week.

I would also like to read more articles and do more research about writing in the mathematics classroom. I found it interesting how many students enjoyed working on the journal assignments and I believe they would thrive on more of these types of assignments.

Unfortunately, time is always an issue for educators so I did not use writing assignments for every lesson. Although as I use journals year after year in my classroom, I can build on the journal assignments I have used in the past. I would also like to begin using more written work in the chapter tests. Currently, all of the tests I use are pre-made from the district so much of it includes pencil and paper calculations with very little or no written essay questions. A goal I hold for myself is to adapt all of the tests to my teaching with at least one writing problem similar to the journals for each objective.

I find myself pondering several questions upon my completion of this project: Should the writing journals be a place for true reflection without fear of scrutiny and assessment? Would the assessment grades improved if all of the homework assignments were in the form of journal problems? More importantly, does homework really tell us anything about a student's knowledge of mathematics?

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Appendix A

Student Interview Questions

1. What do you think is the purpose of written journals in math class?
2. Do you like writing in your journal? Why or why not?
3. Do you believe your journals help you better understand math problems? Please explain.
4. Do you believe your journals help you with your math homework? Please explain.
5. On average, how often do you use your math journal to help you with your homework? Please explain.
6. Do you think your math journal helps you with our whole-group discussions? Why or why not?
7. What do you like best about math journaling?
8. What do you not like about math journaling?
9. When solving math word problems in your journal, do you think you spend more time now than you did first semester? Please explain.
10. How much time on average do you spend math journaling each day?
11. Do you prefer to journal on your own or with a group? Please explain.
12. Do you think your math homework seems easier when you use your math journals? Why or why not?
14. I would like you to work on this problem, saying aloud whatever it is you are thinking as you work through this problem. I especially want to hear you talk about how you decide what to do to solve the problem.

Your mom bought you a 1 year swimming pass for \$384 and is making 12 payments to pay for the pass. How much will each payment cost her?
15. I would like you to work on this problem, saying aloud whatever it is you are thinking as you work through this problem. I especially want to hear you talk about how you decide what to do to solve the problem.

Your school is doing a food drive and your class collected 320 cans of food. You have 8 boxes to pack full of cans. If you want an equal amount in each box, how many cans will you pack in each box?
16. What makes math easy or difficult for you?
17. Has your attitude about writing about math problems changed during your 6th grade year?
18. As I think about using math journals for my class next year, what advice would you give me?
19. What questions do you have for me?
20. Is there anything else I should know about you in regards to math journaling or your general math experience?

Appendix B

Group Interview Questions

What do you think is the purpose of written journals in math class?

If we got a new student in our class tomorrow and I asked this group to tell that person about math class, what would you tell him or her?

What would you tell a new student it takes to be successful in this math class?

What would you tell a new student about math journals?

I am going to ask you to have a mini-debate among this group. I am asking __(name)__ and __(name)__ to think of an argument for why we should stop doing math journals in class. I am asking __(name)__ and __(name)__ to think of an argument for why we should keep doing math journals in class. Talk with your partner for a minute to figure out what arguments you will use, and then I will ask each set of partners to share their ideas and try to convince me.

I am going to show you a sample journal entry similar to one we did in class recently .I would like you to look this over and tell me how you think this could help a student and how it could be improved. How would you score this journal if you were the teacher?

As I continue the use of math journals in my classroom next year, what advice do you have for me?

What advice would you give for the 6th grade students coming into my classroom next year regarding math journals?

Appendix C

Journal Prompts:

When having the students journal about their thoughts/feelings on journal writing in math class, I will use prompts from this list:

Tell me about what you think is the purpose of written journals in math class.

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

Do you believe your journals help you better understand math problems? If so, in what ways? If not, why not?

Do you believe your journals help you with your math homework? If so, in what ways? If not, why not?

On average, how often do you use your math journal to help you with your homework? Please explain.

Do you think your math journal helps you with our whole-group discussions? Why or why not?

What do you like best about math journaling?

What do you not like about math journaling?

Do you prefer to journal on your own or with a group?

Do you think your math homework seems easier when you use your math journals? Why or why not?

Has your attitude on writing about math problems changed during your 6th grade year?

As I think about whether to have my classes next year use math journals, what advice would you give me?

What questions do you have for me?

Is there anything else I should know about you in regards to math journaling or your general math experience?

Appendix D**Set of Problems Stapled into Student Journals:****Journal 1:**

Solve this problem (Show your work!):

When 2,000 pounds of paper are recycled or reused, 16 trees are saved. How many trees are saved if 5,000 pounds of paper is recycled?

Journal 2:

The length of a stadium is 100 yards and its width is 75 yards. If 1 inch represents 25 yards, what would be the dimensions of the stadium drawn on a sheet of paper?

Journal 3:

I am driving to the bank and decide that I want to take out 25% of the money in my bank account to go shopping. If I had \$600 in my account before I went to the bank, how much should I take out when I get there?

Journal 4:

Thomas had a bag with 30 marbles: 12 blue, 7 red, 5 white, and the rest were gray.

- a) He took a marble. What is the probability that it is a blue marble?
- b) If he puts the marble back and takes another one, what is the probability of taking a red one?
- c) Thomas took a grey marble and didn't put it back. What is the probability of taking another grey marble immediately after that?

Journal 5:

A snail is trying to crawl out of a well that is 5 deep. It crawls up 4 feet each day and slides back down 3 feet each night. How long will it take before the snail escapes from the well? Show your work!!!

Journal 6:

Tyler and Christina are playing a game in which each player either wins, loses, or draws (ties) at each turn. The winner of a turn is awarded 5 points, and the loser loses 5 points. If it is a draw, 0 points are awarded. For the first either rounds Tyler had the following results: lose, win, lose, win, win, lose, win, draw. What was Christina's point total for the rounds?

Journal 7:

Two squares are beside each other. One square has 6 times the length of the other square, how many times greater is the area of the larger square? How do you know?

Journal 8:

Now that we have read part of the story One Grain of Rice, I want you to figure out how many grains of rice the village girl named Rani will have at the end of the 30 days. Make sure to show your work in your journal. Good luck!!!!

Journal 9:**Geometric Patterns Activity:**

Directions: Fill in the chart and then draw a picture of your squares on the back of this worksheet.

	# of cubes used	Perimeter	Area
1 x 1 square			
2 x 2 square			
3 x 3 square			
4 x 4 square			
5 x 5 square			
6 x 6 square			

Discussion Questions:

- 1.) What do you notice about the data you have collected for the 6 different squares?
- 2.) Do you notice any patterns? Explain.
- 3.) What do you predict your data would be for a 7 x 7 square? How do you know this?
- 4.) ***Challenge***: Can you find the area of a 17 x 17 square?

Appendix E

Name _____

Journal # _____

Math Journal Scoring Rubric

	4	3	2	1		Score
Explanation	Explanation in journal is clear and easy to understand	Explanation in journal is basic with little or no elaboration	Explanation in journal is unclear and/or incomplete	Explanation in journal is confusing or non-existent		
Computation	Includes correct computation and shows multiple approaches	Includes correct computation with at least one correct computational approach	Includes basic with some incorrect computation	Computation shows no evidence of understanding		
Organization of Thought	Work is clearly organized with diagram or picture	Work demonstrates some organization	Disorganized work; little demonstration of organization	Lacks organization of thought		
Understanding	Excellent understanding of the problem	Understands the problem	Minimal understanding of the problem	Demonstrates no understanding of the problem		
				Total =		