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Writing in a Mathematics Classroom: A Form of Communication and Reflection

Abstract

In this action research study, I investigated the use of journaling in my seventh grade mathematics classroom. I discovered that journaling can be a very rewarding and beneficial experience for me and for my students. Through journaling, my students became more adept at using correct mathematical terminology in writing and in speaking. The students also believed that they learned the content more deeply and retained it better. Additionally, implementing mathematical journals caused me to emphasize the use of correct terminology and thorough explanations of mathematical thinking in classroom discussions. As a result of this research, I plan to refine my journaling process and continue to use mathematical journals with my future classes.

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Math in the Middle Institute Partnership

Heaton/Action Research Project

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As a seventh grade mathematics teacher, I am continuously striving to find more effective teaching strategies. As part of an action research study, I chose to implement journaling into my classroom. I have been a teacher for seven years and have taught mathematics for five years in my current school system. The last three years I have taught seventh grade mathematics.

As a researcher for this action research study, I had my students begin journaling in response to a journal prompt which I provided. Generally, the journal prompt was specific to the concept we studied that day (Appendix C). Students were given a journal form (Appendix D), a folder to store journals in, a copy of the rubric used to score the journals, and a tally sheet on which to record their scores. Usually four days a week, students were provided approximately 10 minutes of class time to complete their journals.

PROBLEM OF PRACTICE

The following are ideas from NCTM's *Principles and Standards* (2000) that relate to my own Problem of Practice:

- **Overarching Principles:** *Learning:* students must learn with understanding, actively building new knowledge from experience and prior knowledge
- **Process Standard:** *Communication:* organizing and consolidating their mathematical thinking through communication, communicating their mathematical thinking coherently and clearly to peers, teachers, and others; analyzing and evaluating the mathematical thinking and strategies of others; or, using the language of mathematics to express mathematical ideas precisely.

In my classroom I noticed a continuous problem concerning communication. Overall, I was not providing the opportunities for my students to communicate their mathematical thinking.

The result was that I was often unsure about how much my students learned or how well they understood a mathematical concept. I started out the year by assessing how well they did on homework assignments. I looked at the numerical answers they gave and used that to determine how successful they were at understanding the concepts or skills. However, it may be that they memorized the skill for the time being, but would not be able to retain it.

Additionally, during classroom discussions, I tried to encourage my students to think for themselves and to share their thinking with the class. This was a tough feat to undertake, but I hoped it would become easier for them with time. One of the problems with my classroom discussion time was that the students who shared are the students who always shared. Also, there was the timid bunch who was mortified to speak in front of the class, especially if they were unsure of the mathematics being discussed. I was still lacking in the questioning techniques that would encourage students to think for themselves. Of course, time is always a constraint, and the lack of it pressured me to get through the discussion time so they would have time to work on their assignments.

In my ideal classroom, I would be very skilled at leading the type of class discussions that encourage critical thinking and encourage students to share their ideas and thought processes. Additionally, I would be able to communicate with each student individually and be able to hear their mathematical understanding of the concepts. This would allow me to gain a deeper understanding of how my students learn and to discover any misconceptions. At the same time, when students attempt to explain their thinking it would help them to reflect on their understanding, process it more thoroughly, and understand the concepts better. Communication in an ideal classroom would be clear and coherent. Students would be able to use the math terminology correctly and express themselves to others precisely. This communication can and

would be both verbal and written. In my ideal classroom, students would be able to write about their mathematical thinking, including their procedural and conceptual knowledge.

When I assessed the current state of my classroom and my ideal classroom I saw a mismatch between my goals and reality. Although I had good intentions about assessing my students' understanding, I was either lacking the skills or was unsure of a process that I could use. I wanted to hear each individual student's mathematical understanding, but I was not sure how this would be feasible. Even though I wanted to have my students explain what they had and had not learned, it was unrealistic to have a conference with each of my students on a daily basis. Also, students were missing out on a learning opportunity when they were not asked to explain their thinking. Additionally, I was missing out on the chance to better understand how my students learn. The benefits that could be gained (and the problems that could be avoided) by having students communicate their mathematical understanding made this topic worth knowing more about.

Communication of mathematical thinking was my main focus. However, I was a bit unsure of what this should look like. I knew that time was an issue. For example, because having individual conferences was unrealistic for my situation, I decided to have my students communicate their thinking in written form. Formats of student writing included writing in a math journal by responding to a writing prompt, free writing, or writing about the day's lesson. Writing in a journal provided the opportunity for students to process their thoughts and explain them in a coherent manner. Students were given about 10 minutes of class time to write in their math journals. They kept their journals in the classroom and read and responded to their journals as well as scored them. One concern that I had was about how much time reading and responding to the journals would take. I was already swamped with teacher duties as it was. By

having the student complete their journals on a single sheet of paper which I provided made transporting the journals easier than having the students record their journals in a notebook. I also developed a three-part rubric which I used to score the journals.

