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Mathematical Communication and Achievement Through Journal Writing

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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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**Mathematical Communication and Achievement
Through Journal Writing**

Abstract

In this study, I investigated my classroom of sixth grade mathematic students on how journal writing influences students' writing and learning and how journal writing influences my mathematics teaching. I discovered that students enjoyed writing in their journals and reading my responses. Students could openly communicate their questions, thoughts, and opinions. They shared with me what it was like for a sixth grade math student. They also pointed out the concepts they understood or the ones that challenged them. Some students stated that the journal writing helped them think harder. As a teacher, reading and responding to their journal writing gave me insights into their thoughts and feelings about math beyond a daily assignment and a grade. Through their writings, it helped guide me on what mathematical learning strategies were working and not working. Together, we are working toward academic growth, improved instructional strategies, increased communication between students and myself, and finally, students care about what they are learning and feel they have an integral part in their education.

Introduction

This study takes place in a rural community in northeast Nebraska. Rapid changes in student demographics brought challenges to our school district over the past 10 years, which indicated changes needed to be made in district philosophy and educational practices. Our Latino population increased dramatically, in part because of employment opportunities at a local meatpacking plant and local migrant entities. During the 1990-1991 school year, our student population was comprised of less than 1% Latinos. Student population figures from the 2000-01 school year showed Latinos making up about 18% of our total enrollment. In the 2004-05 school year, the Latino population increased to 30% of the total student population.

In 2008-2009, approximately 350 students attended our K-6 elementary school. This number has remained somewhat constant over the past 10 years. Although the total number of students has remained constant, the makeup of our district has not. The district has seen the ethnic change from nearly 100% Caucasian to an even split between Caucasian and Hispanic students. ELL (English Language Learners) courses were implemented to support students learning English. In addition to this ethnic change, the district also has experienced a great increase in the number of Free/Reduced students. Currently, the elementary's low-socio-economic student population is in excess of 60%.

These changes in student demographics also have brought about changes in philosophy for the district, including increased special education services, lower teacher to student ratios, English as a second language teachers and programs for kindergarten to twelfth grade students, and a breakfast program. We have worked toward three sections per grade at the elementary level. One of these sections is being taught by a dually

endorsed teacher (Elementary and Special Education). This staffing change has reduced our student to teacher ratio from approximately 22:1 to 17:1.

With changes in student demographics, education also has changed. When I started teaching math, I taught fifth and sixth grade high-ability classes. –Students were capable and liked math. But our district decided inclusion works better for everyone, so my position changed to a ~~half-½~~ time 6th-~~sixth~~ grade math teacher and ~~½~~-~~half~~-time K-6 Spanish teacher. Now, my math class came with a range of abilities from students who still struggled with addition and subtraction, to students who were ready for algebra. It was a big adjustment. I was now dealing with failing grades, learning disabilities, late homework, and student apathy.

I knew I had to change my teaching practices. I taught three math classes with 20 students each. I felt I was stuck in the middle. If we went over the same topic for too long, I lost the ~~higher-higher~~-ability students. If I went to fast, I lost the ~~lower-lower~~-ability students. How could I reach the ~~lower-lower~~-ability students and yet, challenge the ~~higher-higher~~-ability students? ~~Lower-Lower~~-ability students were given visual charts, study guides, and shortened assignments. They were also encouraged to attend an after-~~school~~ homework club, where they could receive help with homework. ~~Higher-Higher~~-ability students were given challenge problems and encouraged to attend Mathcounts, a middle school math program. But, it wasn't enough. Students were failing and losing interest in math. I needed to learn new strategies to help all students feel successful.

Math in the Middle, a NSF-funded research project at the University of Nebraska-Lincoln, provided me with a great opportunity. The focus of Math in the

Middle was to develop intellectual leaders in middle-level mathematics (grades 5-8), improve student achievement in math, and reduce the achievement gaps in the mathematical performance of diverse student populations in Nebraska. Through this program, I ~~have~~ discovered new ways to explore and explain mathematics concepts with my students. We worked outside of the textbook by looking at the golden rectangle, patterns in geometry and nature, and different ~~problem-problem~~-solving strategies. In a teacher's eyes, all of these ideas were exciting and important mathematical learning opportunities.

But what did my students think? How were they doing? Were they as excited as I was? Were they learning new ideas? Was it helping them to think more deeply about math? What could I do to help? What could I change to help them understand? I wanted to know more about my students' thinking about the new learning opportunities that I brought to them. Although I had searched for the answers of the above questions by observation, daily assignments, and test scores, I still did not gain a clear understanding. I wanted to get an even better idea of their progress and thinking of mathematics.

Journal writing in math could help accomplish this goal. By requiring students to write in journals, I could have a better understanding of student's thoughts about math and how I could improve my teaching. I could have a more personal connection to each student, as well as, know what I may need to re-teach or personally talk one-to-one with. I don't always have time to individually assess students. By reading and responding to their journals, I am hoping to open up communication and improve math grades. It may give me insight into how I could help them. I could see who was turning in good work, but still not understanding the process. I could use it as a private dialog between the

student and me.

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Problem Statement

The first Nebraska state standard emphasized writing across the curriculum. Educators have been encouraged by their districts to have students write in Language Arts, Social Studies, Science, Math, PE, Music, and Art. So, it interested me to have students expand their writing by explaining a topic in their own writing, expressing new ideas and strategies, and communicating feelings of boredom to frustration. The Math in the Middle coursework has challenged me to go beyond just finding the answers for problems, but seeking the whys behind the solutions. Therefore, I tried to adapt what I had learned into my elementary classroom by challenging my sixth graders to explain their thinking, regarding how they arrived at a solution. National Council of Teachers of Mathematics [NCTM] (2000) states that students should recognize and use connections among mathematical ideas, understand how mathematical ideas interconnect and build on one another to produce a coherent whole, and recognize and apply mathematics in contexts outside of mathematics. (p. 63-66). Through representation, NCTM also states that students should also be able to “create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use representations to model and interpret physical, social and mathematical phenomena.” (p. 64-71). Although writing in a journal is not a new idea, it would be one way to touch on these two principles and standards. I wanted to take it further. I wanted to study if journal writing would open up communication and hopefully, improve learning.

Literature Review

Before I started my action research, I researched articles that had already been

published about journal writing. I wanted to know what others had already discovered and how it would relate to my research. Teachers have been encouraged to implement writing across the curriculum and I questioned – did I have the time and would it be worthwhile? So, during my study of journal writing in math literature, three main themes appeared: journal writing in math increased learning for students; journal writing gave teachers insight into student’s learning; and journal feedback needs to be descriptive and private.

How Journal Writing Influences Students’ Learning

Journal writing can produce many benefits for students. Borasi and Rose (1989) looked at a regular college mathematics course in a small four-year liberal arts college. Their analysis ~~suggests~~ suggested that journal writing may provide a valuable addition to current modes (product and answers, anxiety, external manipulation of symbols, and passive and disengaged learning) of mathematics instruction. They found the benefits to be increased learning of mathematical content, improvement in learning and problem-solving skills, re-evaluation of one’s view of mathematics, and a therapeutic effect. Students who are normally quiet in class have an opportunity to communicate with the teacher. In addition to journaling having these great benefits, Baxter, Woodward, and Olson (2005) studied one teacher and the weekly journal writings of four-low achieving 7th-seventh grade students and found that students who did not actively participate in mathematics discussions did respond when asked to write about mathematical ideas.

Another benefit of journal writing is that it helps students organize their ideas and reflect on their thinking. Brookhart, Andolina, Zuza, and Furman (2004) studied third graders’ self-assessment of learning their zero through nine - multiplication facts. They

concluded that student involvement in their own assessment could enhance their abilities of reflection and metacognition (thinking about thinking). The authors conclude that if journaling is used to self-assess, writing was deemed successful into a deeper experience. Albert (2000) investigated seven middle school students' journal writing building on research of Vygotsky. This researcher found that the use of writing in mathematics showed an increase of cognitive function including critical thinking, sound reasoning, and problem solving in students when comparing with students who did not use writing in mathematics. Communicating mathematical ideas through writing is more beneficial than communicating ~~verbally~~orally. Pugalee (2004) asserted that students use a metacognitive framework when writing, which would be more effective than the think-aloud process, a strategy where students think out loud through a problem-solving process, such as reflecting on the steps used to solve a problem in math, ~~write what they say~~. The author studied 20 ninth grade algebra students who participated in a two-week enrichment period where they wrote and verbalized mathematical ideas and received feedback. Pugalee discovered that students who wrote about their problem-solving processes produced correct solutions at a statistically higher rate than when using think-aloud processes.

Journaling should be used consistently over time to achieve results in writing and learning. Articulating thinking through writing is both challenging and empowering. Identifying problems, describing solutions, and analyzing difficulties through writing can show students are actively connecting new ideas with what they already know. Clarke, Waywood, and Stephens (1993) studied about 500 students over a four-year period. They discovered three categories of writing: recount, summary, and dialogue. In the dialogue

mode, students were focusing on the ideas being presented and connecting it to what they already knew, the highest level of learning. Shield and Galbraith (1998) studied students from three ~~8th~~-eight grade classes (12 to 13 years of age) from two schools. They used a detailed method for analyzing student's writing products over a three-month period. Their results coincided with Clarke et al.'s findings. Shield and Galbraith stated that it is a long-term task for teachers to increase the meaningfulness of their students' mathematical writing in a way that will promote a higher level of thinking about the ideas.

Berry and Sharp (1999) agree that journals provide an opportunity for students to learn mathematics by doing instead of watching. They studied a student-centered learning model for university students. They suggest that students should be active and the staff should be less active and there are positive advantages of co-operation and discussions as important parts of the learning process.

While not all research has found significant differences between students who wrote in class and those who did not, Porter and Masingila (2000) ~~fount~~-found only small gains in achievement but consistently stated d that more research needed to be done and ~~offers~~-offered suggestions for improving learning through writing. The researchers studied an introductory calculus course at a research university. Their research showed that students must be engaged intellectually with mathematical tasks that require them to articulate (either in writing or aloud) and description or justification for the mathematical ideas involved. Ntenza (2006) studied grade 7 classes in South Africa and compared his research to the study conducted in the United Kingdom and the United States by Davison and Pearce, who claimed that writing improved student's performance substantially. Although, Ntenza's study showed some gains between learners who wrote in math class

and learners who did not, the results were not substantial. Bangert-Drowns (2004) also found that writing had a small, positive impact on academic achievement. They studied 48 school-based writing-to-learn programs and predicted factors to increase impact.

These factors included d the use of metacognitive prompts, increasinge treatment length, starting students writing in math after grades 6-8, and keeping writing assignments short. By carefully considering such factors, Bangert-Drowns (2004) suggested that one could expect enhanced effects on writing to learn.

Most of the research recommends that journal writing in math benefits students, because it encourages students to think, reason, and utilize higher-er-cognitive levels. While these articles researched third grade students through college level classes, my project will specifically look at sixth grade students. My project included a pre- and post-er-survey and academic growth measurement in daily assignments and tests. Baxter, Woodward, and Olson (2005) focused on journal writing in math found that students who did not actively participate in class responded well when they were asked to write. My project also discovered that some students were intimidated to ask questions. These literature articles provided me a foundation for my study. Building er-on the previous findings, ~~but~~ I wanted to explore further whether journal writing would give students confidence to ask questions and contribute to class discussions.

How Journal Writing Influences Teachers' Teaching

Teachers also can ~~also~~ receive benefits from journal writing. Borasi and Rose studied students in a regular college mathematics course. Their analysis ~~suggests~~ suggested that teachers reading journals obtained a better evaluation and remediation of individual students, long-term instructional effects, and improvements in the teaching of

the course.

Rodgers (2006) ~~advises~~advised teachers to listen to the feedback. She interviewed students about their experiences as learners and teachers' accounts. Feedback is about students' learning and not about the teacher's teaching. When learners feel they are listened to, they are eager to share their experience. She gives six caveats to teachers: 1) stay open, don't defend, don't explain; 2) respond in a way that students know that you have understood what they wrote; 3) it's all about the students (not me), feedback is an exploration of learning rather than a critique of teaching; 4) avoid re-teaching, use the opportunity to understand the learning and their learning, as well as your own teaching; 5) follow through by analyzing and acting on the feedback, trust; and 6) it's a process, it will take time and adjustments to make it work. She also stated~~s~~ that seeing teaching, self, and the curriculum ~~as~~were secondary to seeing students and their learning. In other words, student learning takes precedence over teaching. Rodgers's~~s~~ findings played an important role of guiding my responses to my student's feedback.

Baxter (2005) also agreed that from students' journals teachers could gain great insights into the student's learning. This researcher pointed out that a journal provided valuable information for improving instruction and served as a private means for communicating between teachers and students. Fried and Amit (2003) agreed that keeping journal writing private is important. Fried and Amit studied two eighth grade classrooms in which students' writings were exclusively public. They stated that private journals allowed for writing preliminary ideas, musings, and reflections; while public journals were ever open for inspection and contained only finished work.

Teachers need to help students explore the world of math by listening and

knowing the ways students express their thinking. Smith III and Phillips (2000) focused their studies on gaining insights into student's thinking. By listening to students, teachers can realize their knowledge and their limitations. Liedtke and Sales summed it up best by saying that without a teacher, the most important and most valuable learning outcomes related to metacognitive awareness, will not be reached. Writing, as an integral component of mathematics teaching, can have a positive effect on attaining many important goals of the mathematics curriculum. Clarke, Waywood, and Stephens (1993) added that the ultimate goal of the teacher is to challenge and empower students to articulate their own thinking.

Journal Feedback

When reading and responding to journal writing, there was important information given. Rodgers (2006) suggests giving descriptive rather than evaluative feedback. By doing this, it grants the students the authority of their experience as learners and the teacher ~~assumes~~ assumed the stance of the learner. Fried and Arnit (2003) agreed that teachers should not grade journal writing and to keep it private.

Rodgers (2006) gave three purposes of journal writing and descriptive feedback. The primary purpose of descriptive feedback is to gather information about what students have learned and how they have learned it, including what helped their learning and what hindered it. The second purpose is to increase the student's awareness of his or her own learning processes. Finally, the third purpose is to create trust and a cooperative community where by the teacher, as well as each student, becomes aware of multiple ways of learning. Shield and Galbraith (1998) provided a framework to judge journal writing. Students demonstrated their thoughts and understandings of mathematical ideas

by including a goal statement, link to prior knowledge, the general procedure, and practice exercises.

How a teacher reads and writes journal feedback is very important if it is to be effective. Rodgers (2006) and Fried and Amit (2003) agree that teachers should not grade journal writing. It should be kept private and descriptive, not evaluative. I followed their suggestions, because I wanted students to feel they could express their ideas freely. By using descriptive feedback, I built trust and could increase communication and understanding.

Previous studies provided a foundation for my students. However, they ~~have had~~ some limitations. These studies focused on either students' learning or teachers' teaching, not both. Also, most of these studies were observations by the researcher rather than reported by the teachers themselves. My study ~~extends extended~~ previous findings by combining both students' learning and teachers' learning, and exploring journal writing in ~~6th-a sixth~~ grade classroom from an insider's perspective.

Purpose Statement

The purpose of my study ~~is was~~ to look at how mathematical communication and journal writing ~~influences influenced sixth~~^{6th} grade students and their teacher. Data collection took place in my classroom during ~~nine~~⁹ weeks of the 2009 spring semester.

This study will attempt to answer the following three research questions:

1. What will happen to students' mathematical achievement when they write about mathematical ideas in a personal journal?
2. What happens to my mathematics teaching when I implement the use of personal mathematics journals for students in my math class?

3. What will happen to the quality of students' written explanations over the semester when using personal mathematics journals and receiving specific feedback?

Method

A mixed method was used for this study. Quantitatively, my data looked at the statistics of average grades and test scores. Qualitatively, my research explored opinions from my students and my building's principal.

Participants

Thirty-seven sixth grade students, between the ages of 11 and 12 years of age, participated in this study. Students consisted of 20 males and 17 females. Ten of the 37 students are considered ELL students and 13 of the 37 students qualified for free and reduced lunch. My building principal, a 40-year-old Caucasian male, also participated in this study.

Data Resource and Collection

There ~~are~~ were six types of data resources used in this study. The first data collected in the study ~~is~~ was a pre-survey (see Appendix A) given on Monday, February 16. This was to find out if students had ever kept a class journal, how might it benefit them and the teacher, and how they described themselves as a math student. This was given to all 18 students in the first class and all 17 students in the second class. A post-survey (see Appendix B) was given at the end of the nine weeks, on Thursday, April 30. This was to learn about what students liked and did not like about keeping a math journal, before they started writing and after they started writing. I also wanted to know their opinion on the benefits of journal writing, losses/no change/improvements in

their journal writing over the nine weeks, and another description of themselves as a math student. I did not gather every student's pre-survey and post-survey. After I started my research, two students moved into our district, three had prolonged illnesses, and two were on vacation.

A second data collection was students' writing in their math journals. In each of those weeks, I provided a prompt regarding what to write about (see Appendix C).

Students were encouraged to write for at least 5-five minutes to communicate their thoughts on proposed topics. Topics included qualities of a good math teacher and a good math student; what they were surprised to discover that week in math; give examples, descriptions, and explanations for using line graphs and double-line graphs; how successful they felt in math and ideas to help them feel more successful; explain how decimals, percents, and fractions are related; and give an example and explain right acute, obtuse and straight angles. After I collected the journals, I read them and responded to their answers. These responses were scored by a rubric with a scale from 1 - 4 (see Appendix D). A score of 4 indicates the highest quality of student response to journal prompts including explanation of mathematical thinking. Students did not see their score, only my response. This part of the data collection went smoothly.

The third area of collection was a principal observation (see Appendix E) at the beginning of the nine weeks on Wednesday, February 18, 2009. The second principal observation occurred at the end of the -nine weeks on Tuesday, April 28, 2009. These were both scored with a rubric (see Appendix F). During this professional observation of the class, the principal focused on the teacher's use of time, content knowledge, explanations, and reinforcement. This data was an outside view of what was happening

during mathematics class time to compare my teaching before and after research was conducted. This part of the data collection also went very smoothly.

The fourth data collected were two student interviews (see Appendix G). The first student interview was Tuesday, March 3, and the second student interview was conducted on Thursday, March 19. Students were randomly selected from a list that a fellow teacher provided. Both groups, consisting of low-, medium-, and high-ability learners, went to another room over noon recess and recorded the questions and responses on cassette tape. Students seemed intimidated by the tape recorder and most of their answers were short and quiet, so I gave extra prompts and ideas to help the conversation along. Yet, it was a positive experience.

The fifth data collection was my personal journal (see Appendix H) I. I struggled to make-find time to write, but it seemed to go fast once I started. It helped me think about the week, what went well and what could have gone better. Three analytic memos were written on February 22, March 22, and April 19. These writings also helped me reflect on the data I was collecting and what I needed to do next.

The final data collection was students' test and overall grades during this research study. Students' averages included Chapter 5 test scores taken on Friday, February 13, Chapter 6 test scores taken on Friday, March 20, ^{3rd}-third quarter grades, which ended on March 20, and ^{4th}-fourth mid-quarter grades, which were posted on April 24.

Data Analysis

To study students' mathematical achievement when they wrote about mathematical ideas in a personal prompt, I used pre-surveys and post-surveys to determine their opinions on the benefits of journal writing and suggestions on continuing

journal writing for next year's sixth grade class. Two student interviews were given to explore verbal ideas and thoughts during this research study. It was another way to discover their attitudes about writing in a mathematical journal. I also used students' test scores and quarter and mid-quarter grades to examine students' achievement gains.

To discover the changes in my mathematics teaching due to the implementation of personal mathematics journals for my students, I compared the principal's ~~ste~~ two observation notes, which ~~was-were~~ further scored by myself based on a rubric. In addition, I read through my personal journal to look for new ideas, thoughts, and strategies after I implemented the research strategies in my classroom.

Students' journal writings were read and scored using a rubric to look at the quality of students' written explanations over the semester when using personal mathematics journals and receiving feedback. This was to determine ~~ifn~~ writing improved, stayed the same, or worsened during this research study.

Findings

In this section, I will present my research findings. Before I report detailed results, I will first introduce my average teaching day, which will provide a general context of my research findings. Our school morning ~~follows-followed~~ a 50-minute block schedule that ~~includes-included~~ social studies, science, English, math, and an exploratory block (physical education, computer, library, and Spanish). I ~~teach-taught~~ social studies, English, Spanish, and two math classes. Math class ~~consists-consisted~~ of students asking questions on the previous day's assignment, a daily lesson, and 10 minutes of class time.

Because I ~~am-was~~ a ~~half-1/2~~ time ~~sixth~~6th grade teacher and ~~1/2-half~~ time Spanish teacher, I ~~leave-left~~ at noon and headed to my K-4 Spanish room. Another teacher ~~comes-~~

~~came~~ in at 12:10 p.m. and ~~was as~~ the afternoon ~~sixth~~^{6th} grade teacher. Students ~~came~~ back after lunch at 1 p.m. and she ~~assists~~-~~assisted~~ students with studying and homework until reading. The afternoon teacher ~~instructs~~-~~instructed~~ from the same math book in another building, so she ~~knows~~ the material and ~~can~~-~~could~~ assist students with questions. The problem ~~is~~-~~was~~, she explained ~~eds the material~~-~~it~~ completely different. One student wrote in their journal that it “confizzles us”.[‡] She also ~~will~~-~~would~~ not help students from my first class. She ~~kept~~^{eps} the door locked and ~~demands~~-~~demanded~~ quiet study time. Quiet study time ~~is~~-~~is~~ fine, but students ~~are~~-~~were~~ not able to get the help they needed~~ed~~. Hopefully, ~~it~~-~~this~~ will change in the future. When you work in a small school, you are asked to fill many responsibilities, and I felt I was not doing the best job I could for students. Therefore, I decided to seek solutions for my students’ struggles from journal writing. Below, I present my findings according to each of my research questions purposed in this study.

What Will Happen to Students’ Mathematical Achievement when They Write about Mathematical Ideas in a Personal Journal?

My first assertion ~~is~~-~~was~~ that students’ mathematical achievement would improve when they wrote about mathematical ideas in a personal journal. My research findings supported~~ed~~ this assertion. The first set of data I ~~want to~~-~~considered~~~~ed~~ ~~was~~-~~is~~ end of the Chapter test grades. ~~Sixth~~^{6th} grades students took the Chapter 5 Test on Fractions on Friday, February 13. The average test score was 75.08 out of 35 students (5 A’s; 4 B’s; 9 C’s; 3 D’s; 9 F’s). Compared to their scores on ~~the~~ Chapter 6 Test on Collecting and Analyzing Data, ~~which was taken Friday, March 20~~, the average test score was 80.16 out of 37 students (13 A’s; 15 B’s; 5 C’s; 0 D’s; and 4 F’s), ~~which was taken Friday, March~~

20. There is-was a 5.08 increase on their overall test performance during this research study while students were writing about mathematics in personal journals. Figure 1 shows-showed the changes of students' mathematical achievement between the two quarters:

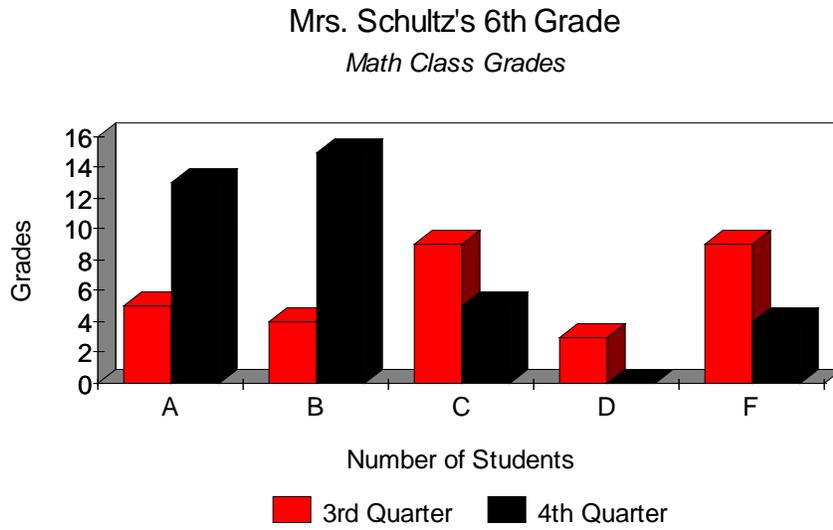


Figure 1. Changes of students' achievement between two quarters

Third quarter shows a bell curve for grades A, B, C, and D, including a high bar for F.

4th-Fourth quarter mid-quarter grades shows-showed a shift of grades moving mainly in the A, B, C range. While there is-was still a number of F's, it is-was lower than and not as significant as seen-in-the 3rd-third quarter. It is-was also interesting to look at the comparison of 3rd-third quarter grades' average to 4th-fourth mid-quarter grades. 3rd-Third quarter, which ended March 13, showed an overall grade average of 77.7 and 4th-fourth mid-quarter grades, which were posted April 24, showed an overall average of 79.7, a two2--point improvement. Individually, 21 out of 35 students (60%) improved their grades, 3-three out of 35 students (9%) stayed the same, and 11 out of 35 students (31%) decreased their grades. The students who improved their grades jumped from an

average of 73.047 to 80.9 (an increase of 7.853 points). The students who lowered their grades fell from an average of 85.09 to 80.9 (a decrease of 4.19 points).

As I read through and scored students' journals, I noticed a pattern with students who did well at language arts, but struggled with mathematics. One student, whose quarter grade improved from an 81% to 85%, scored consistent 4's for each journal prompt. Her journal response (week 3 journal writing prompts) to the bar graph and double bar graph stated, "Bar graphs and double bar graphs are used to display organized data. It's fairly easy to understand once explained and put into action. For double bar graphs, you need 2 sets of data to compare. For example... (she drew a double bar graph). Bar graphs are easier. You only need one set of data. For example, (she drew a bar graph)." –She also responded well about percents, decimals, and fractions in her mathematics journal. "They are all fragments of a whole. They are just little or big pieces. It's just different ways of writing it. $25\% = \frac{1}{4} = 0.25$." I believe that by connecting writing to mathematics, she was able to improve her achievement.

Another student, whose grade did not significantly improve from 3rd-third quarter (778%) to 4thfourth –mid-quarter (-79%), responded to the bar and double graph prompt by providing an example of each. He wrote, "Bar graphs are easy. You have on bar on the graph (under the bar graph). You have two bars on the graph (under the double bar graph). Bar graphs are easy." He also wrote very little on comparing percents, decimals, and fractions. He gave an example of "99% 0.99 99/100" and wrote, "They tell how much there is." He scored a 3 for his first response and a 2 for his second response. His written comments were not as in-depth as the first student.

During the student interviews, students expressed that they thought journal

writing helped them understand math. What follows are typical responses:

S1: You can know what we are thinking and feeling.

S2: It let us to tell you what it it like to be a sixth grade math student.

S3: Start journal writing right away next year to help next year's sixth graders.

Although it ~~is-was~~ not conclusive that journal writing ~~is-was~~ the sole cause of increased academic achievement, there ~~is-was~~ an overall increase in academic achievement in math during my implementation of journal writing in my teaching. Since journal writing was a new experience for most students, it seemed six weeks was not an ample enough time to determine accurate results. However, my findings showed ~~ed~~ that there was a correlation between the achievement improvement and their journal writing.

It is worthy of mentioning that there were other possible factors that might have affected my students' achievement changes. For example, was student achievement change due to the journal writing, was it due to improved teaching practices, or was it due to change in subject matter? As I looked over the students who had improved their overall grades, there seemed to be many different reasons. However, when analyzing closely, I found journal writing still served as a mediate enabling other factors that facilitated student learning to take place. For example, one student, who is a SPED student, received a 34% for ~~3rd-third~~ quarter and received a 61% for ~~4th-fourth~~ mid-quarter grades. Since ~~4th-fourth~~ quarter has covered charts and graphs and geometry, thus involving more visual topics and hands on activities to do, this student was able to give visual examples and express herself in journal writing in a way she hadn't before. This ~~is-was~~ possibly because journal writing provided a space for this student to maximize her learning ability in ways that ~~being-were~~ consistent with her learning style. In addition, my

extra assistance with this student's learning attitude might also have played a role in her achievement. During the journal writing, this student wrote, "It is a little bit hard for me in math class. It is hard for me to get my homework done on time. I wish I could be a better student like Amanda, Cassy, Emily, Tyler, Austin, Joe, Abbie, Selena. I am stressed about my homework and my grandpa in the hospital." Because of reading this journal writing, I was able to ask her how I ~~could~~ help and offer encouragement. The private dialog between us may have encouraged her and empowered her to do better.

What happens to my mathematics teaching when I implement the use of personal mathematics journals for students in my math class?

My second assertion ~~is~~-was that there would be changes in my teaching, as a result of reading journals. I knew I needed to make changes to better assist students in their learning. As I read through their writings, things began to happen. Students were given time to ask questions before turning in the previous day's assignment. Concepts that were not understood or were unclear were then approached in another way. While explaining the mathematical process, steps for solving problems were written on the board. More hands on activities were assigned and monitored.

One student wrote in her journal, "I wish you would go over some of yesterday's homework before we turn it in." I thought this was a great idea, because generally, if one student ~~s~~ had a question, they all had a question. As class started ~~ed~~s, students ~~go~~et out their homework and asked ~~ed~~ questions. I asked ~~ed~~ ~~what~~ other students what they thought and asked ~~ed~~ them to explain how they found their answer. Students ~~take~~-took turns discussing what they did and when we ~~w~~'-ere done, they turned ~~ed~~ in their work. This ~~reinforcees~~-reinforced students who solved the problems and it ~~allows~~-allowed other students to hear how their

peers ~~think~~thought. Also, it ~~is~~was not always the same students who answereded. They ~~take~~took turns exchanging ideas and it endeds up being a great discussion about math. I believe a peer can explain their thinking and it can help another student understand their ideas. I hate to admit, but I was a lecture, give examples, and assign problems teacher.

Not anymore.!!!

Another example of change came from an excerpt from a student's journal which stated, "I didn't understand the scaling and scale drawings." This suggestion from the journal writing prompted me to pursue a better teaching strategy helping my class understand this concept. Inspired by a colleagues' suggestion, I employed an alternative approach to this subject. Students in my class picked a "Peanuts" cartoon picture and taped it to a 1 cm x 1 cm graph paper. They then used a ruler and drew horizontal and vertical lines. Next, they took a blank piece of paper and drew 1 in. x 1 in. squares. Lastly, they transferred the cartoon to the larger graph paper, outlined their drawing with a black felt tip marker, and erased the pencils lines. Most students loved this activity and got another perspective on scaling and scale drawings. It was something I would not have thought of doing, and it turned out to be a memorable and educational activity.

Students' suggestions for the journal writing also contributed to the change of my teaching style to teach for "all". One student wrote in her journal, "One way I can be successful is by you writing the steps on the board." I actually got this idea from a parent of a SPED student with ADHD. During a parent teacher conference, we were talking about ways to help her student and she shared with me an idea she learned from her doctor. So, as I was explaining how to divide fractions, I would stop after every step and write what I did on the side. I ~~have~~ received many comments that it helped them

understand the process better. Not only did the SPED student benefit, but other students did as well.

Another change occurred after my fourth journal prompt, “what ideas do you have to help me make you feel more successful?” Students responded that they wanted to come up to the board more often and practice problems before they started ed the assignment. They wanted more hands-on activities. So, we discussed ~~the one hundred~~the 100 squares with the grey perimeter. The class did an excellent job of participating and did not want to stop and go outside for recess. One of my students surprised me when he saw $10^2 - 8^2$. He ~~is~~was a capable math student, but he ~~does~~did not like to show it. ~~It is not cool.~~ I was so proud of him that he felt confident enough to say his idea aloud for everyone to hear.

My principal’s observation and feedback also provided evidence regarding the change of my teaching. During his first observation, he watched my second math class take their data they had gathered the day before and discover the mean, median, mode, and range. Afterwards, he stated that he could see the difference in my teaching. Students were thinking about ideas and solutions. It ~~is~~was so different from the traditional way of teaching math. My principal also told my sixth grade colleague, who also is~~was also~~ a participant of Math in the Middle, ~~that~~ he ~~is~~was excited ~~in~~about the changes he ~~sees~~saw in my teaching. In particular, he praised Math in the Middle and wanted other teachers to observe what we’re doing. !

There were a number of statements in the students’ journals that they did not like fractions, and they still don’t understand them. I asked those students for suggestions for what I could do to help. One idea was to assign 5 to 10 problems in class and have them

show their work to me to see if they ~~ware-were~~ on the right track. ~~Then a~~Assign the rest of the work and help students who needed more practice. In other words, slow down and let us have a chance to learn it well. That was an eye-opener, because I felt the same way in our Math in the Middle classes. The instructors did an excellent job teaching us the math material, but I also could have used more time to learn it and learn it well. There were times I was so frustrated and near tears, because I felt everyone else understood it and I didn't. To find out I was doing the same thing, made me feel terrible. Time is always an issue in education and it's hard to find the balance.

What will happen to the quality of students' written explanations when using personal mathematics journals and receiving specific feedback?

My third assertion was their written explanations of mathematical solutions would improve after writing in a personal mathematics journal and receiving feedback. My first journal prompt asked for three qualities of a good math teacher and three qualities of a good student what they were surprised to discover this week in math. Out of 32 journal responses, the average score was 3.3. Most students wrote caring, respectful, responsible, ~~and~~ trustworthy, ~~and others~~. My feedback to a number of students stated that it ~~is-was~~ interesting that we both had ~~ve~~ responsibilities in their education. One student answered, "I found it surprising I failed the test when I actually studied for it." This ~~is-was~~ the same student who said aloud $10^2 - 8^2$. He really opened up and wrote earnestly. I kept encouraging him to try his best, make good choices, and ask questions when he didn't understand.

The second journal prompt asked student to write brief descriptions for line graphs and doubled line graphs and then give an example and explain. Out of 31 journal

responses, the average score was 3.1. There were some excellent graphs, but some did not explain how they made their graph or they forgot the axis labels. One student wrote, “Draw a vertical and horizontal line, then write numbers on the vertical line (start with 0). Put a label on and on the horizontal line. It depends on what the graph is about then put a label on. Draw bars and put a title on.” The student included a graph about how many pets and said she chose her topic, because she loves animals. It was not a fancy description or graph, but I could tell she knew what she was saying.

Ideas for me to help them feel more successful were the third prompt. Although, there was a tremendous amount of ideas, some students thought everything was okay or they did not have any suggestions. Out of 32 entries, the average score was 3. My 10² – 8² student wrote, “I feel I was successful until ALGEBRA entered my life!!! I wish you could be here during study time. I think that would help me and everyone else.” He expressed his frustrations and gave a solution to the problem.

Another student responded to the question in Spanish. She ~~is~~ was an ESL student who ~~has~~ had lived in the United States about 1-½ years. She came to our school knowing little to no English. She ~~has~~ was ~~been~~ an eager student and ~~has~~ made great strides. ~~She can~~ could understand what ~~is~~ was said to her and ~~improves~~ improved daily in her English speaking. She asked to be included in the regular classroom, instead of following our dual language assistant. Her translated response ~~states~~ stated, “I feel well because you help me in mathematics. Thanks to you for helping me learn English and learn math. Thanks for all you do to help me.” These words would have been extremely difficult for her to write in English or express ~~it~~ aloud. She ~~has~~ worked very hard to learn English and to be included in the classroom.

Class noise was another idea that was ~~well~~-written about frequently. The student wrote, “Some of my ideas are that when you are teaching math that nobody blurts out any answers or talk. That makes me frustrated when I’m trying to learn and people are talking.” This comment drew my attention to the problem behaviors of a few students in my class. For example, there was a very bright student, who, ~~however~~, struggled waiting to be called on, because he wanted everyone to know how smart he iswas. Although ~~h~~h I had talked to him a number of times about letting everyone else think about it and to be patient, this still occasionally happened. Thus, the journal writing highlighted the crucial issues that needed to be addressed through my students’ complete, ~~and~~ clear and understandable expressions of their feelings.

The fourth prompt asked students to explain how percent, ratios, and fractions are related. Out of 33 responses, the average score was 2.8 out of 4. To have scored a 4, the response needed to be detailed and clear. Most students responded correctly, but did not reduce the fraction or forgot the fraction altogether, therefore earning a score of 3 (response is clear, but needs more details/explanations is not complete and lacks clarity) or a score of 2 (response is a little difficult to understand with few details/explanation ~~is~~ minimal and very confusing).

I changed the fifth prompt and asked what they liked and didn’t like about ~~6th~~ sixth grade math. Out of 21 responses, the average score was 3.4 out of 4. One student wrote, “I like the fact that we do more homework. Not because I like homework, because I feel I know more than when I started.” There were many complaints about homework, but this student saw the value of her work. Another student explained, “It’s sort of a repeat. The mean, mode, median, and range we learned three times. Once in fourth, fifth,

and now sixth, but it's always nice to refresh your mind. You could go to a higher level for me, but it might be bad for the other students." Here I believe he ~~is-was~~ telling me he ~~is-was~~ bored ~~and-but~~ he understood ~~ands~~ why I ~~can't-couldn't~~ go any faster or deeper. Most elementary students do not see outside of themselves and how it may affect others, or care.

The final prompt asked students to give an example of a right, acute, obtuse, and straight angle and explain. With regard to the 27 responses, the average score was 3.2 out of 4. Most angles were drawn and labeled correctly. Students liked using protractors and their journal entries showed their understanding of the angles and their measurements. Although these scores demonstrated a high quality of my students' journal writing, there was still room for improving the clarity, completeness, and depth of their responses.

Over the six weeks of research, journal writing did not show improvement. Their scores ranged from 2.8 to 3.4. Although the writing did not improve, there were gains elsewhere. I observed that more students felt comfortable to speak up in class, not just with answers, but how they arrived at the answer. We recently spent an entire class talking about journal writing in math and their opinions. They talked openly, earnestly, and deeper than I would have thought.

Conclusions

Journal writing in math class was beneficial to my students and ~~myselfme~~. – Concerns, frustrations, and ideas were exchanged to communicate how to improve learning and valuable discussions ~~that~~ took place throughout this research.

Our class discussions evolved to include new ideas and opinions that would not have taken place before we began journal writing. Rogers (2006) stated that when

learners feel they are listened to, they are eager to share their experience. Students felt they were being listened to and therefore, shared their ideas with the whole class.

I had to point out to the class that we already level for reading. So, there are people who do not want to level for everything and some students will always be in the same classes. I did not express that another reason was the concern for the lower students to have someone to model after. I can see both sides of the argument and I don't know the clear answers. There is some leveling of math in our junior high and then in high school where you can choose what math courses you want to take.

Journal writing helped me gain great insight into my students learning. As Smith III and Phillips (2000) stated, by listening to students and how they express their thinking, teachers can realize students' knowledge and their limitations. —Fried and Amit (2003) also suggested that it was a private conversation on their understanding of math concepts and feelings. —Therefore, teachers can take that information and improve their instructional practices. My findings were consistent with previous research. I found that journal writing helped me make changes to help students by changing some of my teaching methods. Consistent with Borasi and Rose (1989), I obtained a better evaluation of individual students and improvements that I could make to my mathematical teaching.

A teacher should also challenge and empower students. Baxter, Woodward, and Olson (2005) suggested that by writing in journals, it provided students who are normally quiet in class an opportunity to communicate with the teacher. By requiring students to write in journals, I feel I provided an avenue for students to express their own mathematical thinking. They felt like they had a voice in their own education.

Like Porter and Masingila (2000), my research only showed small gains in

achievement. –I agree that more research would need to be done to give substantial suggestions for improving learning through writing. As Clarke, Waywood, and Stephens (1993) concluded, it is a long-term task for teachers to increase the meaningfulness of their students' mathematical writing. In my study, many of the students stated that mathematical journal writing should continue for next year's sixth grade students. This would give me more data and time to work out any problems. My suggestions would then have more weight to them and be more insightful.

Most importantly, this research opened up communication between myself, as a teacher, and them, as students. Rodgers (2006) and Fried and Amit (2003) stated that keeping feedback private and descriptive, not evaluative, students and teachers build trust and increase understanding. In my research action, although we did not always agree, ~~but~~ we were both heard and, sometimes, that is-was the best communication.

Implications

I would like to continue to implement weekly journal writing next year. Every year is different and what better way to know one another. I can continue reading, listening, and evaluating each student in a more personal way. A 50-minute block of classroom time does not always allow for the personal, one-on-one connection. Too many voices are not heard.

This ~~6th~~-sixth grade class helped me become a better teacher. By sharing students' comments and feelings, I can use the information to provide a better educational experience in math and other subjects. I can better understand what it is like to be a ~~6th~~-sixth grade math student. Teaching is not only about imparting ideas, but it is also about listening and responding to our students. Every teacher needs to take time to listen to

students and meet their needs for mathematics in an ever-changing world. By
cCommunicating with ~~each other~~ one another and working toward sthe same goal, we can
together strive to be the best we can be.

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Appendix A

The 6th Grade Math Pre-Survey

Name _____

Date _____

Have you kept a journal in other classes? If so, what class?

What did you like about keeping a class journal?

How might writing about math be beneficial for the student and the teacher?

How would you describe yourself as a math student?

Appendix B

The 6th Grade Math Post-Survey

Name _____

Date _____

What did you like about keeping a journal about math?

What didn't you like about keeping a journal about math?

How has keeping a journal about math benefited you this semester?

How would you feel about keeping a journal about math next year? What changes, if any, would you make?

How would you describe yourself as a math student?

How do your journal entries in February compare to your journal entries in April?

Appendix C

Students' Journal Prompts:

Week 1:

Write about three qualities of a good math teacher and three qualities of a good math student.

Week 2:

What were you surprised to discover this week in math? *Explain your thinking.*

Week 3:

Write brief descriptions for bar graphs and double-bar graphs. Give an example of data that would best be represented by a bar graph and explain why you chose this type of data.

Week 4:

How successful do you feel in math class? What ideas do you have for me to help you feel more successful?

Week 5:

Write an explanation of how proportions and ratios are related. Write a proportion with a missing value and use cross products to solve the proportion.

Week 6:

Give an example and explain a right, acute, obtuse, and straight angle.

Appendix D

Rubric for Scoring Journal Writing

CATEGORY	4	3	2	1
Response to journal prompts	Response is detailed and clear.	Response is clear, but needs more details.	Response is a little difficult to understand with few details.	Response is difficult to understand and is missing the main idea and details.
Explanation of mathematical thinking	Explanation is complete, clear and easy to understand	Explanation is not complete and lacks clarity	Explanation is minimal and very confusing	Explanation did not cover journal topic

Appendix E

Principal Observation Sheet

Teacher _____

Date _____ Class _____

Give a general overview of the class (teacher, students, lesson).

How was the time used? How much time was used to get started, lesson, homework time?

Did the teacher demonstrate knowledge of the content and explain it clearly?
Give examples.

What reinforcing words did you hear?

What did you like about the class?

What suggestions do you have for improving the class?

Appendix F

Rubric for Principal Observation

CATEGOR Y	4	3	2	1
Teacher's knowledge	Teacher demonstrates full knowledge of lesson content.	Teacher is at ease with content, but fails to explain clearly.	Teacher is uncomfortable with content and is able to demonstrate basic concepts.	Teacher does not have grasp of information; teacher cannot answer questions about subject.
Classroom management	Teacher uses time well, gives clear directions, and encourages strong mathematical thinking.	Teacher uses time okay, gives directions, and encourages mathematical thinking.	Teacher has some lapses in class time, gives inconsistent directions, and sporadically encourages mathematical thinking.	Teacher does not use time wisely, gives confusing directions, and does not encourage mathematical thinking.

Appendix G

Student Interview Questions

1. What helps you understand math the most?
2. What do you like most about math? Why?
3. What do you like least about math? Why?
4. If you don't understand a math idea from class or homework, what do you do?

What do you think the purpose of writing in a journal for math is?

Has writing in your math journal helped you understand a math concept better?

Why or why not?

Does journal writing help you express your math struggles and concerns with me?

Has your attitude about writing in a journal changed since the beginning of the February? If so, how and why?

How can I know if you really understand a math concept?

Are there any questions or comments for me?

Do you have any ideas or suggestions for me to help you understand math?

This semester I have changed some of my teaching practices. What advice would you give me about continuing these changes next year?

Is there anything else I should know about you to better understand your problem solving in math or your general math experience?

Appendix H

Personal Weekly Journal Prompts

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

What are some observations you made this week while reading the students' journals?

How has reading this week's journals influenced your teaching?

Other comments: