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Strengthening Student Understanding by Implementing Rubrics to Provide Effective Feedback

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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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Strengthening Student Understanding by Implementing Rubrics to Provide Individualized Feedback

Abstract

In this action research study of my classroom of sixth grade mathematics, I investigated the impact of rubrics on strengthening students' mathematical understanding and students' ability to communicate about problem solving processes. The feedback was given on three daily bell-work problems assigned at the beginning of each class over the previous lesson. I discovered that the use of these rubrics were beneficial to the students and teacher. Once students were given the expectations of the bell-work problems and became comfortable with the rubric, the quality of their work and communication of solutions was higher than before the rubric system was implemented. As a result of this research, I plan to transition into a system of providing individualized feedback on specific daily homework problems in an attempt to give students meaningful information based on current skill acquisition.

Introduction

I, like most educators, am always in search of the best way to increase the knowledge, performance, and self-esteem of my students. I have researched and implemented different forms of instruction, practice, and assessment throughout my career and have learned that different methods work best for different students. Realistically though, many factors limit my ability to completely individualize teaching for each of my students. My goal has been to find a balance between what is best for each and every student and what I am able to provide for them given the constraining factors often faced by classroom teachers.

I have taught at the same elementary school for the past three years. One building houses all K-12 students in the district, but the students are separated into elementary school (K-6) and high school (7-12). Of the approximately 550 students attending school in my town, about 300 of those students are in grades K-6. This town is considered to be a middle-class agricultural community with a Hispanic student population of approximately 30%.

Roughly 41% of students qualify for free/reduced lunch prices, which is about 4% higher than the state average. Over 11% of the student population is classified as English Language Learners (ELL); more than double that of the state average. In addition to ELL students receiving educational services, about 15% of students qualify for special education services.

Because of the diverse student population and the many challenges that these students face, the district has provided its teachers with a number of professional development opportunities. Over the past two years, I have had the opportunity to learn more about research-based strategies to increase student achievement in the classroom. Instructors of school improvement sessions and in-services from the local educational service unit used research-based instructional strategies (Marzano, Pickering, & Pollock, 2001) as a base for assisting teachers in strengthening classroom practices. It is because of this teacher education that I have become interested in the strategies of Marzano et al.

A very applicable strategy to the teaching of middle level mathematics is the strategy referred to as Setting Objectives and Providing Feedback. In their book *Classroom Instruction that Works: Research-Based Strategies for Increasing Student Achievement*, Marzano et al. (2001) suggested, "One of the most generalizable strategies a teacher can use is to provide students with feedback relative to how well they are doing" (p.96). As an educator, my responsibility is to give students an accurate sense of how they are doing in my class, but sometimes I struggle with knowing the best way to share this information with students. Like most educational institutions, my school uses letter grades and percentages in core subject areas as a means of communicating student performance to teachers, students, and parents. As most of the other teachers, my grading system reflected a student's overall skill, in the

form of assignment and test grades, as well as their degree of participation in class and in completing homework assignments, but there was very little explicit feedback given from me other than “great job” or “please get help on this concept.” I did try to have student conferences, but had been inconsistent in the frequency and with the content of these informal conferences. Each year, I found myself “tweaking” my grading system, but was still struggling to come up with a way to adequately show what a student can do.

Grades and report cards are traditionally used to measure a child’s overall success in the classroom. Certainly, students receiving “A”s in my math classes are proficient learners, but there are other factors including student attitude and effort, work ethic, prior knowledge, and parental support that could contribute to a grade in school. Does the “A” student necessarily know more than the “C” student who does not have the same support system or work ethic? Do grades truly reflect what children can do?

Problem Statement

As a learner who is motivated by checkmarks and grade point averages, I have been known to fall into the unfortunate thinking that most students share these ideals. I have learned over my six years of teaching though, that grades are usually only motivators to the students who do well in class. These particular students see high grades as indicators of successful skill acquisition and application, and low grades as an indicator of deficiencies and the need for extra help or practice.

To students who do not do well, a low or failing grade neither shows what the student is capable of, nor motivates them to do any better. A simple letter or percentage does not show a student his/her areas of strength nor does it communicate improvement opportunities. For these students particularly, more direction and assistance is needed from the teacher in order to increase the self-esteem and skill level of struggling students.

I have come to the conclusion that simply putting a number or letter grade on an assignment, test, or report card, does not always reflect a student's proficiency in an area, his/her ability to apply mathematical knowledge, and general attitude and participation in classroom activities. In addition, a number or letter grade does not communicate with students where they should improve themselves. My ideal classroom would have students knowing exactly what their areas of strength and weaknesses are, and using that knowledge to work to improve their skills. The students would hold themselves accountable for their own learning, and would show genuine effort in achieving mastery of as many concepts as possible. My ideal classroom would also have parents who are regularly updated on their child's performance in class, and would help work with their child in strengthening that performance. Students in my ideal classroom would be motivated to work hard and to always show me what they can do.

Would there be a positive response from students if they were to receive frequent and effective feedback in terms of their current skills and behaviors as well as constructive input on areas of weakness and suggestions to help combat

classroom struggles? Would a rubric be an appropriate communication tool to assess student knowledge and ability to apply mathematical skills learned in class? Would providing feedback through a rubric be more helpful and motivating than a simple letter grade every nine weeks?

The instruction contents that I focused in this action research are two chapters selected from our math textbook involving ratios and percentages. These chapters are especially important as they cover very relevant mathematical skills that students need for their adult lives. These chapters are, however, particularly challenging as most students traditionally struggle. According to National Council of Teachers of Mathematics (NCTM) (2000) number and operations standards, students are expected to work with decimals and percents to solve problems and to justify whether their answers are appropriate using necessary estimation skills. I chose to implement a rubric-style feedback system during these two chapters to ensure that each of my students is able to show proficiency and application of the concepts and skills learned.

This issue of providing feedback also relates closely to the NCTM (2000) Assessment Principle. According to NCTM, Assessment should both support the learning of mathematics as well as provide useful information to teachers and students. Students and teachers alike should be given valuable information based on assessments, and then use that information to make informed decisions about how best to move forward. Assessment should be a part of

everyday classroom instruction and the information gained from assessments should be used to help guide instruction.

Motivating students to do their best by providing them the proper tools and feedback to do so is important to students and teachers. Students who are receiving feedback concerning their individual skills will understand the areas that are strong as well as to pinpoint the areas where improvement is needed. This feedback is the key to help motivate students to work toward teachers' expectations thus performing to their potential. Since teachers are held accountable for student success on standardized assessments, knowing the precise areas of strength and weakness of individual students can help a teacher plan meaningful lessons that ensure student success.

Literature Review

While investigating previous research, I came across three common themes regarding feedback: features of effective feedback, feedback as a tool for student learning as well as a tool for teacher teaching, and the use of rubrics as a means of providing feedback.

Features of Effective Feedback

Walter Lamberg (1980) cites Olds, Brethower, and Smith (1970), who have described feedback as "any information on a performance which affects subsequent performance" (p. 63). Based on this description, feedback can take a variety of forms; a signal of a correct or incorrect answer or an in-depth conversation with a student about his or her work.

There has been a lot of research and discussion concerning effective feedback and not all types of feedback have been proven effective. Tunstall and Gipps (1996) conducted a study involving 49 six- and seven-year-old children of various achievement levels in six London schools. These researchers concluded that feedback of letter grades or confirming correct answers has little or no effect on subsequent performance. Simple letter grades and percents are not effective forms of feedback; neither is simply telling a child they have the right or wrong answer. In order for feedback to be effective, students need to be given more direction.

One of the features of effective feedback is its specificity. Bangert-Drowns, Kulik, Kulik, and Morgan (1991) studied effect sizes for different types of feedback using meta-analytic procedures to review past studies concerning feedback and assessment. These researchers noticed that, "When feedback merely indicated that a response was correct or incorrect; it resulted in a lower effect than when the feedback in some way informed the learner of the correct answer" (p. 232). This finding echoes what Tunstall and Gipps said about right/wrong feedback. I have also seen in my own classroom that checking an answer wrong gives the student no information about what exactly he/she did wrong in order to obtain an incorrect answer and how the student might correct the problem.

Walter Lamberg (1980) presents ideas on the role of feedback in writing instruction based on past research studies, methods texts, and discussion in

articles. He elaborates on the earlier description of feedback given by Olds, Brethower, and Smith. Lamberg describes feedback as, "information on performance which affects subsequent performance by influencing students' attention to particular matters so that those matters undergo a change in the subsequent performance" (p. 66). Effective feedback specifically details suggestions which can be used by the recipient in order to improve upon current skills or performance.

It is widely agreed by the educational field that feedback must be specific. As previously mentioned, Robert Marzano, an internationally recognized scholar, along with fellow researchers Pickering and Pollock, states that feedback is most useful when it is specific to criterion (Marzano et al.,2001). According to these researchers, feedback should be given to students so that they know where they stand in regards to skill acquisition, as opposed to norm-referenced feedback, which would tell them where they stand in regards to their peers. Norm-referenced feedback does not give the student information about their learning, so the student has limited information about how to improve. The most effective feedback is more detailed and descriptive, giving the student a better sense of what exactly was correct, or alternately, providing the student with constructive information with improvement plans.

The second feature of effective feedback is "timely." Most current recent research has supported the effectiveness and importance of timely feedback (e.g., Marzano et al.,2001). Marzano et al. explained, "The timing of feedback

appears to be critical to its effectiveness.... In general, the more delay that occurs in giving feedback, the less improvement there is in achievement" (p. 97). If the point of feedback is to confirm what is correct and fix what is incorrect, then it is vital that students receive this information soon after the initial task.

Researchers Lemley, Sudweeks, Howell, Laws, and Sawyer (2007) performed a quasi-experimental study to examine the impact of immediate versus delayed feedback on high school junior and senior learners in distance courses at Brigham Young University. These researchers found that students who received immediate feedback scored higher than those who received delayed feedback. When comparing two sets of students, one class given immediate feedback and the other receiving delayed feedback, students receiving immediate feedback scored almost one-half of a grade higher in history and one-fourth of a grade higher in health than did the students receiving delayed feedback. Those students receiving immediate feedback had more time to correct any mistakes they had been making. Correct performances were also reinforced. Because of this, these students scored higher on average than their peers who were not given sufficient time to make improvements once feedback was given.

The third feature of effective feedback is that it comes from a reliable and positive source. Researcher Kathleen Brinko (1993) reviewed prior literature, empirical studies and pertinent theological pieces concerning the practice of giving feedback in order to come up with a set of characteristics of effective

feedback. She found that feedback is most effective when the source is found to be credible, knowledgeable, and well-intentioned. Positive and helpful feedback coming from a credible source is more likely to be taken well by the student. Students need to know that the feedback comes from a positive place and is meant to help them be successful, rather than simply pointing out educational flaws.

Brinko elaborated further about the features of effective feedback and concluded that effective feedback contains models for appropriate behavior. In addition, feedback must be considered to be a process and not a quick fix. In order for students to fully understand what is expected of them, the skill or behavior must be correctly modeled for them to use as a reference. It is not enough to tell them what they will be expected to do, they need to be able to see the form the final product should take in order to have success. It is very important also to note that providing students with feedback, even if it is very positive, appropriate, specific and timely, needs to be an ongoing routine in the classroom. Teachers must be diligent about providing good models for feedback in order to most effectively manage their classroom and students.

This research clearly states that the most effective feedback is specific to the student and situation, given in a timely manner, and given by a credible source in a positive manner. When conducting my action research, I will need to follow these guidelines when administering feedback. I will strive to be positive and specific when conversing with students and will aim to have feedback given

by the next class period so that I can see the full benefit of using effective feedback.

Effective Feedback as a Tool for Students and Teachers

Feedback plays a vital role for both students and teachers. Students are often motivated by effective feedback. Coddling, Eckert, Fanning, Shiyko, and Solomon (2006) conducted a study of sixth grade students in a large, suburban middle school in the Northeast U.S. to see if adding performance feedback to interventions would increase students' mathematical fluency and accuracy. Based on interviews and surveys, these researchers found that specific feedback given to the students based on their performance served as motivation for the children to exceed previous academic performance. Therefore, when given specific information on performance, students have the tools and motivations to increase the level or quality of past work. When students are given very clear, high expectations, along with individualized feedback to help steer them, they become motivated to exceed those expectations.

In addition to motivating students toward success, feedback can serve as an assessment tool. Tunstall and Gipps (1996) assert that feedback plays an important role in assessment. In their article about feedback and assessment, they discuss the importance on feedback as a formative assessment, "Feedback from teachers to children, in the process of formative assessment, is a prime requirement for progress in learning" (p. 389). They argue that students need to be given feedback from the teacher in order to learn a skill. Therefore, feedback

is more than just a conversation about goals and how students see themselves as learners. Rather, feedback is offering specific suggestions and information about whether students have mastered a concept.

When effective feedback is provided to students - focusing on the process of learning rather than the product - it can have a positive impact on student achievement. Vollmeyer and Rheinberg (2005) conducted a study of 211 university and high school students in Potsdam, Germany. In this study, half of the students received feedback during learning and the other half did not. They found that, "learners expecting feedback used better strategies right from the start. Thus, they acquired more knowledge over fewer trials" (p. 589). When students were familiar with the process of feedback, they were able to make better decisions in regards to their own learning, simply because they knew they were going to be receiving feedback later on and put helpful strategies in place beforehand.

Feedback also plays an important role in guiding teachers' instruction in the classroom. When compiling seven principles of effective feedback based on the results of research on formative assessment and feedback, Nicol and Macfarlane-Dick (2006) noted that in order to produce feedback that meets students' needs, teachers need good data and also need to be involved in reviewing and reflecting on this data. It is not enough to look over grades in a grade book to determine whether students are having success. Teachers need to collect relevant data and then be involved with analyzing the data. After this data

collection and assessment, the teacher can then determine which areas need the most support for particular students. A plan can then be formulated in order to ensure that all students are learning, applying, and retaining necessary skills.

While the research I have found has been informative, it has been difficult to find a lot of research concerning feedback in a mathematics classroom. Most of the studies conducted have been centered on reading and writing, so it is difficult to know how the results will translate to my own research. A second difficulty was finding appropriate research conducted with students in the middle grades. A majority of the subjects from the research that I read were high school or college aged. Students in the middle grades are not necessarily going to have the same thoughts and reactions as much older or much younger students. It will be interesting to see if my students have similar opinions on feedback.

The Use of Rubrics as a Means of Providing Feedback

Most of the research that I have read, while giving me good information about the characteristics of effective feedback as well as about how feedback can be used to support students and teachers, has not given me a lot of guidance as to the best instruments to provide feedback. Marzano, Pickering, and Pollock (2001) refer to rubrics as a powerful tool that can provide students with feedback in terms of specific levels of skill and knowledge. Since this statement is consistent with the findings of effective research, I have decided to use a rubric in my action research.

It has been found that rubrics can be good tools for providing feedback if used effectively. While studying Chinese schools and their educational reforms along with other educators and researchers, Martin-Kniep (2000) concluded that in order for rubrics to be effective, they need to be used strategically and on a regular basis. Martin-Kniep is an educator, researcher, and Chief Executive Officer of the Center for the Study of Expertise in Teaching and Learning, and has worked internationally, focusing her work on alternative assessment, standards, action research, and school improvement. Martin-Kniep has acknowledged that once students internalize attributes of quality, they will be able to evaluate their own work and the work of others. In familiarizing students with using a rubric consistently, they will become more proficient when evaluating future work.

Research has also been conducted to determine student's views on feedback through a rubric. Smith (2008) conducted a study of 232 junior level students at the College of Business and Economics at a public, Midwestern university. These students were surveyed and interviewed about their feelings and preferences when it came to how instructors graded work. According to Smith, rubrics, in students' opinions, demonstrate fairness and objectivity on the part of the grader.

Another finding of Smith's study was that students felt that expectations on performance were not usually made very clear, which is a situation that could be remedied by using an appropriate rubric. Students studied suggested the use

of grading rubrics or matrices or grading sheets in order to communicate grading objectives to the students. Students preferred receiving feedback from a rubric showing expected traits. The students also indicated a need to know what they did wrong and how they might improve. All of these findings are consistent with the qualities of effective feedback and how feedback can be used to aid students and teachers. If used appropriately, rubrics can be useful tools in delivering effective feedback.

Previous research provided a foundation for my action research. I was able to use what I learned from reading past studies to come up with a method of feedback that would work best for the action research project. My goal was to make the feedback specific and criterion referenced. Because of my teaching situation, the use of a rubric, as suggested by Marzano and others (2001), would be the most efficient method of providing feedback to my students.

I found very little research regarding rubrics as a specific feedback tool and nothing at all when put into the context of middle level mathematics. As a result, my action research was unique in those regards and would address the gap in the research already completed. As a teacher-researcher, my work was unique as I was able to provide deep insights into my students' abilities. Because I had already worked hard to build a positive rapport with the students, I received better-quality information back from the students, which helped me guide my teaching in a more effective way.

Purpose Statement

The purpose of this study was to investigate what would happen when I implemented a rubric to assess my sixth grade students' overall ability to apply mathematical knowledge during a unit of study involving ratios and percents. I explored the changes in the quality of mathematical work performed on three daily review problems (called bell-work), as well as changes in the quality of the communication of solutions. I was curious to see whether the system of using rubrics would be an appropriate tool for providing feedback and how the attitudes of the students would change based on the feedback. With the specific foci on students' achievement and abilities to communicate of mathematical solutions, I asked the following research questions for this action research:

- What will happen to the quality of the students' bell-work problems after the rubrics are implemented as an instrument providing feedback?
- What will happen to the level of student performance on daily assignments after the rubrics are implemented as an instrument providing feedback?
- What will happen to my teaching when I implement rubrics as an instrument providing feedback to improve my students' mathematical abilities?

Method

This action research was conducted on 15 students in one section of my sixth grade math class from February to May in the spring semester of the 2008-2009 school year. I had several setbacks in the course of this data collection which caused my research to go further into the school year than was originally planned.

Participants

During the 2008-2009 year, I taught two sections each of fifth and sixth grade math. I chose my second section of sixth grade to be the basis of my action research. At the beginning of this project, I had 16 students having a wide range of abilities, including two students qualifying for special education services and two students in the English Language Learners (ELL) program. Of these 16 students, one student was excessively absent and unable to participate in the study.

The Bell-work Problems

Prior to implementing my scoring rubric as a feedback tool, I collected several samples of bell-work problems completed by the students in my class as pilot data. The bell-work problems were math problems that the students would be expected to complete at the beginning of most daily classes. These three problems focused on skills learned in the previous lesson. The problems would consist of two basic, knowledge-level problems in which a correct answer was all that was necessary as well as a third application problem. This application

problem was usually aimed at putting the skill learned into a real-life context, where the students would need to figure out what was being asked and how to apply learned knowledge to answer the question. In addition to answering this application problem, students were prompted to explain in writing their work and solution as well as to explain why their answer makes sense. I then used my scoring rubric (see Appendix A) to score these problems based on two criteria:

- Mathematics- Did students come up with the correct solutions for each of the three problems? Did they show the required work?
- Communication- Did students fully explain the work performed on the application problem? Did they justify their answer?

Procedures and Data Collection

Once I had a few sets of problems collected and scored, I introduced my students to the scoring rubric and gave them a bright blue copy to keep as a reference. This rubric was adapted from Marzano, Pickering, and Pollock (2001). In addition to the rubric, my students received example communication pieces at each scoring level of a problem previously solved in class (see Appendix B) as well as a set of steps to assist them in explaining their solutions (see Appendix B). I spent an entire class period going over the rubric and the class then compared and contrasted the qualities of the requirements of each scoring level. That night, students were assigned one practice problem to solve and explain using the rubric as a reference. These practice problems were then scored by

their peers the following day after discussing the solution and comparing it to the rubric and examples.

Once my students had an introduction to the rubric and had a chance to practice using it, I began scoring the bell-work problems each day. They would receive their scores and feedback at the beginning of each class period so that they could see how they did on the previous day's bell-work prior to starting work on the current problems. I recorded the mathematics and communication scores, made a copy of the problems as a reference, and then returned the scored work to the students. The rubric scores were later put into a spreadsheet in order to help me to better analyze the data.

In addition to the bell-work scores, I kept track of daily assignment averages, quiz and test scores, as well as made informal observations about the attitudes and efforts of the students and their ability to participate in class discussions. Daily assignment, quiz, and test scores were kept in a grade book in order to look for changes in individual scores. A group of seven students were interviewed in late April with questions concerning their attitudes about math and their thoughts about the effectiveness and purpose of feedback and practice problems (see Appendix C), however I only received the proper permission for three of the seven students interviewed.

Lastly, I kept a teacher journal to help me keep track of my progress as well as to note interesting things that I had noticed during lessons, in conversations with students, or on student work. I made it a habit to journal

every Friday during my afternoon planning time and reflect on that week's lessons. I attempted to answer each of my personal journal prompts (see Appendix D) each week in order to help me to see changes that were occurring in my teaching.

Data Analysis

To determine whether or not the rubric increased the quality of student work on bell-work problems, I calculated the mean mathematics and communications score for the pilot set of data and also for the bell-work problems that were completed after the implementation of the rubric. I then compared the mean scores to determine the amount of growth. I also looked at individual growth by comparing selected student results. I was interested to see if the quality of their communication about the solution had increased after the feedback was given. Lastly, I read through my journal entries made throughout the course of the research, specifically looking for instances when I noticed changes in student performance or attitude about math.

Findings

Before I present my research findings, I first describe my average teaching day which will provide background information. My average class period of teaching began with students entering my classroom and completing the three bell-work problems that I had provided for them to solve. The first two knowledge/ computation problems, came from supplemental materials provided by the textbook company corresponding with the previous day's lesson. These

problems would have been almost identical to the practice problems assigned on the homework for the previous lesson. The third problem was either taken from similar supplemental materials or made up by myself. I tried to make sure that the application problem involved at least one skill learned from the previous lesson and that it was easily relatable to the students.

If students had completed bell-work problems in the previous class period, I would pass those out to the students prior to them beginning on the current application problem. I would make general comments to the entire class about strengths, areas for improvement, or any common mistakes that I was noticing. I instructed students to refer to their copies of the rubrics and the example problems while solving their daily problems, as well as instructed them to check over their returned, scored problems to see my suggestions and comments.

After completing the bell-work problems, the students would check the previous day's assignment together with answers provided on the ELMO document camera. Students would have an opportunity to ask questions about missed or misunderstood problems. It was during this time that I would gather some informal feedback from them as to their struggles with the material and the overall difficulty level of the assignment. If a particular concept seemed to be causing some confusion to more than one or two students, I knew that it was a concept that I needed to re-teach and review to some extent. These conversations, together with the graded homework assignments and scored bell-work problems, provided me with feedback to better drive my instruction.

After I felt that the class had an adequate understanding of the previous material, I would present the new material and I would try to have a conversation with the class regarding how students could apply the new skill to life outside of school. Students would brainstorm ideas, and if time permitted, I would use these ideas to make up some problems that could be solved as a class. Once I felt that the students were ready, they would complete a few, guided practice problems together from the textbook. Usually they would complete one or two problems in a whole-class setting where students would be in charge of instructing me how to solve each problem. I would almost always give students a chance to try some problems on their own, while still having a support system of classmates. I stress to each of my students the importance of using their classmates as a resource as well as helping others when one is able.

Each Friday, I would give a short, 10-question quiz over material from the current week's math lessons (see Appendix E). These questions would come directly off previous assignments. In addition to already having seen the exact problems from the quiz, students were encouraged to use their notes taken during class. It is my intention, as a math teacher, that students are able to solve problems using appropriate resources and these quizzes were a way for me to assess whether students were able to adequately solve problems.

In addition to daily assignments and weekly quizzes, I would occasionally spend an entire class period focused on problem solving, which would give me an opportunity to revisit the rubric and re-teach writing up solutions to

application problems. Usually students were then to choose one problem from the section to solve and write up so that they could present these solutions and the class could have practice using the rubric to score solutions. At this time, the students would give each other feedback about the strong and weaker points of their solutions.

After gathering data on daily performance and occasional assessments and data from observations documented in my teacher journal as well as through conversations in student interviews, I was able to go back and answer my original research questions. Below, I report my research findings according to each of the research questions.

What Will Happen to the Quality of the Students' Bell-work Problems After the Use of Rubrics is Applied?

My assertion is that the quality of the mathematics and communications components of the problems increased upon the completion of this intervention. Once students were given the expectations of solving the problems and ample practice, along with constructive and personalized feedback from previous problem sets, the quality of these problems and the rubric scores started to increase. They were better able especially to communicate about their solutions to the application problem. Table 1 illustrates the class rubric scores for bell-work problems.

Table 1. *Class Bell-work (BW) Scores*

	Bell-work Problem	Number of Participants	Math Component		Communication component	
			Mean	Standard Deviation	Mean	Standard Deviation
Pre-intervention	BW1	13	1.69	1.44	1.15	0.56
	BW2	15	2.6	1.4	0.5	0.7
	BW3	16	2.8	1.4	0.7	0.7
	BW4	14	2.4	1.4	0.6	0.8
Post-intervention	BW5	15	2.6	1.15	1.6	0.99
	BW6	14	2.9	1.4	2	1.1
	BW7	15	2.4	1.1	1.5	0.8
	BW8	15	3.1	0.9	2.6	0.9
	BW9	14	2.4	1.3	1.8	1.1
	BW10	14	2.9	0.9	2.4	0.9
	BW11	15	2.7	1	2.5	1.3

In general, there is a trend of higher scores earned after the implementation of the rubric feedback. The first four sets of bell-work problems were scored prior to the intervention. At that stage, students did not receive feedback regarding these sets of problems, so I expected for the mean rubric score, especially for the communication component, to be lower than the mean scores once the rubric was introduced to the students. In order to see the changes in the scores clearly, I compared with data from the first four bell-work problem sets and the last seven sets. The mean scores for the mathematics and

communication components before and after the intervention are shown in Figure 1.

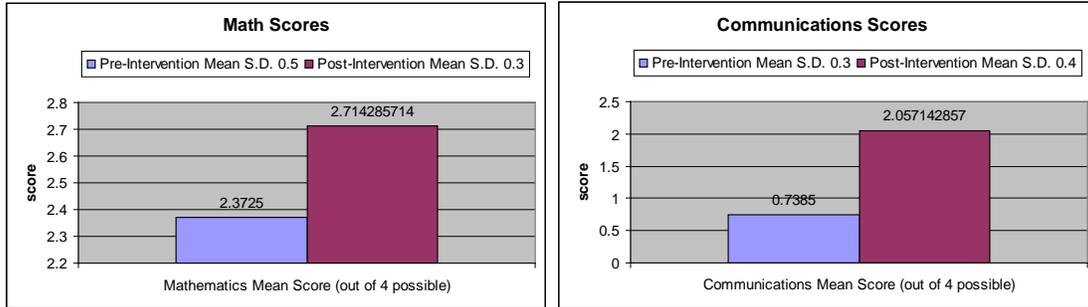


Figure 1. *Math and Communications Scores*

Figure 1 clearly shows the increase of scores, both for mathematics and communication. The increase for the communication component is much more drastic with an increase of 1.3 points for the mean score. The increase for the mathematics was only 0.34. I next wanted to better analyze the trend of higher scoring that I witnessed. I compiled the scores into a scatter plot in order to better see what happened to the scores throughout my research (see Figure 2).

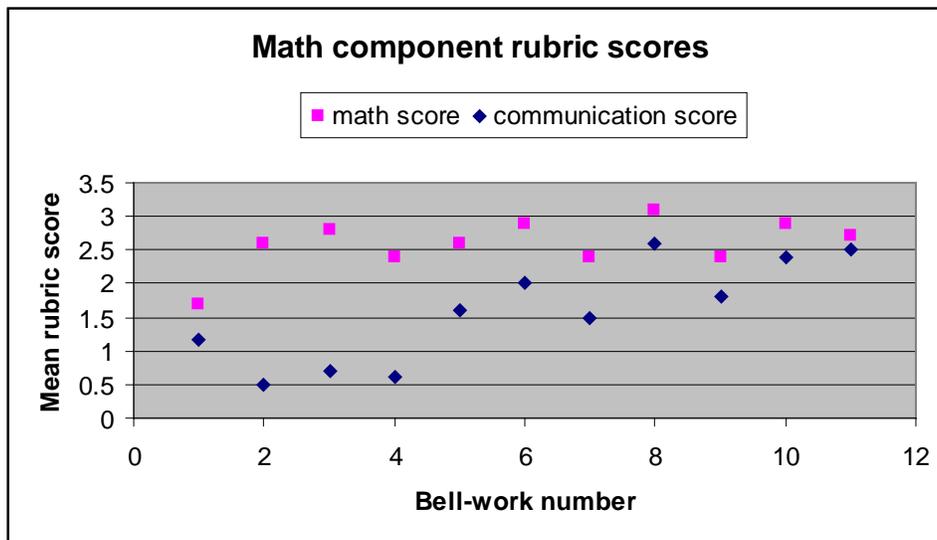


Figure 2. *Bell-work Component Rubric Scores*

Figure 2 clearly shows a trend of increasing scores for both components of the scoring. It is also interesting to point out that toward the beginning of the intervention, there is a large spread between mathematics and communications scores. This indicates that the students were able to correctly solve the problems, but were not able to adequately explain their solutions. As the students continued to practice and receive feedback, this gap began to close, indicating that they were more able to explain their solutions, while still coming up with correct answers.

There are some drops in both communications and mathematics mean scores. These results could be based on any number of factors. The difficulty of the material varied from one day to the next as each bell-work problem set represented its own mathematical skill. The way that problems were worded, especially in the problems that I chose to write myself, could have caused some confusion in what was being asked, causing lower scores for both math and communication. Other issues related to transferring problems from the ELMO incorrectly and not completing all of the required problems resulted in lower scores as well.

The main factor that could have been responsible for unexpected results was that of time. When I first introduced my students to the rubric, I allowed them a couple of entire class periods to practice writing, presenting and scoring solutions. Once the initial teaching was over however, students were expected to complete three problems (some being fairly complex) in addition to a well-

written solution to the application problem before learning the new material.

With 45-minute class periods, I certainly felt a time crunch, which probably had an impact on my students. I tried very hard not to rush them, but I know that some of them did not perform their best work because of time issues.

I tried a few different things in regards to time management with disastrous results. On the seventh group of bell-work problems, I tried to move the problem set to the end of class to see if that might make for a smoother class period. The following is from my March 27 teaching journal after this lesson:

I had a frustrating group of bell-work papers yesterday as no one scored higher than a "3" on communication, and most were 1's. The problem though, was that instead of giving them the problem at the very beginning of class, I gave the problems at the end of the class period and asked that they finish before leaving the room. I did not get papers from 2 of the students, and the rest I feel rushed through their work so they were sure to get it done. This is mostly my fault and I messed up the consistency of the intervention. I know now, that we MUST do these problems at the beginning of class, no matter what the circumstances are in order to have an accurate idea of their skills. Explanations had been getting better until this day. I hope we can get back on the right track.

Although there were some frustrations throughout this process, I was pleased with the increase of the scores for both components of the problems.

Both mathematics and communications scores rose, so not only were students better able to solve math problems upon the completion of the research, they were also more capable when explaining solutions. To showcase this improved ability, I compared students' communication pieces from before feedback was given to explanations turned in after the implementation of feedback.

I decided to look at one low-ability, one average-ability, and one high-ability student to see improvements in communication. Figure 3 shows examples of Danny's bell-work solutions.

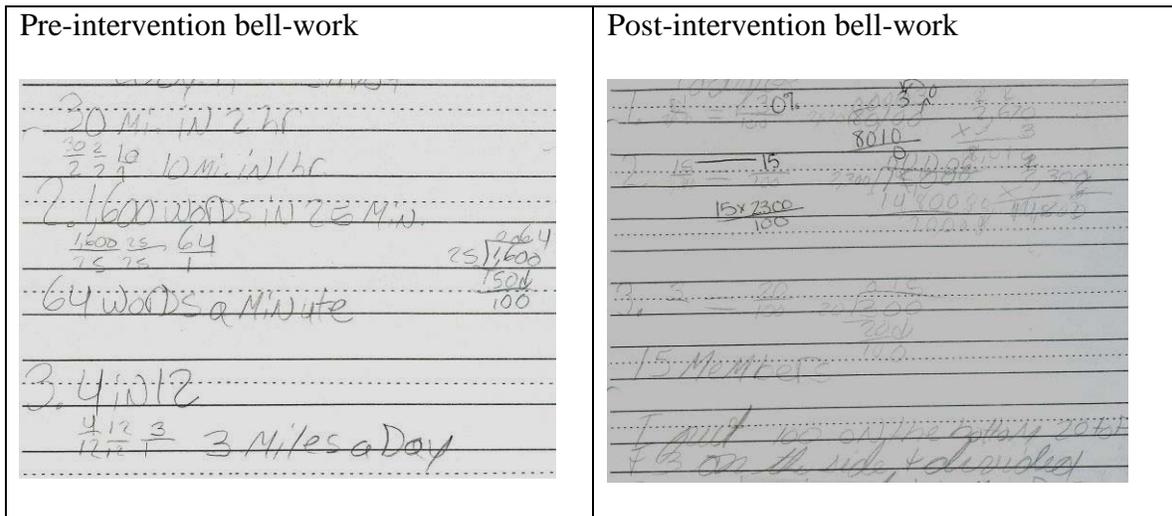


Figure 3. *Danny's pre- and post intervention bell-works*

Although the post-intervention communication piece only scored a "1" in Communication, an explanation, "I put 100 on the bottom 20 top and 3 on the side and divided 20 divided by 300 is 15. That is my answer," is clearly an improvement from no written communication as in Figure 3. Danny is a low-ability student with poor self-confidence in all areas, especially in math. For this

With Adam, a high-ability student, I wanted to provide feedback that would help him improve his solutions, which were of above-average quality even before introducing feedback. Figure 5 shows examples of his improvement.

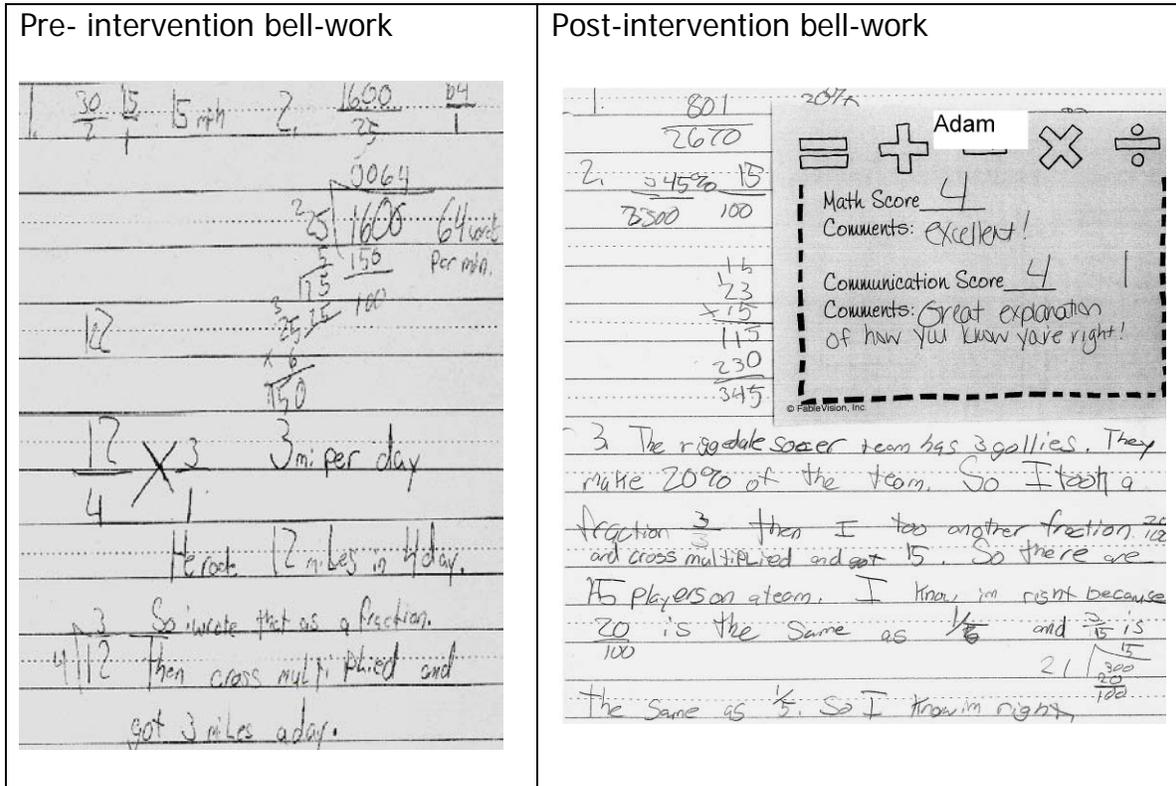


Figure 5. Adam's pre- and post-intervention bell-work

My goal with Adam was to help him to express how he was able to determine whether his solutions were reasonable. Although he wrote about how he solved the problem in pre-intervention bell-work, he did not include information about how he knew his answer was correct (see Figure 5 left). In his later work, he began elaborating on his thinking. In post-intervention bell-work,

he states, "I know im [sic] right because $\frac{20}{100}$ is the same as $\frac{1}{5}$ and $\frac{3}{15}$ is the

same as $\frac{1}{5}$. So I know im [sic] right." (see Figure 5, right) This showed me that he knew how to logically think through the reasonability of his solutions.

It is clear from these typical cases and the data obtained from average rubric scores, the communication about problems increased. Some students improved more than others. One of the main factors contributing to this improvement was the fact that, once the rubric was implemented, students had a clear sense of what was expected from them. In addition, students were also given sample solutions as a model and guidelines to follow when writing about math. However, it's difficult to tell whether the feedback, the sample rubric and solutions, or a combination of the two led to this improvement.

What Will Happen to the Level of Student Performance on Daily Assignments Once Rubrics are Implemented as an Instrument Providing Feedback?

In order to answer this research question, I purposely selected a couple of students to track their progress on daily assignments during this intervention. I wanted to see if the improvements made on the bell-work problems would translate into improvement on daily assignments as well. Six students with various levels of ability were carefully chosen based on their previous assessment and classroom performance. The two lower-ability students were Danny and Britney; the two average-ability students were Allison and Kylie; and the two high average-ability students were Adam and Marisol. Since I began using the rubric and feedback system with the students on March 17, I was looking for any

differences in scores prior to that date compared with after the system was in place. Figure 6 shows the situation of two lower-ability students' daily homework performance:

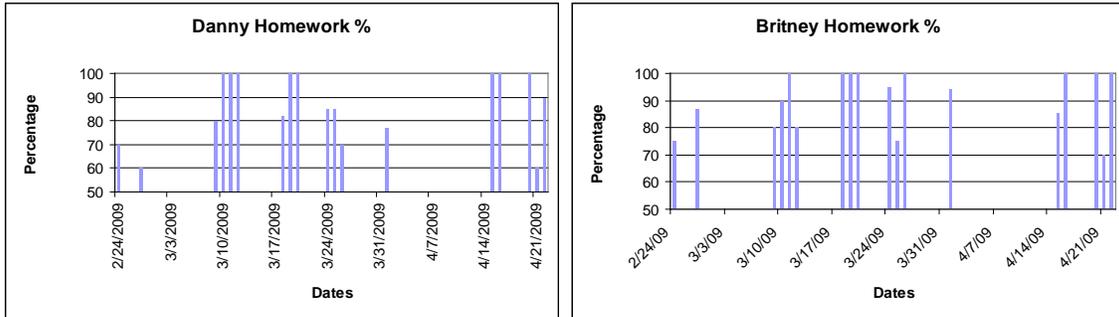


Figure 6. *Danny and Britney Daily Homework Scores*

It appears that Danny may have improved initially after the feedback system was used, but it was not a permanent improvement. In Britney's case, she received more 100% scores after the intervention than she had before, but there are also some lower scores. The data does not clearly show the difference between and after the rubric was implemented in students' daily work. Figure 7 shows two average-ability students, Allison and Kylie's performance change.

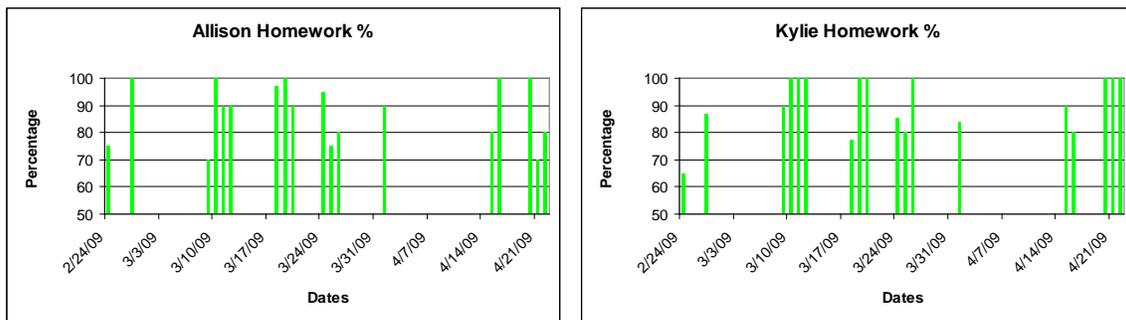


Figure 7. *Allison and Kylie Daily Homework Scores*

In looking at the work of these two girls, I am also left without many conclusions. Allison was inconsistent in her scores before and after the

intervention, as was Kylie. It is difficult to determine the trends in daily work for this group of students as well. Figure 8 tracked two high-ability students, Marisol and Adam:

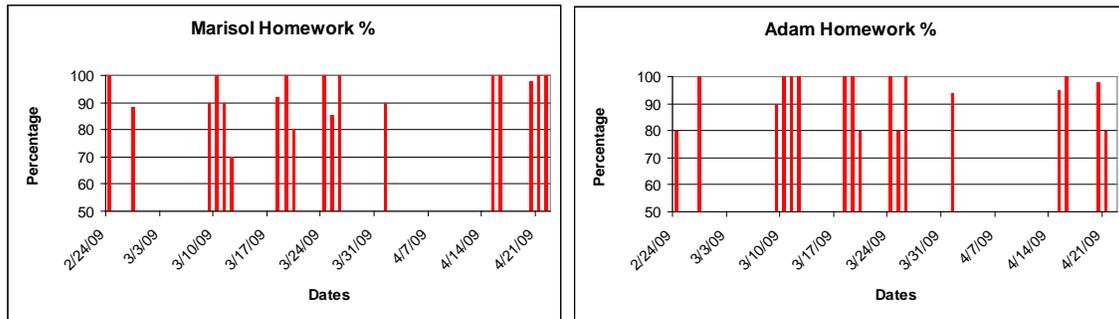


Figure 8. *Marisol and Adam Daily Homework Scores*

It appears as though Marisol benefited from the feedback system toward the end of the intervention, as all of her scores were above 95%. Most all of her lower scores came prior to the intervention, so it appears that the feedback has caused an increase in the quality of her daily assignments. However, in Adam's case, it appears as if he did better work before the intervention. Variables that caused this data to be inconclusive need further exploration.

My system of grading may have been one that did not help in the conclusiveness of the data. I only score about five problems on normal, daily book assignments. The remaining points are what I call participation points that come from the amount of effort put into the assignment based on the overall completion and the amount of work and calculations shown. The total point value for these assignments is 10 points, which cause for extremely high scores or extremely low scores depending on the situation.

Another possible reason of my inconsistent findings regarding the daily homework is related to the nature of the assignments. Each lesson was practice over an isolated skill which changed on a daily basis. If the concept were one that was seen by the students as "difficult", then the scores might reflect the difficulty of the lesson rather than the results of the intervention. It would be easy to say that the more difficult concepts caused lower scores, but that may in fact be completely false. It is possible that for the more difficult assignments, these students chose to get help from a teacher or parent, or took it upon themselves to put forth more effort and time, possibly resulting in a higher grade. Perhaps it was the "easy" assignments that were the lower grades due to over complacency or just rushing through work.

Another factor that could have affected my results was in the inconsistencies of math class and assignments during this semester. At the beginning of March, students from the college began coming in to teach art to all of the elementary students. Because of this, my afternoon (sixth grade) math classes were both shortened to 20 minutes. The result of this shortened time for class was that the students often times were not instructed over new material, nor did they have time to complete bell-work problems. Most of the time, all that was completed in this short time was a discussion over the previous day's assignment.

In addition to shortened schedules do to art class or other assemblies, illness, school activities or athletic events, several instruction days were taken

away for vacations or testing. During the dates of my action research, the elementary school had a three-day Spring break, two-day parent-teacher conference, three-day Easter break, a day for a sixth grade field trip, as well as a day off for students so teachers could attend the state reading conference. Although we all needed a lot of these vacation days in order to make it through the school year, it made it difficult to accurately and consistently collect data for this project. Furthermore, I spent three days reviewing and assessing for No Child Left Behind (NCLB), as well as six days reviewing and assessing for the Terra Nova. Between the breaks and tests, there were many pauses in mathematics instruction.

Although it may be difficult to use daily scores to determine the effectiveness of the feedback, observations made by me throughout the intervention lead me to assert that students did see an increase in their skills as a direct result of receiving individualized feedback from me. The following was taken from a journal entry dated March 20, where I was discussing the overall confidence level and attitude of the class:

I have been hearing that percents are easy, which makes me smile as I have heard the opposite in years past. I have heard a lot of, "this is pretty fun", which surprises me when I hear it coming out of a 12 yr old mouth. I tell them I think it's fun too. I have seen some hands go up this week that hardly ever are raised, which leads me to believe that the confidence level as a whole has gone up.

Through my interviews with five students, I learned that the kids had many positive things to say about the use of the rubrics and feedback. When I asked the group of students being interviewed about how I had begun using rubrics this semester, before I could even get to the question about their feelings on the chance, all five students there began raving about how they liked the system put in place for this action research. When Allison was asked how she felt about receiving daily feedback on problems, she commented, "I really like (the feedback)... you work it out again so if we get it wrong, we can see what we did wrong." Kylie added, "I like the part of it where the feedback could tell you what you get wrong and how you did it wrong." All of the students interviewed appreciated the work I had put into helping them find their mistakes and suggestions I had made to help them on future problems.

Although it is difficult to determine what happened to students' daily assignment scores based on the use of the bell-work problems and rubric feedback, I do have evidence that students responded positively to the intervention. Neither Kylie nor Allison, for example, showed improvement on daily work after the implementation of the rubric scores; however both girls had admitted in interviews that the feedback has given them guidance when they are struggling. Because the students have some direction when making mistakes, they know better how to correct those errors, resulting in a higher rate of success and a positive attitude.

What Will Happen to My Teaching When I Implement Scoring Rubrics and the Use of Specific Feedback in an Effort to Improve My Students' Mathematics Abilities?

Before I could effectively use the rubric, I first needed to familiarize my students with the rubric and the expectations of bell-work problems. They needed to practice writing solutions clearly and also had to get used to receiving feedback from me and deciding how to use that feedback. My job was to help them learn to use the rubric and the feedback given as an instrument to improve their math skills.

It was a daily challenge to find the time required to give students to complete bell-work problems as well as the time necessary to appropriately score the papers. Depending on the particular lesson, it might take up to 20 minutes for each student to complete the task of solving the three problems and writing a thorough explanation for the application problem. I thought that it was important not to rush them and to give them the opportunity to work as long as necessary, but I sometimes found myself needed to make up that time lost. The consequence may have been not covering the new material as I may have with more time.

As the project went on, I noticed that like the students, I became more proficient in the use of the rubric. As I explained in a March 27 personal journal entry, "I am becoming more confident in using the rubric. I am able to easily determine a score without referring to the rubric as often, making it easier to

work in an efficient manner when scoring papers." Each day that I scored papers, I found myself more familiar with the requirements of each particular scoring level and could score papers more quickly. Because of this, I found myself giving more written feedback toward the end of the project as I had extra time to do so. My skillfulness of providing feedback with increased quality could have been a factor that contributed to students' enhancement of their work.

Although I think I ended strongly with my project, I wish I would have been more efficient with my feedback system at the beginning. I often found myself struggling with the most efficient manner in which to have my students complete the bell-work problems. This frustration was expressed in my journal on April 3, "I need to continue working out the kinks in time-management. What could the students who finish bell-work early be doing while waiting on their classmates? I don't want to do something that would make them want to rush through their explanations."

My assertion for the question of what happened to my teaching as a result of this project is that I was able to better pinpoint the successes and frustrations of my students, which allowed me to better guide them through my teaching. As a result of scoring these problems, I was able to see common mistakes and would take time to address these errors in class. If only one or two students struggled on a particular skill, I was able to work one-on-one with those students in order to address any questions. The scoring of these problems assisted me in managing my time more effectively when it was time to review for a test. I was

able to allot more review time with areas that I noticed were missed more often making the review more helpful to the students.

In general, students were better able to perform work on and explain mathematics bell-work problems after the implementation of the rubric feedback. As seen in the student samples, they became increasingly comfortable expressing their solutions through writing and became more active participants in classroom discussions. Students upon the completion of the project were asking more specific questions to aid in understanding rather than blurting out, "I don't get it." The student-teacher relationship became closer and more positive throughout this process as I was better able to diagnose individual problems and assist the student one-on-one.

Conclusions

My action research focused on using rubrics to provide effective feedback to sixth grade math students. This study contributes to this field in unique ways. First, my study focused on the use of rubrics as a feedback device and there was a limited amount of previous research concerning this specific tool. Second, as a teacher researcher, I was able to investigate feedback from a new angle and was provided deeper insights into this issue. Third, there was a lack of prior information and research on the use of feedback in a middle school mathematics classroom.

Because of this research, I found myself becoming a more informed teacher. I better understood the capabilities of my students and knew better how

to assist them in meeting learning objectives. Rodgers (2006), has performed international research and written articles about the positive outcomes of descriptive feedback on learning and teaching. In an article describing descriptive feedback and drawing on her past experiences working with teachers and students using effective feedback, she witnessed what she referred to as, "A shift from seeing teaching, self, and the curriculum as primary to seeing students and their learning as central" (p. 228). Although I did not focus on the implementation of curriculum in this research, I have noticed a shift from self to student learning. Overall, I have found that feedback is beneficial to teachers and students.

Throughout this project, I found that I have grown incredibly to provide individualized feedback to students, which helped build a closer relationship between students and me, allowing students to come to me for help more easily. As many researchers (e.g., Marzano et al., 2001; Bangert-Drowns et al., 1991) pointed out, one of the main characteristics of effective feedback is specificity, which could lead to improved student performance. In my action research, students were given specific interventions to combat future struggles as well as individualized dialog based on his/her strengths. These personalized instruction, clarification and advice enhanced their learning. Meanwhile, my teaching also became more effective and differentiated due to this personalization. A result of this feedback is a deeper, more positive relationship with the teacher which in turn, increases the self-esteem of the students. As Rodgers (2006) suggested,

the importance of a partnership between students and teachers sharing a common goal: student success.

Through this action research, I also found that the implementation of a rubric provided me a tool to more effectively diagnose mathematic struggles which I could then re-teach or come up with personalized interventions. These bell-work problems were more reliable indicators of what students knew than homework, tests or quizzes. As Nicol and Macfarlane-Dick (2006) concluded, teachers should generate information about students by, "setting assessment tasks, by questioning students in class and by observing student behaviour. Such information helps teachers uncover student difficulties with subject matter and study methods" (p.214). In my action research, I was able to learn a lot about my students and their mathematical ability by analyzing work on the bell-work problems. Because of the feedback given to them, my students had better information about their own skill level and strategies to help them improve upon specific concepts. Nicol and Macfarlane-Dick added that good feedback practice is not only about providing students with usable and accessible information to improve their learning, but also is about giving good feedback to the teacher. Effective feedback can better provide teachers with information on how students are performing than can most formal assessments. Teachers use information received from students to help determine how instruction should proceed.

I have always been a believer that students who can explain the process of solving a problem can also solve the problem. This thinking has been altered a

bit through this project as I have found that students, who can explain to me orally how to solve certain problems, are not always able to do so independently. The use of effective feedback in my classroom has assisted me in better knowing the abilities of my students. According to Nicol and Macfarlane-Dick (2006), teachers need good data about how students are progressing in order to produce relevant feedback that meets the needs of students. I have learned that I need to combine conversations and dialog with students with their written attempts at a problem so that I can better learn about their struggles and areas of strength. I can then in turn, help them become a better math student by providing them more differentiated instruction and specific, meaningful feedback.

Implications

In this study, I have seen the overall positive impact that effective feedback has on student learning. The students involved in my action research were seen carefully reviewing handed-back material containing feedback. They would read through my comments and look back over their mistakes. I would often hear comments such as, "Oh, now I see what I did wrong". Contrarily, students in my other classes would simply check the score written on the paper and proceed to throw the graded assignment into the trash. There was nothing helpful offered by me in terms of feedback, therefore most students saw no value in the paper.

In terms of my teaching next year, I plan to continue providing effective feedback, in some form, on a daily basis. I anticipate that this process will evolve

as I work through the year and try different strategies based on the situation. Since I will be teaching in a self-contained classroom setting, I will be responsible for scoring and analyzing a much smaller number of daily math papers. It would be far too time consuming to provide feedback for every problem on each assignment, but a system of scoring a small sample of problems and providing specific feedback on those few problems, could provide benefits to my students.

Because of this study, I have also altered my thinking and am no longer satisfied to think of a score or letter grade as meaningful feedback. I plan to take what I have learned through this project and make it work for me and my students. I see this as being a long-term and frequently-changing process as I continue to improve the effectiveness of my teaching while striving to meet the needs of each of my students.

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Appendix A

“Bell-Work” Rubric

Score	Mathematics/Computation	Communication (Application problem)
4	<p>I have the correct answers and labels (if appropriate) to all 3 problems</p> <p>I have no computation errors</p> <p>I have work to show how I got my solutions</p>	<p>I wrote HOW and WHY I solved the problem as I did</p> <p>I explained WHY my answer makes sense</p>
3	<p>I have the correct answers to at least 2 problems</p> <p>I have very few or very small errors in computation</p> <p>I have work to show how I got my solutions</p>	<p>I wrote about HOW I came up with my answer, but not enough about WHY I solved the problem that way</p> <p>I explained WHY my answer makes sense</p>
2	<p>I have the correct answers to at least 1 problem</p> <p>I am making computation errors, which are causing me to get incorrect solutions, but I know how to perform the skill</p> <p>I have some work</p>	<p>I wrote a little about HOW or WHY I came up with my answer</p> <p>I somewhat explained why my answer makes sense</p>
1	<p>I did attempt every problem, but have no correct solutions</p> <p>I have little or no work to back up my answer</p>	<p>I wrote very little about HOW I solved the problem or somewhat explained why my answer makes sense</p>
0	<p>I did not attempt to work each problem</p>	<p>I have no writing about the problems</p>

Additional Comments on Mathematics and Computation:

Additional Comments on Communication on Application problem:

Appendix B

“Bell-Work” Sample Communication

A package of pretzels has 4,950 calories and 450 milligrams of sodium. If each pretzel has 33 calories, how many milligrams of sodium does each pretzel have? From Houghton Mifflin Mathematics: Level 6 (Greenes et al., p. 315)

Sample “4” Communication:

I want to know how much sodium each pretzel has. I have already been told that each package has a total of 4,950 calories and a total of 450 milligrams of sodium. I also know that each pretzel has 33 calories. Since the whole package contains a total of 4,950 calories and each pretzel has 33 calories, I can divide $4950 \div 33$ to find out how many pretzels are in each package. $4950 \div 33 = 150$, so there are 150 pretzels in each package. If there is a total of 450 milligrams of sodium in the entire package, and I know that there are 150 pretzels in the package, then I can divide $450 \div 150$ to see how many milligrams of sodium is in each pretzel. $450 \div 150 = 3$ so that means that each pretzel contains 3 milligrams of sodium.

I think that my answer makes sense, because when I look at the measurements for the entire package, I noticed that each package contains about 10 times the number of calories as it does milligrams of sodium (4950 is about ten times bigger than 450). When I look at the measurements for each pretzel, I also see that the amount of calories is about ten times bigger than the amount of sodium (33 is about ten times bigger than 3).

Sample “3” Communication:

I want to know how much sodium is in each pretzel. I know that there are 4,950 calories for all of the pretzels in the package, as well as 450 milligrams of sodium. I also know that each pretzel has 33 calories. I divided $4950 \div 33 = 150$. Then I took $450 \div 150 = 3$ so there are 3 milligrams of sodium in each pretzel.

My answer makes sense because if there are 150 pretzels in the bag, and each one has 3 milligrams of sodium, then the bag would have a total of 450 milligrams of sodium.

Sample “2” Communication:

The question is: how many milligrams of sodium are in each bag so I divided $4950 \div 33 = 150$. Then I took $450 \div 150 = 3$. There are 3 milligrams of sodium in each pretzel.

The amounts of sodium are less than the number of calories, so my answer makes sense.

Sample "1" Communication:

I divided $4950 \div 33 = 150$. Then I took $450 \div 150 = 3$ milligrams per pretzel.

Sample "0" Communication:

$4950 \div 33 = 150$

$450 \div 150 = 3$

How to write up a math problem: (First, I like to solve the problem mathematically)

1. **Tell why you are solving the problem.** What is the question asking you to find? Try to restate it in your own words so it makes sense.
2. **Tell what information you are given.** What do you already know? How can that information help you solve the problem?
3. *******Tell about HOW you are going to solve the problem and about WHY you are doing it that way.******* You should use the word "because" (or something similar: "Since", "If/Then") to explain how your work is going to help you get the answer you want. Restate the computation problem you solved: Don't say, "I multiplied", instead say, "I multiplied 12×24 to find out how many hours are in 12 days since there are 24 hours in each day".
4. **Answer the question.** Go back up and reread the question and make sure your solution answers it. Use a complete sentence. Include any appropriate labels.
5. **Go back and check to make sure your answer is reasonable.** DOES YOUR SOLUTION MAKE SENSE? Prove it!! Is there a way to double-check your work to make sure your computation is correct? Using more than one explanation of proof is even better!

The goal of writing up problems is to have a solution written that could be used to TEACH someone else how to solve the problem. I need to be able to clearly see that you understand the problem and your work. I should be able to follow you step-by-step through the entire problem by reading your paragraph(s).

Writing about math takes practice. I am looking for *improvement* and do not expect everyone to get all "4s" for every single problem, however it should be your goal to *try* to get a "4" each time.

Appendix C

Student Interview Questions

- How do you tell if you understand a lesson?
- How do you think a teacher knows if you understand a lesson?
- What action do you take when you miss problems on your assignment? Why?
- What do you feel is the purpose of daily homework? Do you think this is the same purpose teachers have when they assign daily homework? Explain.
- Do you feel that the “bell-work” problems are helpful? Why or why not?
- If you were in charge of taking grades for this class, how would you do it? Why?
- Do you think your grade shows how you perform in math? Why or why not?
- This semester I have changed some of my teaching practices, especially related to how I give feedback on written assignments. What advice would you give me about continuing these changes next year?
- What would you tell someone who is new to our class what it takes to be successful in this math class?
- Is there anything you want to know from me?
- Is there anything else I should know about you to better understand your thoughts about math and assessment?

Appendix D

Personal Journal Prompts

- Have I noticed any changes in the amount and/or quality of student responses and questions during the daily lessons?
- Have I noticed any changes in the amount of problems missed on daily assignments?
- Have I noticed any changes on the accuracy of student responses to the “bell-work” problems from the previous day’s lesson?
- Have I noticed an increase in students’ abilities to explain answers?
- Are the students able to pinpoint at least one thing that is going really well this week as well as one area where they need to work a little harder?
- Am I noticing an increase in comfort level in the mathematical abilities of my students?
- What are MY strengths this week and areas that I need to continue working on in my teaching?