LITERATURE REVIEW

In preparation for my research project, I located five research articles. Each research project took place within the last ten years. All projects used journal writing activities in a mathematics classroom. Although they differed slightly in their purposes, they each provided a look into the benefits of journaling in a mathematics classroom. In analysis of the five research projects, I focused on five separate themes: purpose of research, method of journaling, data collected, possible benefits, and findings from the research.

Purpose

Each of the research papers that I studied were quite similar in the purpose stated by the researchers. Each research project used journal writing in a mathematics classroom to serve a valuable classroom purpose. Some used the research to look for the general effects of journaling on students, the classroom, and the teacher. Others had more specific goals in mind such as an increase in chapter test scores. Hackett and Wilson (1995) used three methods of treatment to see if writing and speaking skills using mathematics could be improved. In addition to journal writing, the research also implemented cooperative groups and student-created portfolios (Hackett & Wilson, 1995). Another research project analyzed specifically if using writing in mathematics could affect chapter test scores. The research consisted of data from two similar populations, one which received the treatment and one which did not receive the treatment (Bolt & McCoy, 1997). In Singapore, a research project was conducted to learn if math journals could be used as an alternative form of assessment (Amir & Lianghuo, 2002). Another research

project was conducted with the goal of using journals as a way to increase oral communication in the classroom. The research intended for journals to help students feel more confident in their mathematical abilities, and therefore, communicate more in class (Grbavac, Piggot, & Rougeux, 2003). Similarly, Baxter, Woodward, and Olson's (2005) research project attempted to use journals as an alternative form of communication, especially for low-achieving students who often are uncomfortable sharing in class.

Each research project had a purpose that could bring value to a classroom. I planned to use my research project to learn how journaling in mathematics could be a useful form of communication between the students and the teacher and how journaling could benefit and increase each student's learning experience.

Method of Journaling

Many of the research projects I studied implemented the use of journals in similar ways. Most had the students write journal entries on a regular basis. Only one project had the students complete journals only four times throughout the length of a chapter (Bolt & McCoy, 1997). All the projects provided the students with either writing prompts or writing stems. Additionally, Baxter, Woodward, and Olson's (2005) project started with affective writing prompts to get students to feel comfortable with the writing process. One project (Grbavac, Piggot, & Rougeux, 2003) also provided a structured journal format for the students to follow. Three research projects discussed the physical aspect of the journals, usually notebooks. Grbavac, Piggot, and Rougeux encouraged the students to decorate the notebooks. Amir and Lianghuo (2002) wrote that although they initially started with a notebook, they moved to a single sheet per journal response. It was noted that the single sheets were easy for the teacher to transport the journals

and therefore read through and respond to them more easily. All projects provided class time for the students to journal.

Each teacher needs to use methods that are suited best for his/her unique teaching styles and classroom. For my action research project, I decided to provide journals that were both affective and specific to mathematical content. Additionally, to make the journal process efficient for my students and myself, I provided each student with a journal sheet for each journal. I also provided each student with a folder in which to store their journals. Students were able to keep a tally of their journals and their journal scores in their folder.

Data

All five of the research projects that I studied used a variety of data. Most of them included a student survey and teacher journals or interviews. I found it interesting that Hackett and Wilson's research included a parent survey to learn about parents' attitudes toward writing and math. It was believed that the attitudes and beliefs that parents hold about their own mathematical abilities do affect their children's beliefs and that their negative beliefs can be used "as a crutch to explain their child's own lack of abilities in mathematics" (Hackett & Wilson, 1995, p. 18). Another set of data used in Grbavac, Piggot, and Rougeux's research project was a tally sheet on which teachers would record the number of times students communicated orally in class. Although this data may be valuable, the method was too time-consuming and overwhelming to continue to administer; therefore, the method was abandoned (Grbavac, Piggot, & Rougeux, 2003).

Benefits of Mathematics Journals

There were many consistent themes in each of the research articles. In preparing for their research, the researchers studied the possible effects of using a journaling activity in

mathematics. The strongest themes that they presented are the increase in communication that can take place in the student-teacher relationship through the use of journals and the teachers' ability to use the journals as a way of checking for understanding. On the other hand, Baxter, Woodward, and Olson's research only focused on how the students would benefit from the act of journaling about mathematics. This included a development of mathematical thinking and the opportunity to reflect on one's own learning processes (Baxter, Woodward, & Olson, 2005). Interestingly, one of Grbavac, Piggot, and Rougeux's possible benefits focused on the students' strengthening of their self-concepts. It was believed that journaling would help students to learn about their thought processes, and therefore, increase confidence and positive self-worth (Grbavac, Piggot, & Rougeux, 2003).

Although the research projects were valuable references as I developed my research project, I also saw that each project had a gap that I needed to fill before bringing my project into my classroom. I hoped to keep an open mind throughout the course of my project and to stay open to the possible benefits of journaling as well as the possible negative aspects of journaling.

Findings

All of the research projects were found to have beneficial effects. Most project findings even matched their purposes. Grbavac, Piggot, and Rougeux's research project hoped to use journals to increase oral communication in the classroom; however, there were only minor increases in the student's oral communication. They stated that the plan "should not have assumed that improved thinking and writing would naturally result in improved oral communication" (Grbavac, Piggot, & Rougeux, 2003, p. 60). Instead, the journals should have been accompanied with "oral activities in class through which students would have the opportunity to practice their oral communication skills" (Grbavac, Piggot, & Rougeux, 2003, p.

59). However, the teachers who participated in the research did believe that communication among students and between the teacher and the student did strengthen. Additionally, trust increased and writing improved (Grbavac, Piggot, & Rougeux, 2003).

Although their research did not find that journaling increased oral communication, Baxter, Woodward, and Olson's research did result in a belief by the researchers that written communication would be an effective alternative to oral communication, especially for low-achieving or shy students. In one example of a journal response, a student was believed to have been "able to express her hesitance and then describe her thinking without holding herself up to public scrutiny by her peers" (Baxter, Woodward, & Olsen, 2005, p. 128). The other main finding from Baxter, Woodward, and Olson's research was that the teacher was able to learn what the students did and did not understand about the mathematical content (Baxter, Woodward, & Olson, 2005). This was also the case in Amir and Lianghuo's research. With this knowledge the teacher was then able to "re-teach or zoom in on the pupil to correct his misconception if necessary" (Amir & Lianghuo, 2002, p. 8).

Only one research project, Hacket and Wilson's, reported finding a deeper understanding of mathematics by their students. In addition to journaling, their project also implemented cooperative groups and portfolios. The combined treatment resulted in an increase in use of mathematical terminology and an improvement in verbal skills (Hacket & Wilson, 1995).

An interesting research project that used two separate populations – one as a control group – had a purpose of using journals to increase chapter test scores. Four journal responses were implemented throughout the chapter. Compared to the control group, the group that used journal writing had a statistically significant increase in test scores (Bolt & McCoy, 1997).

Although each of the five research projects that I studied had different purposes and different findings, each project provides valuable information that can be used by mathematics teachers interested in implementing journals into their classrooms. The benefits of using journals can range from improvement in mathematical thinking to a teacher's ability to know how well his/her students understand the concepts being learned. Additionally, I believed that using journaling could have a variety of benefits; however, I wondered about the negative aspects of using journaling in mathematics. I hoped to provide my students with a useful learning experience through journaling, but I also wanted to be open to any negative effects.

PURPOSE STATEMENT/RESEARCH QUESTIONS

The purpose of this study was to discover if and how journaling in mathematics could help students reflect on and reinforce the content learned. Additionally, my research assessed how reading my students' journals affected my teaching. Data collection took place during the spring semester, 2006 in my seventh grade mathematics classroom. This study attempted to answer the following research questions:

- What are the effects of having my students complete a mathematics journal?
- How will my teaching be affected by reading my students' mathematics journals?
- How can writing in mathematics journals be used to help students reflect on and reinforce their learning of the mathematics concepts?
- What are students' perceptions of journaling about mathematics, and will those perceptions change over time?

Each of these questions can be related to the research articles which I studied. Many ideas that were used by past researchers were useful as I implemented journals into my classroom. Also, I believe that my research will be of interest to other teachers of mathematics.

I am able to provide others with a description of my research concerning implementing journaling in math and the troubles and successes experienced. My study is able to serve as another resource for mathematics teachers and hopefully provide insight that they will be able to use in their own classrooms.

METHOD

In my research I used a variety of types of data collection procedures. In order to learn about the effects of having my students complete a mathematics journal I used pre- and post-interviews with five students (Appendix B). I also surveyed the entire seventh grade class about their beliefs about journaling and mathematics at the beginning and at the end of the journaling process (Appendix A). Additionally, I kept a weekly journal where I could record any observations about my students' journals and class interactions (Appendix G).

My second research question was aimed at learning how my teaching would be affected by reading my students' math journals. The primary source of data for this area of my research was my own weekly journals. In my journals, I would be able to record any changes that I believed I was making in my teaching or in my lesson planning due to reading my students' journals.

As part of my research project, I also wanted to learn how journals could be used to help students reflect on and reinforce the math content they were learning. I collected data from my weekly journals and from my pre- and post-interviews with a small focus group of five students. The interviews asked specific questions about how the students felt they had benefited from the journaling process. Additionally, I used a rubric to assess my students' journals in the following three areas: 1) accuracy, 2) terminology, and 3) thoroughness (Appendix F). Students were able

to keep track of their scores on a table and look for any changes (Appendix E). I also recorded the journal scores on a spreadsheet and found the mean, mode, and standard deviation.

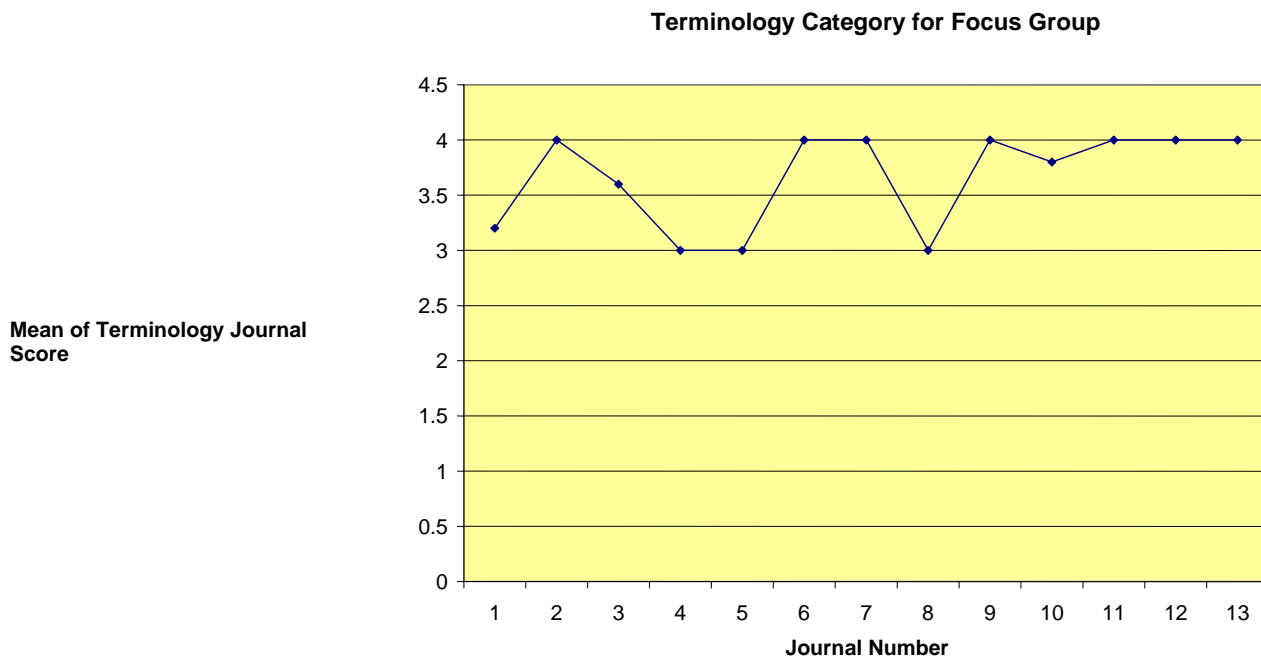
My final research question focused on understanding my students' perceptions about journaling in mathematics. The pre- and post-interviews and surveys were the main source of data collections for this area of my research. However, I also had my students complete a journal about their opinion on math journals. They completed these toward the beginning and end of the journaling process. The surveys that the students completed used a Likert scale. I assigned numbers from +2 to -2 and recorded the average of each survey on a spreadsheet. I also found the mean, mode, and standard deviation for all of the surveys. For the journals, I determined whether each journal had a positive, negative, or neutral opinion about journaling and also recorded that data on a spreadsheet. Again, my weekly teacher journal also served as a source of data.

ANALYSIS

One of the three categories on which student journals were assessed was the use of terminology. I believe that during the journaling process, students became more adept at using correct terminology in both writing and speaking. This was seen as students began to correct themselves without any prompting from me. For example, when explaining how to change improper fractions into mixed numbers, a student began by using the words, "top number" and "bottom number." However, she quickly corrected herself and restated her directions using the correct terms of numerator and denominator. Additionally, I noticed that I began to put more emphasis on modeling and encouraging the use of terminology during class time. I began to state during classroom discussions that we needed to use correct terminology when discussing the mathematics content. I also corrected myself during classroom discussions by replacing

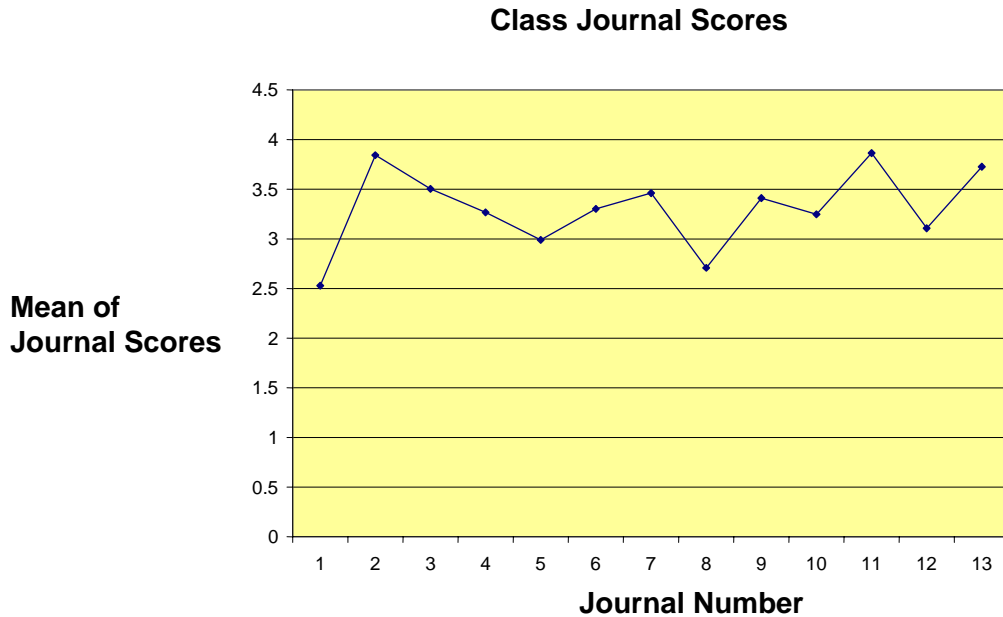
slang with the correct terminology. Additionally, after a couple of weeks of using journaling and emphasizing the use of terminology, I started to record new mathematical terms on a section of the classroom whiteboard. This was prompted during classroom discussions as a reference that we could all use while explaining the mathematics. I noticed that many students referred to this while writing their journals.

I recorded the scores of each category in the rubric for my small focus group. Below is a line graph of the mean of their scores for the terminology category.



As you can see from the graph, there are no conclusive results from the journal scores for the focus group as to whether the journaling process increased the use of written terminology. The standard deviation for the category of terminology was 0.44.

I recorded the journal scores for my seventh grade classroom on a spreadsheet. Below is a graph which shows the mean for the journal scores throughout the journal project.



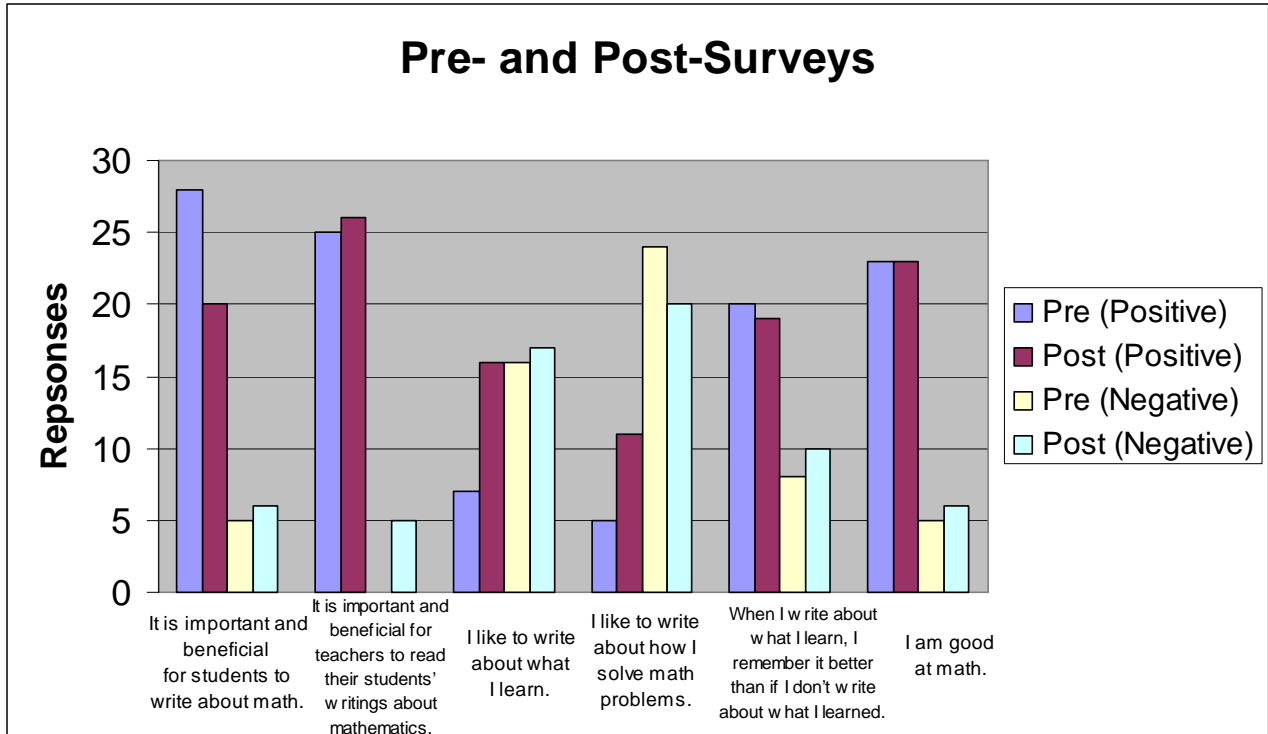
The data represented in the graph does not seem to reflect any statistically significant progress in writing student journals. The standard deviation for the mean of the journal scores was 0.404.

Using math journals in my classroom has caused changes to my teaching and lesson planning. For example, I decided to have my students complete their journals during class time. This required me to set aside approximately 10 minutes of class time for journaling. In response to this, I decided to shorten the length of homework assignments that I had previously given. I also noticed instances when I discovered misconceptions that my students had about particular math topics. For example, by reading student journals I discovered that many students did not understand how to borrow within a mixed number in order to subtract two mixed numbers. Because of this, I was able to re-teach an important concept before moving on. Additionally, some students were not able to explain the conceptual method of borrowing a useful form of one from the whole number. Instead they described the short-cut method of adding the numerator and denominator together to get the new numerator. Realizing that many students didn't

understand why they were solving math problems the way they were caused me to continue to emphasize the conceptual understanding.

Another way in which my teaching has changed is that I became more aware of encouraging my students to thoroughly explain their mathematical thinking during classroom discussions. Having students explain how or why they solved problems the way they did was not something that was foreign to my classroom. However, it was inconsistent at best. I noticed that a few weeks after starting the journaling project, I became much more consistent at giving students the time to explain how they solved the problems and to explain why they made the choices they did. Many students began to explain their thinking out loud to the class without being reminded or waiting for me to prompt them to explain. Since one category of the rubric which I used to assess student journals focused on thorough explanations of mathematical thinking, it was natural for this to have crossed over into class discussions.

Journaling about mathematics has the possibilities of helping students to remember the content better and learn the content more thoroughly. Journaling about mathematics can benefit students. This belief was evidenced in data about student beliefs that came from pre- and post-surveys. Following is a graph showing the frequencies of student responses to each of the six statements from the survey.



The graph reflects the student beliefs about journaling and mathematics. Four out of the six statements received statistically significant positive responses (Strongly Agree or Agree) as opposed to negative responses (Disagree or Strongly Disagree). A tally of the positive and negative frequencies for the six statements is depicted in the table below:

Statement	Positive Response		Negative Response	
	Pre	Post	Pre	Post
1	28	20	5	6
2	25	26	0	5
3	7	16	16	17
4	5	11	24	20
5	20	19	8	10
6	23	23	5	6

The graph and the table show that all statements except numbers three and four have greater frequencies of positive responses. This suggests that there is a theme that the majority of students believe that journals are beneficial and worthwhile; however, the majority does not like the task of writing journals. However, the number of positive responses to statements three and four did increase greatly from the pre-survey to the post-survey.

Data about the students' beliefs of the benefits or lack of benefits of journaling was also collected from student interviews and journals. The interviews and journals show themes such as students believe that writing about mathematics helps them understand and remember the content better. The students also show an understanding of the benefits of journaling for the teacher. Students believe that reading students journals will help the teacher know how well the students understand the mathematics. Below are some quotations from interviews with the focus group and from student journals.

Quotations from the interviews:

- “I think that it teaches me better. I understand it better when I write it down on paper.”
- “If you forget something you can look back and see it in your own words.”
- “There’s not really a downside to it because it kinda helps the teacher know if we understand what we are doing in math. It’s easier for me to understand if I put my words down on paper. I think about it more and overall I understand it more when I go to do problems on paper.”
- “I can write down what I think. I’m not good at explaining how to do things out loud.”
- “You can look back on them and read it in your own words so you understand it better. Writing things down, you remember it better.”

- “It’s easier for me to understand what I’m doing in math because (when journaling) I’m going through the steps and thinking about it at the same time.”
- “If I write it down I get it into my brain.”
- “It helps you if you don’t know what to do you can write it down and if it’s wrong you can help us.”
- “There are so many kids in class, but you can see how much everybody knows.”

Quotations from student journals:

- “It helps me learn more.”
- “(Teachers) will know if we need to go back and review.”
- “Instead of listening and thinking I knew, I actually know that I know.”
- “I like journals because I understand it more when I wright down my thoughts.”
- “I think that journaling is a good way to help us better understand what where doing in math class because we have to write it down and that helps me remember it better.”

On the other hand, there were also negative comments shared by some students about the use of journals in mathematics. Some common themes are that students don’t believe that journaling helps them remember or understand the mathematics content. Another theme is that some students do not like to write. Below are some quotations taken from student about using journals.

Quotations from student journals:

- “I don’t like to have to write about the stuff I’m thinking of.”
- “I don’t like them at all!!! It doesn’t give us as much time on our homework. If you want to see if we know the material, look at our homework not at a journal.”
- “(Journals) don’t teach us much about math.”

- “I don’t think writing about what I’m doing helps me learn it better.”
- “I do not like doing journals in math because I don’t see the point of doing journals. It just seems like a waste of time. And in math your not suppose to do English.”
- “I don’t know y we do this. It don’t help me and it don’t help u.”

Quotations from student interviews:

- “Takes forever.”
- “If you don’t have enough time then you have more homework at home.”
- “Sometimes I just didn’t feel like writing.”
- “I don’t really like writing that much.”
- “I don’t like journaling because of all the writing, and I don’t really get how to do all that stuff. But I’m getting better at how to do all that.”
- “Boring, takes up class time. I just don’t like to journal.”

My final research question was about students’ perceptions about journaling and if their perceptions would change after experiencing the journaling process in mathematics. As you read above, there are a variety of student opinions about using math journals. Additionally, I used data from the pre- and post-surveys and the student journals about journaling. For the surveys I assigned numerical value from +2 to -2 and found the mean for each student. Because each statement was worded positively, any negative numbers would reflect negative perceptions about journaling about math. I then found the mean for the entire seventh grade class. For the pre-survey, the mean was 1.36. The post-survey had a mean of 1.13. This is a change of about -.23. The standard deviation for the mean of the pre- and post-surveys was 0.163. Overall, the data did not change significantly. However, the response is still weighted with a positive value. A

statement of +1 would reflect a response of “agree.” Therefore the mean value for the entire class falls near the “agree” category of the survey.

Further data from the surveys is depicted in the table below. The table shows the frequency of student responses to each of the six statements.

Statement	Strongly Agree		Agree		Undecided		Disagree		Strongly Disagree	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1. It is important and beneficial for student to write about math.	4	3	24	17	6	14	3	4	2	2
2. It is important and beneficial for teachers to read their students' writings about mathematics.	8	5	17	21	14	8	0	4	0	1
3. I like to write about what I learn.	0	2	7	14	16	6	10	9	6	8
4. I like to write about how I solve math problems.	1	0	4	11	10	7	16	12	8	8
5. When I write about what I learn, I remember it better than if I don't write about what I learned.	4	5	16	14	11	10	7	7	1	3
6. I am good at math.	6	7	17	16	11	10	2	3	3	3

The frequencies of most of the student responses did not change dramatically from the pre- to the post-survey. However, two statements did have a large change in the frequency of student responses. Statement number three and four had large differences in the frequency. Statement number three, “I like to write about what I learn,” increased from 7 to 14 responses in the “Agree” category. Statement number four, “I like to write about how I solve math problems,” increased from 4 to 11 in the “Agree” category.

For the student journals, I determined whether the journal reflected a positive, negative, or neutral view toward journaling. For example, if a student stated that he or she liked writing

the journals or thought they were beneficial, I counted the journals as a positive response. On the other hand, if a student stated that he or she did not like writing the journals or that the journals were not helpful, then I counted the journals as a negative response. If a student did not state any like or dislike or whether the journals were helpful to him or her or not, then I counted the journal as a neutral response. For the first student journal I found 12 positive responses, nine negative responses, and seven neutral responses. After experiencing the journaling process, students completed another journal where they could share their opinions. This time there were 15 positive responses, eight negative responses, and four neutral responses. Overall, there were three more positive perceptions about journaling and one fewer negative perception.

INTERPRETATION

Using journaling in my seventh grade mathematics classroom was a new experience for me. Although it was challenging to implement, it was a positive experience. I believe that it benefited my students and me in a variety of ways. Having a rubric with the three categories of accuracy, terminology, and thoroughness helped my students to explain their mathematical thinking in an organized way. The requirements for the journal crossed over from writing to speaking. I found myself emphasizing the good habits that I wanted my students to use when journaling during classroom discussions. This even caused me to be more aware of and use the good habits myself. Students also began using these good habits without prompting from me. These habits ranged from using correct terminology to taking the time and effort to explain how and why they were making the choices that they did.

Using journaling in math class also gave me the opportunity to read about and learn from my students. I was able to get a sense of how well they understood important mathematical

concepts. Sometimes I was able to make decisions about when to review concepts or what to emphasize in the next lesson.

Journaling about mathematics requires a high level of thinking which can help students learn the concepts. Many students shared the fact that they believed they learned better and remembered more when they wrote about the math. Students also could use their journals as a reference which they could use on homework or to review concepts.

Students' perceptions about writing math journals ranged from very positive to very negative. Perceptions did not seem to significantly change throughout the journaling process. The majority of the students who enjoyed writing journals or hated writing the journals continued to feel the same way.

This experience of using journals in mathematics is one that I will continue to use. I will continue to provide a form for the students to journal on and a folder to store their journals in. I will also continue to provide a tally sheet for my students to track their own progress. This also provides an opportunity for students to graph actual data about themselves. A major change that I will make in the future is to only have students complete journals once or twice a week. Having students complete journals nearly every day was too much and burned many students out. Fewer journal entries would also lighten the load required for myself.

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APPENDIX A

Student Survey

Name _____

Date _____

Please respond to the following items by drawing a circle around the response that most closely reflects your opinion: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), or Strongly Disagree (SD).

1. It is important and beneficial for students to write about mathematics.

SA A U D SD

2. It is important and beneficial for teachers to read their students' writings about mathematics.

SA A U D SD

3. I like to write about what I learn.

SA A U D SD

4. I like to write about how I solve math problems.

SA A U D SD

5. When I write about what I learn, I remember it better than if I don't write about what I learned.

SA A U D SD

6. I am good at math.

SA A U D SD

APPENDIX B

Interview Questions

Pre-Interview:

1. Describe past experiences you have had keeping a journal.
2. What do you like about journaling?
3. What don't you like about journaling?
4. Describe experiences you have had writing about mathematics.
5. Tell about your feelings and opinions about keeping a journal in which you write about mathematics?
6. How might writing about math be beneficial for the student and for the teacher?
7. How would you describe yourself as a math student?

Post-Interview:

1. Tell about your feelings and opinions about keeping a journal in which you write about mathematics?
2. What do you like about journaling about math?
3. What don't you like about journaling about math?
4. How has keeping a math journal benefited you this semester?
5. How would you feel about keeping a math journal in your math class next year? What changes would you make to the process?
6. How would you describe yourself as a math student?
7. Do you see changes in the way you wrote journal entries in February as compared to the way you wrote journal entries in April?

* Students will have their math journal during the interview in April. They will be able to look through it during the interview.

APPENDIX C**Journal Prompts**

Journal #1: *Describe how to make and use fraction bars to estimate fractions. What ideas do you have about how to estimate a fraction using a calculator?*

Journal #2: *Write about three qualities of a good teacher and three qualities of a good student. Explain your thinking.*

Journal #3: *What I know about borrowing within a mixed number so far is _____.*

Journal #4: *Explain in detail how to solve $12 \frac{1}{6} - 9 \frac{2}{3}$.*

Journal #5: *Explain how to use models to show how to multiply $\frac{5}{6}$ and $\frac{7}{9}$. Use pictures when you can. Explain your process thoroughly.*

Journal #6: *How does this method of changing customary units relate to multiplying fractions? Explain how to change 15 pints into cups.*

Journal #7: *What do you think of the use of journals in math? What are the pros and cons for the student and the teacher?*

Journal #8: *Describe the discovering Pi lab.*

Journal #9 *Write about two of the properties. Use examples.*

Journal #10: *Show how to solve $3 \div \frac{1}{4}$ using pictures. Then explain how to solve it without pictures.*

Journal #11: *Describe how you know when angles are acute, obtuse, right, or straight. Draw and label each kind. Name their degrees.*

Journal #12: *Thoroughly discuss the polygon activity. What did you like and dislike about it?*

Journal #13: *What do you think of the use of journals in math class? What are the pros and cons for the student and the teacher?*

APPENDIX E

My Mathematics Journals

Name _____

Journal Number	Accuracy Score	Terminology Score	Thoroughness Score	Average
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				

APPENDIX F*Rubric for journals specific to mathematics: Revised 3-20-06*

Journal Entries	1	2	3	4
Accuracy	Response is not accurate	Minimal accuracy	Main ideas are accurate, but some minor inaccuracies	Response was accurate
Terminology	No use of terminology	Attempted, but not used correctly or minimal use of terminology	Some use of terminology or a few errors in terminology	Terminology used and used correctly
Explanation of mathematical thinking	Did not cover journal topic	Explanation is minimal and/or very confusing	Explanation was not thorough or lacked clarity	Explanation was thorough, clear, and easy to understand

Rubric for affective journals:

Journal Entries	1	2	3	4
Explanation/Thoroughness of Response	Did not cover journal topic	Explanation is minimal and/or very confusing	Explanation was not thorough or lacked clarity	Explanation was thorough, clear, and easy to understand

The points for each category will be averaged and a percentage will be assigned using the following scale:

<u>Total Points</u>	<u>Average</u>	<u>Percentage</u>
12	4.0	100%
11	3.7	97%
10	3.3	93%
9	3.0	90%
8	2.7	87%
7	2.3	83%
6	2.0	80%
5	1.7	77%
4	1.3	73%
3	1.0	70%

No credit will be given if the journal is lacking in effort.

APPENDIX G

Teacher Journal _____

Date_____

Did you discover any misconceptions about the math content when reading the student journals?

What are two or three observations you made this week when reading over the student journals?

How has reading this week's journals influenced your lesson plans?

What is one question that you have after reading this week's journals?

Other comments: