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Forgetting to Remember: Formative Assessment in Sixth Grade Mathematics Classroom

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Abstract

In this action research study of a sixth grade mathematics classroom, I investigated what would happen to the students' understanding of mathematical concepts and what student learning would look like when multiple formative assessments were implemented and descriptive feedback was given by the teacher. I also examined how my own teaching would be affected when I utilized descriptive feedback on formative assessments in attempts to decrease the number of retakes needed on summative assessments. I discovered that my students were better prepared for summative assessments when multiple formative assessments were implemented and when I utilized information from the formative assessments to frame the teaching and re-teaching of concepts in my classroom. I found that I was given more opportunities to communicate with my students about their strengths and weaknesses through the use of descriptive feedback. I believe that the characteristics of my research project led to giving me a deeper understanding of my students' mathematical proficiency. As a result of this research, I plan to implement portions of my practice with new classes of sixth grade students. I am interested in implementing these strategies in other subject areas, such as science or language arts.

Introduction

Throughout my teaching career at my present school, I had noticed a problem with the students' retention of concepts during summative assessments such as quizzes, chapter tests and criterion reference tests mandated by the school district. Every year I seemed to have students that glided through class each day. They'd take their notes from my direct instruction, complete in-class activities, but then "forget" how to do problems on tests and quizzes. In some instances those students had accountability issues. They did not work to their potential and did not take responsibility for their own learning. This made it extremely difficult for them to have any success in the classroom. I found myself holding up the entire group to get these students organized and on track with the lesson. They did not perform well on homework and often had difficulties turning it in on time, if at all. When they were absent they conveniently forgot to make up their missing work. These students were not performing well on formative work such as daily homework or in-class assignments, which then led to their downfall on summative evaluations.

I had experienced tremendous diversity in my school's population. The enrollment for the school in the 2008-09 academic year was 859 students. This included sixth, seventh, and eighth grade students. Within this student body many ethnicities were represented. Table 1 below shows the ethnicities and the percentage of the population that they embodied. Of our student population 55% of them participate in the Free or Reduced Lunch Program and 13% of the total population is identified as gifted.

Table 1.
Student Diversity Percentages at present school in 2008-2009.

Ethnicity	Percentage of Total Student Population (n=859)
White	59%
Native American	2.3%
African American	18%
Hispanic American	13.7%
Asian American	6.8%

In previous years I had taught sixth grade general math and had come to expect this mix of students from various at-risk backgrounds. About half of my students came from low-income families and around one-fourth of them had English Language Learner (ELL) accommodations. I realized that because of their backgrounds it was understandable why they had trouble with formative assignments. It seemed that without active parental involvement, with an increased likelihood of violence in the home, and with a lack of appropriate role models, students would have difficulties in meeting expectations in the classroom. However, this year I taught a section of sixth grade math for high achievers. Naively, I expected that this group of gifted young mathematicians would be different. I envisioned that their homework would be understood, turned in, and completed the day that it was due. I thought that this class would be ready to learn and take responsibility for their learning. I was ready to see test grades that reflected the understanding that was shown on their homework. In short, I expected a lot. However, again I had a group of students that struggled to get homework turned in, failed to get assistance with misconceptions that were present and performed unsuccessfully on summative assessments. I was ready to implement strategies that would help students recognize where they needed assistance before a summative assessment was offered to them.

According to the National Council for Teachers of Mathematics (NCTM) (2000), assessment was supposed to “furnish useful information to both the teacher and the students” (p. 22). However, I was not getting an accurate representation of what my students could do because they were having difficulty retaining information. This issue stemmed from the inability of my students to organize their mathematical thinking. The NCTM also explained that “learning with understanding is essential to enable students to solve new kinds of problems they will inevitably face in the future” (p. 21). When the students did not understand mathematics conceptually then they were not able to communicate their capabilities to me during summative assessments. I needed students to be able to show how and why concepts and methods were implemented and communicate this as needed. I needed them to retain information by making connections to prior mathematical knowledge. I did not want math to be a set of arbitrary rules that my students memorized, but instead a tool that they could retrieve for use, at will.

My topic of inquiry attempted to alleviate this discouraging situation. I implemented multiple types of formative assessment into my classroom instruction. I felt that multiple hits on a topic would “cram the knowledge” into their heads, as Scott, a student in my classroom during the research project, had said. Not only did I try a variety of assessment techniques, but I also gave descriptive written and oral feedback to the students regarding their progress toward reaching their goal of understanding. Then, I analyzed the influence that the implementation of these strategies had on my students’ understanding and their learning process as well as my own teaching.

In my ideal classroom my students would ask for help if needed and understand that when they perform poorly on formative work they needed to look for assistance before the summative assessment was placed before them. I wanted my students to understand their mistakes and persevere to arrive at the correct solution. I was looking for strategies that would support the development of prepared, responsible students who were ready to meet challenges and take them on instead of avoiding them. This was how I came to select my topic of inquiry. I felt that I needed to change my teaching methods

considering I had the same problem across different groups of students with varying math proficiency levels. I was having the same scenario occur year after year, and since I could no longer place blame on an at-risk population of students, as the group this year was high achieving, I knew an adaption to my teaching needed to be made.

Another factor that played into the selection of my research topic was a presentation given at a monthly staff meeting in my building. During these meetings improvement of student achievement was always the goal. At one particular staff meeting in the fall semester one of our administrators presented some interesting facts regarding how to raise the level of concern in our students about assessment. One of the pieces of information shared was that the use of descriptive feedback on assignments instead of just a score alone could assist in the process. I found this quite interesting and decided to incorporate it into my action research plan.

Problem Statement

The ability of students to retain information for future use is worthwhile in any subject. Specifically it is essential in mathematics because concepts build upon each other as a student progresses through a curriculum and courses. If a student struggles with retaining information it can lead to their detriment as successful lifelong learners. The students could have a feeling of ineptitude that will carry through their high school and college years of learning. When students struggle with retaining information, their confidence levels decrease, which could result in a lack of effort shown on learning mathematics. Students that are confident in their abilities tend to put forth effort because they believe that they will succeed, whereas a student with a feeling of incompetence tends to give up easily.

I wanted to implement other formative assessments besides the use of homework to assist in the retention of concepts. When students retain the information needed and then are successful on summative assessments, their confidence levels increase. By using alternative techniques as well as adding them to the use of homework, students will be exposed to the concepts again and again. As

Norton Juster, a children's author and a Professor at Hampshire College, said, "Practice makes permanent." I expected that my students' mathematic skills and understanding would increase automatically when they experienced more than one type of formative assessment.

The use of descriptive feedback also was a boost to their confidence level. Giving the students a written or oral "pat on the back" for a solid effort instead of only a numerical ranking at the top of a paper was an instant confidence builder. Again, by building this confidence more effort is exerted and this all then leads to a better understanding of the material. The descriptive feedback also gave students an opportunity to fix their mistakes. From comments given by the teacher, they could analyze their errors and improve upon them. When errors in their thinking and calculations were pointed out and then either explained or questioned, the student seemed to raise their level of concern regarding the topic. They became more aware of their problem and worked to improve upon it. This increased level of concern and awareness of errors also led to a more competent student of mathematics.

This problem with retention plagues our schools nationwide. High-stakes testing is becoming more and more prominent in our school across curricular areas. As stakeholders in the education of students we need to implement strategies that work to counter the inability of students to remember concepts during these times of testing. As parents of these students, we need to be aware of the gaps in their learning and work to rectify the damage done by previous years of "cramming" without retention. In this action research project I explored what happened to students' retention of material when the use of multiple formative assessments and descriptive feedback were put into place.

Literature Review

Assessment has been identified as a "particular feature of high-quality mathematics education" (NCTM, 2000, p. 11). We are told by the NCTM (2000) that the assessment principle is a part of "a vision to guide educators as they strive for continual improvement of mathematics education" (p. 11). Although it is agreed upon that assessment can be classified as formative or summative, there is a

debate regarding the correct use of these two types of assessments. The ability of these data gathering devices to give worthwhile feedback on the progress of students also has been challenged. The ultimate goal of my research was to increase a student's ability to retain information through the use of multiple formative assessments and descriptive feedback. In my own teaching I did not feel that I had adequately used formative assessments for what they could potentially accomplish in the classroom. This project gave me the opportunity to intentionally implement this learning instrument to benefit student learning. In this section, I reviewed literature focusing on three aspects: formative assessment, teacher feedback, and student retention of information.

Formative Assessment

William and Black (1996) gave detailed accounts of the researchers, Michael Scriven, B.S. Bloom, J.T. Hastings, and G.F. Madaus, who first used the terms "formative evaluation" and "summative evaluation" in their articles. Formative assessments were defined as a "type of evaluation which all who are involved…would welcome because they find it so useful in helping them improve what they wish to do" (p. 538) and summative assessments were explained as "assessments given at the end of units that judge the extent of students' learning of the material in a course" (p. 537). William and Black explained tensions that arose between the two types of assessment and suggested sources of improvement for this dilemma. These researchers also explained that teaching successfully depended on how well a teacher used information from previous formative assessments. The teacher must modify his or her teaching to accommodate for the students involved.

Teachers use formative assessments to gather evidence of what the students know and improve their learning. Tunstall and Gipps (1996) developed a study that took place in six different schools among eight teachers and 49 students in the first and second grades. This study looked at the understanding and perceptions of feedback's part in formative assessment among these participants. Tunstall and Gipps found that certain types of formative assessment were more likely to encourage the

students to learn the material. These types of assessment were able to build collaborative relationships between teacher and students through various methods of discussing work. Based on these findings, Tunstall and Gipps explained that formative assessment "is that process of appraising, judging or evaluating students' work or performance and using this to shape and improve their competence" (p. 389). It is noteworthy that similar to Wiliam and Black, Tunstall and Gipps used the word "improve" in their definition of formative assessment.

The type of formative assessment that is being used in a teacher's practice may or may not have a positive influence on students' learning. Torrance and Pryor (2001) categorized different approaches of formative assessment as "convergent" and "divergent" based on the exploration of how the teachers of 5- to 7-year-old children used knowledge gained from formative assessments in their classroom settings. According to Torrance and Pryor, in convergent assessment the focus is on finding out "if the learner knows, understands or can do a predetermined thing" (p. 616). The foundation of convergent assessment is behaviorist. Therefore, the assessment is done by the teacher on the student. For example, a teacher might give a survey to the students to find out "if" they know information. On the other hand divergent assessment takes on a more constructivist approach. The essential goal is to find out "what the learner knows, understands, and can do" (p. 616). Since the goal of formative assessment is to improve student learning, the use of divergent assessment is more effective because it is insignificant to determine "if" the student knows the material. Instead, focusing on "what" they know can essentially lead to more specific adaptations to teaching strategies that are suitable for the learners.

The type of assessment that I used in my action research project was "a part of instruction to support and enhance learning" (Shepard. 2000, p. 4), rather than simply giving a student a grade in class. Shepard focused her article on the historical background of assessment and the need to change current assessment practices to adhere to constructivist teaching theories. She discussed the importance of moving toward a broader range of assessments that were part of the learning process instead of

separate from it. Indeed Rick Wormeli (2005), provided detailed types of formative assessment in the book “Summarization in Any Subject,” including journal writing, graphic organizers, summarization pyramids, and the use of summary ball. These activities greatly inspired my action research and will be elaborated on in my methods section. These activities were used in my project as, “assessments for learning” (Shepard. 2000, p. 9), which counter the high-stakes testing practices that often reap negative effects on student learning. Using this type of “dynamic (and) on-going assessment” (p. 10) is intended to make a shift in classroom practice that puts assessment into the instructional process instead of only at the end as an afterthought. As Shepard explains, assessment completed during the learning process allows teachers to find out what a student can do by themselves as well as with guidance from the teacher. Teachers can use this information to determine their next steps in teaching.

Black and William (2003) explored how teachers can effectively carry out formative assessments to improve student achievement. The researchers used training sessions and observations to encourage 24 secondary mathematics, science, and English teachers to use what was identified as “good formative assessment” (p. 630). The teachers were given complete control over which techniques to use and believed to be appropriate. They found that a boost in the “students’ mindfulness” (p. 631) was part of the reason why formative assessment worked. When students were made aware of formative assessments it often yielded positive results. Along with an increase in teacher collaboration and communication when carrying out the research, the researchers noticed that the teachers needed to “own” their instructional methods. They adapted formative assessments to fit into their classrooms, which improved the course of learning for their students. These research suggestions provided guidance for my own action research.

Formative assessments are beneficial to the learning process for students. Increased communication between students and teachers was considered to be a positive result of formative assessment according to Tunstall and Gipps (1996), where as Black and Wiliam (2003) found that the

educators were more likely to work together in using this type of assessment practice. Torrance and Pryor (2001) agreed with Shepard (2000) that formative assessments helped educators determine where their students were in the learning process as well as told them where to go next.

Descriptive Feedback

An important feature of an effective formative assessment is to provide descriptive feedback, according to Nicol and Macfarlane-Dick (2006), who pointed out that "assessment … is specifically intended to generate feedback on performance to improve and accelerate learning" (p. 199). Therefore the use of descriptive feedback weaved its path through my action research project. Nicol and Macfarlane-Dick highlighted the benefits of formative assessment and feedback as leading students down a road toward evaluating themselves, instead of merely allowing a teacher to evaluate them. These researchers argued that educators as a collective whole preach about allowing students to take control of their own learning, yet educators hinder students' progress by denying them a way to "regulate their own learning" (p. 215). As a result Nicol and Macfarlane-Dick suggested "seven principles of good feedback practice" (p. 205) to assist students in this process as described below:

1. helps clarify what good performance is;
2. facilitates the development of self-assessment in learning;
3. delivers high quality information to students about their learning;
4. encourages teacher and peer dialogue around learning;
5. encourages positive motivational beliefs and self-esteem;
6. provides opportunities to close the gap between current and desired performance;
7. provides information to teachers that can be used to help shape teaching (p. 205).

Nicol and Macfarlane-Dick explained that an investigation conducted by Gibbs and Simpson (2004) showed that "if students receive feedback often and regularly, it enables better monitoring and self-regulation of progress by students" (p. 209). According to Nicol and Macfarlane-Dick, giving information

to the students about their learning encouraged the students to become a stakeholder in their education, and students were more likely to address misconceptions and check themselves for understanding.

Kulhavy (1977) reviewed previous research on student performance when feedback was implemented. In this study, feedback was defined as "procedures that are used to tell a learner if an instructional response is right or wrong" (p. 211). Based on reviews, Kulhavy, concluded that, "supplying feedback after an error is probably far more important than providing confirmation" (p. 221). Kulhavy explicitly highlighted the "delay feedback" set up by Anderson's (1972) study where two groups of students were tested with one given immediate feedback while the other group's feedback was delayed. Although, there was not a specification on how long the delay was, it was found that the group that was given delayed feedback outperformed the other group. This study also showed that the students in the delayed feedback group analyzed their feedback in more detail than the immediate feedback group. As Kulhavy explains, examining feedback that was given to an individual was "known to improve performance" (p. 223). When students were given time to analyze their errors, then their ability to execute the skill was improved.

Brookhart, Andolina, Zuza, and Furman (2004) invited 41 students from two third grade classes to participate in a project that used feedback and self-assessment to learn basic multiplication facts. The students reflected each week on their progress and goals, and their experience led to a rise in memorization of the math facts. A teacher responded during an interview that the "students' primary learnings came from seeing how they did on the test (and) receiving feedback in a consistent manner" (p. 222). This observation brings to light that feedback may need to be given in a consistent manner in order for it to be meaningful and effective overall.

Brookhart (2008) explained that feedback was only worthwhile if the students are able to hear in it a "clear, positive message" (p. 54). She explained that worthwhile feedback gave the students a

description of their work, interpreted the method used by the students, and then told the students where to go next. Brookhart also asserted that in order for feedback to "drive the formative assessment cycle" (p. 56) it needed to show the student the route that would lead to the learning goal. The student needed to be given enough feedback for them to be able to understand where errors were made. However, it was important that the feedback was not so specific that it did not allow the student to reflect upon it themselves. The student needed to be able to contemplate the methods used and how to improve upon them.

Different types of feedback were offered by Tunstall and Gipps (1996). Some of these types included verbal and nonverbal, positive and negative, process or product-related, the ability to follow criteria, and individual and group feedback. They further described what implementing these types of feedback in an approving or disapproving manner would look like. The researchers used the different styles of feedback in positive and negative manner to decide if it affected the students. They concluded that through the use of assessment strategies that highlight individual progress toward mastery of a concept, provide evaluation that is private when acknowledging students' effort, and accept "mistakes as part of learning" (p. 403) will assist students in achieving their goals.

Rodgers (2006) referred to descriptive feedback as a reflective conversation. This researcher provided a resource that examined descriptive feedback's influence on teaching and learning. Seven teachers participated in the study. They explored the dialogue that exists between students and teachers regarding how students learn best. The teacher-student conversation often develops trust between the two and gives students a chance to determine ways to improve their learning. The feedback that is exchanged between students and teachers is often open and honest. The students explain what works and what does not work for them as learners. As conversation occurs and teachers make changes to accommodate, the students become "empowered learners rather than simple

bystanders in the education process" (p. 229). Teaching and learning was looked at as a partnership whose ultimate goal is the understanding and retention of material by the student.

Previous researchers agreed in the supportive role that feedback played in teaching and learning process. Nicol and Macfarlane-Dick (2006) and Brookhart (2008) agreed that the feedback given to students about their efforts should be delivered in a positive manner. Rodgers (2006) described a reflective conversation that existed between students and teachers, which Nicol and Macfarlane-Dick (2006) also described as one of their good feedback practices. This conversation gives opportunities to close the gap between the students' current practice and what is desired of them. Kulhavy (1977) and Brookhart, Andolina, Zuza, and Furman (2004) conducted studies that showed that consistent feedback helped students to evaluate their performance and led to improved performance. Feedback is a complex skill to master as an educator. The educator must consider how and when to implement any one of the various types of feedback depending on the needs of his or her students. Feedback assists students in determining where weaknesses lie and when brought to the forefront, students can improve in the specified areas so that they are able to store the knowledge to make connections among curricular areas in the future.

Retention of Information

The ultimate goal of formative assessment, along with descriptive feedback that I reviewed above, is to help students retain the useful information that they learned. Kiewra (2002) focused on the retention of information in college students by implementing four important learning elements: note-taking, organizing, relating, and monitoring. When note-taking was looked at as a formative assessment, an instructor could determine what students knew by reviewing what was interpreted during the lecture from the material documented in the students' notes. Kiewra found that the "more notes students record the better they perform on tests" (p.73). Organization of the notes taken also was very important as Kiewra explained. The use of tables and matrices assists with noticing relationships,

which then in turn increase comprehension by the grouping of information. The accurate completion of the organizational tools supported retention of the material and also provided a formative assessment piece for an instructor. Relating what the students already knew to what they were being taught also was critical. When students developed internal and external connections with the curriculum, achievement also was increased because students were able to hang on to information for extended periods of time. Finally, Kiewra discussed that a dilemma in monitoring students was "many students do not know that they don't know the material until they are tested" (p. 77). It was essential for instructors to implement formative assessments so that students could learn to "monitor their understanding" (p. 77). Formative assessments allowed students to recognize gaps in their understanding and then aided them in becoming better prepared for summative assessments. Providing descriptive feedback on the formative assessments will teach students how to monitor themselves in the future. Kiewra gave explanation to the reasons why educators needed to follow the NORM (Notes, Organize, Relate, Monitor) practice with their students. If educators can teach students the skills of learning, students will learn "for a lifetime" (p. 78).

Peladeau, Forget and Gagne (2003) examined college students who were asked to use a computerized flashcard program until they reached a level of mastery. They found that the use of these flashcards increased exam scores and long term retention. Although there has been a widespread belief in the harmfulness of drill and practice, a positive regard was given to the amount of practice and attitudes about the course and activities. A conclusion of the study showed that over-learning, continuing to practice even though a level of mastery has been reached, improved retention. Therefore, allowing students any opportunity to practice, such as formative assessments, assisted students in holding onto important concepts. Another deduction that the authors came to was that it was not apparent if achieving higher levels of fluency with the material led to any academic benefits. Being able to be accurate with speed was not justified as a technique that would increase retention of the material.

Practicing formative assessments that were placed on time constraints were not effective in assisting students to retain information.

The authors had a common theme among their research, in so much that retention of the material required the students to practice or study the material. Kiewra (2002) reported that taking more notes over concepts improved test performance and that by using the strategies of note-taking, organizing, relating and monitoring, retention of the material was increased. Peladeau, Forget, and Gagne (2003) found a rise in retention as students practiced their basic multiplication facts. These studies showed that when students strove beyond adequacy or general expectations, retention of the material was affected.

This Study

As I implemented my action research I focused on affecting the ability of my students to retain information in my classroom. I put into practice different formative assessments and increased the use of feedback by using what was outlined by Tunstall and Gipps (1996). I gave constructive criticism to my students on how they would best improve upon the formative assessments, which in turn transferred to the summative assessments. In my action research some common formative assessments that were used to gather this data included daily homework, warm-ups, and summarizing strategies, which were both oral and written. As I completed my action research I remembered the statement on grading from Black and Wiliam (1996) and I acted upon it by using only my professional opinion about my students. Since I was the one who implemented techniques to gauge understanding during learning, I was able to determine the best way to grade the students. Inspired by Torrance and Pryor (2001), I found that I needed to be sure that I was specific about the purpose of the types of formative assessment that I was going to implement as well as what would be the most effective way of applying them. Instead of only using convergent assessment that would give me a thumbs-up or thumbs-down on student understanding, I made the move toward employing a more divergent approach that assisted me in

identifying what the student knew and could do. When I had this information, I knew where to go with my teaching. I had a better perception of the abilities of my students.

I took into account Nicol and Macfarlane-Dick (2006) while implementing feedback into my action research. I challenged myself to give feedback to my students to advance learning and allowed my students to have a role in the assessment process. Kulhavy (1977) found that giving feedback after errors was more important than confirming that an answer was correct. I implemented this finding into my action research by providing my students with mostly corrective feedback. I informed them of what they were doing wrong rather than only confirming correct answers. However, I also used advice from Brookhart (2008) and used "clear, positive message(s)" (p. 54) when informing them of their errors. Kulhavy also professed that feedback needed to be analyzed by the students. Therefore, in my action research I was sure to allow the students ample time to look at their feedback carefully to take advantage of the learning opportunity.

I wanted to do all that I could to assist in the retention of material and so, like Kiewra (2002), students monitored their understanding before a summative assessment. Students used the multiple formative assessments as checks for their understanding. While Peladeau, Forget, and Gagne (2003) also researched practices in retention regarding overlearning information, I did not include this idea as a main factor of my research. I believed that the time that it would take to teach the same concept again and again would interfere with the pacing of the curriculum as identified by my district. However, I did decide that formative assessments would assist in giving the students multiple opportunities to experience a concept. I used different formative assessments to make attempts in improving retention among my students.

My action research builds on previous studies on formative assessment but extends them from new angles. Unlike Tunstall and Gipps (1996) whose research assisted in developing ways of using feedback but did not analyze the teacher's feedback nor look at its impact on students, my research

attempted to evaluate the influence of providing feedback on a middle school child's learning from a teacher's own perspective. In addition most of the previous studies focused on either college students (e.g., Black& Wiliam, 2003; Kiewra, 2002; Peladeau, Forget, & Gagne, 2003) or primary aged children (e.g., Tunstall & Gipps, 1996; Torrance &Pryor, 2001; Brookhart, Andolina, Zuza, &Furman, 2004). My research built on previous research by centering on middle school students. Although I found many articles that have described research about giving feedback and using formative assessments, I found very few articles that explained how educators could assist students in doing the most important task in their careers - remembering what they learned. This was where the gap lay in my research. I did not find research that looked at improving retention from the use of formative assessments and feedback. I was curious to see if retention of material in my sixth grade mathematics class would change through the increased use of formative assessments and descriptive feedback.

Purpose Statement

The purpose of my study was to research the influence of multiple forms of formative assessment on learning and teaching in sixth grade classrooms. In using multiple formative assessments I will support my students in retaining information by giving them various opportunities to experience the concept. In having various opportunities students should gain a greater insight and understanding of the concept that a single formative assessment alone would not have achieved. In conjunction these multiple types of formative assessment were expected to assist students with retaining mathematical concepts on summative assessments. As Peladeau, Forget and Gagne (2003) found, when students were able to have multiple experiences with concepts, they were likely to retain information with ease. Not only will numerous formative assessments aid in the process of retention in this study, but also the use of oral and written descriptive feedback should build confidence levels and encourage the analysis of mistakes made on the assessments.

I sought to understand why students seemed to have difficulty in remembering information for summative assessments. I wanted to understand the influence of implementing the multiple formative assessment types and the use of descriptive feedback on students and teacher. In investigating the inability of remembering content in students I planned to answer the following questions:

1. What will happen to the students' understanding of mathematical concepts when multiple formative assessments are implemented and descriptive feedback is given by the teacher?
2. What will student learning look like when multiple formative assessments are applied to classroom instruction?
3. What will happen to my mathematics teaching when I utilize descriptive feedback on formative assessments in attempts to decrease the number of retakes needed on summative assessments?

Method

Prior to taking part in the Math in the Middle Project, I assigned only one type of formative assessment per lesson on the average day. That one type of formative assessment was in the form of a worksheet that was taken home for homework. I started collecting data and implementing my project January 25, 2009, and because of the nature of my project, I collected some sort of data nearly every day. In my work of putting multiple formative assessments into place, I knew that I documented how much, what kind, and when they were completed. I also recorded the results on tests, quizzes, and homework assignments at intermediate points while this surge of formative assessments took place. In making my study anonymous, the students' names have been changed to pseudonyms.

I identified prior to officially starting my research project which formative assessments I would use or find most useful in my classroom. The types of assessments that I used are displayed in Table 2 below along with a brief description of what was expected in order to complete the assessment. I compiled this particular list of formative assessments based on my accumulated knowledge during my

teaching career. In particular, Wormeli's book mentioned in the literature review, *Summarization in Any Subject*, also served as an inspiration for some of the assessments. The entire staff in my building read this book with intentions of improving school-wide student achievement through the use of summarization strategies during the 2006-2007 school year. His suggestions for using the techniques described in the book gave students more opportunities to practice with the content. These multiple opportunities for practice could be described as formative assessments. I adapted many of his ideas to make them my own and found that I could not use all of these assessments on a daily basis, but did implement two or three within one class period. Each day I would plan on using specific types and sometimes it worked perfectly. Other days, the types of formative assessments that I had planned for needed to be adjusted or eliminated because of time constraints.

Table 2.
Types of Formative Assessments Implemented

Type of Assessment	Description of Implementation
Daily Homework	This was given typically in the form of a worksheet or book assignment. An assignment was given most days with an exceptions being on test days or days before breaks.
"How To" Warm Up	Problems were displayed as students entered the classroom each day. Every student worked the problems and then I drew sticks, which had the students names on them, to select the student who would come to the front to show, "how to" do the warm up.
Journal	The students had a journal to complete every Wednesday. The journals were folders with notebook paper in them in which the students solved the problem that was assigned. I typically copied a problem from the previous night's homework assignment. The students glued in the problem and then solved. I encouraged them to explain the solution in linguistically (in words), mathematically, and pictorial representation. The pictorial representation could be a picture that clarifies what is being asked or represents the solution.
Think Pair Share	I would present a problem to the students after instruction on a skill. The students would be asked to "think" about how they would solve the problem for 30 seconds.

	Then I would have them "Pair" up to solve the problem with their table partner and then I would draw a student's name from the sticks to determine who would "Share" their solution.
Exit Tickets	In the last five minutes of class I would display a problem that would have been discussed during the class period. I would give each student a post-it or small piece of paper and instruct them to solve the problem. As they would leave they would hand me the exit ticket. If they had it correct they walked out the door. If they didn't they needed to see me sometime during that day to show me the correct answer.
One Sentence Summary	In the last five minutes of class, the students would be instructed to write one sentence that summarized what was discussed in the classroom that particular day or how to do a certain problem.
White Board Checks	Individual white boards were used to assess content knowledge among all students. Students completed the problem that I assigned on their white board and hold it up so that I could check for understanding.
Three Questioners	Three different students were assigned the title of questioner for the day. These students had to each ask a meaningful question during instruction that day. They got my attention by holding up a colorful ruler when they were ready to ask a question. The answer to the question had to come from another student in the room.
Summarization Pyramid	The students created a format from 3 lines in their spiral notebook. On the first line they summarize the lesson in one word, on the second line they summarize the lesson in a three word phrase and on the third line the lesson was summarized in a five word phrase.
Student Teacher	I gave each student a small piece of paper. A problem was displayed and the students solved it on the paper and brought it to me the instant that they were done. I sorted the incorrect solutions from the correct solutions as they brought them to me. If the student had it correct, they were assigned the role of teacher and were then given a student, someone who had an incorrect solution, in which to teach the skill. The process was repeated several times, with different students assigned different roles depending on their proficiency with the concept.
Summary Ball/Questioning	This verbal assessment was either done at the beginning of a lesson or at the end. I would ask a question and toss a small ball to a student, who had to then answer. I would repeat this several times until we had either summarized the previous day's lesson or reviewed the lesson of the day.

Not only did I identify which types of assessment I wanted to use I also created a chart for data collection during the week (see Appendix A). On the data collection chart I also included a section for each type that allowed me to circle the choice of “yes” or “no” as to whether descriptive feedback was given during that particular type of formative assessment. Depending on the type of formative assessment used I was able to physically collect data. I included extra sections for other strategies on my data collection chart as I predicted that I would find new and better formative assessments to implement during the research process. I found that I did not use some of the original assessments that I had planned to and found others to implement in their stead. Because of the nature of “How To” Warm Up, Think Pair Share, White Board Checks, 3 Questioners, Student Teacher, and Summary Ball/Questioning, I was not able to collect physical evidence on their use aside from the number of times that I used the strategy. However, I copied or have the actual artifacts from some of the formative assessments that were completed during the research process, specifically from daily homework and journal entries. I documented their individual grades for the formative assessments that were given.

The copies or actual artifacts that were collected were specifically graded with intentions of giving descriptive feedback through written comments on their papers. I wrote between four and five comments on their homework, regarding their proficiency of the skill. I made comments that would either boost their confidence, allow them to reconsider their solution, or guide them a little through the problem solving process. In line with the research from Kulhavy (1977), I encouraged students to fix their errors and submit for re-grading since examining feedback was proven to increase achievement. I also kept track of students that re-submitted homework with corrections made. Their Wednesday journal grades, which were evaluated using a rubric (See Appendix B), also were documented. The rubric assisted me and my students in identifying how well they understood a skill. I documented the grades that each student received on the journal entries as part of my data collection process.

My project was designed to test if formative assessments assisted with retaining information for summative assessments. Therefore, I also had to collect data on summative assessments. Every Tuesday and Thursday I quizzed the students over the previous day's material. Each quiz was typically three or four questions long and took no more than 10 minutes to complete. I scored their quizzes and included them in the students' summative math grades for the class. Chapter tests were the other summative assessment that was used during my research process. I graded and documented the scores, for initial and retakes, on each student through the district-mandated math cards (see Appendices C and D). Through these math cards I was able to easily identify who was successful at retaining information on summative assessments, as they did not have to retake any sections of the test.

Instead of only using physical scores of students to document the progress of implementing my research I also used a template for journaling my thoughts and classroom happenings during the project, (see Appendix E). The template encouraged me to write about situations related to my research questions along with times when students were showing progress as well as times of misunderstanding. In my writing I discussed summative and formative assessment scores and the use of feedback throughout the research project. I used a small spiral-bound notebook to jot down any happenings during or after class and then spent time after school each day writing in some answers to the questions on my journaling template. Finally, on the weekends I used what I had documented during the week from physical student scores of formative and summative assessment as well as from my journaling template to write a formal journal entry that described the happenings of the week in my classroom.

In order to decrease possible bias of my data collection, I also made efforts to hear from the students regarding my project. This is because, as a teacher researcher, I could possibly be forcing an outcome that I wanted to happen. Therefore, I used data collection strategies that encouraged students to give their input, sometimes anonymously, about the helpfulness of the strategies in the classroom. I used two different types of individual surveys, one was on a Likert-type scale, in which they marked

agree, neutral/no response, or disagree depending on their opinion of phrases on the survey (see Appendix F). The other survey gave the students an opportunity to answer questions in an open-ended format (see Appendix G). I gave the students the surveys at the beginning of my research process and at the end. I analyzed the Likert-type survey by tallying the results of the class in each category and the open-ended survey by looking for trends in their answers.

Along with the surveys, which assisted me in gaining an insight into what aspects of my project the students thought to be beneficial I also used individual student interviews. I asked a colleague to select 10 students from a list of 15 students who volunteered to participate in the project. I then asked these 10 students to join me for 15 minutes during their lunch time. I had one student in my room per day for 10 days. During the interview each student was asked to solve a geometry problem about the measurement of angles (see Appendix H), and then was asked to comment on several questions that were used to gauge their beliefs of assessment and learning styles (see Appendix I). I recorded the conversation and wrote specific notes on each and then later transcribed the interviews so that I could further analyze them.

On my road through data collection for my project I ran into a several bumps - as well as a few potholes. I found that the phrase, “The best laid plans of mice and men often go awry,” from *Of Mice and Men*, a book I read in my sophomore English class in high school, suited my data collection process the best. I had thought that I had laid my plan for data collection out without a glitch. I knew what I wanted to collect and how I wanted to collect it. I had created charts to get myself organized weekly and set up specific dates on which I would carry out my plans. However, I soon found that life often gets in the way of data collection. The first challenge I faced occurred on January 26, 2009. (I had started collecting data on January 25, 2009.) I took the first set of homework assignments home to grade them. I knew that implementing the descriptive feedback piece would be time consuming. I wanted to do that by giving written comments on their assignments. Since I was giving them descriptive feedback I had to

analyze their work more than just looking at the answer. I had to give them tips or helpful hints in seeing their errors. In carrying out this well-laid plan, I sat at my kitchen table grading for 45 minutes on one set of homework. To put this into perspective, it usually took me 15 minutes to grade the same amount of homework, without the descriptive written feedback given. I insist on getting homework back to students typically by the next day in my math class, just because I feel that the grade is more meaningful for them. If I wait a few days or a week to get an assignment back to them they have lost interest in its meaning. The process of grading descriptively never really became any easier or faster; I believe that I just got used to it. I did begin to feel stressed when I had other things coming due and had to spend the typical 35-45 minutes grading one assignment. I knew it would be torture if I ever fell behind on grading and so did my best to get homework back to the students the very next day.

Another plan that went astray was my schedule for interviews. I had initially planned on interviewing 10 students. However, I had one student, Dana, who was gone on her interview date and each time we would try to reschedule there would be some other complication that would prevent her from being interviewed. I eventually decided to stop making the attempts at getting her up to the room to interview because it was becoming almost coercive instead of her volunteering to participate in the project.

An ongoing analysis of the data took place throughout this project. During the process of data collection, I was continuously looking for progress being made on formative and summative grades for the class as a whole. I kept track of students who were fixing assignments and then discussed in my journal entries how successful those particular students were in understanding mathematical concepts. To analyze data in reference to the first research question regarding student understanding when formative assessments and descriptive feedback are put into practice, I gathered the copies of student work and organized it into high, middle, and low scores. I then looked for patterns in the middle and low scores, such as the students in those categories and possible errors that were made. After giving

the students feedback I then re-graded the assignment, if a student chose to fix and turn it back in. I checked for student understanding on the concept and commented on any idiosyncrasies in my journal entries each week. I also reviewed my journal entries to draw conclusions for my research. The second research question, which was concerned with student learning when multiple formative assessments were applied to classroom instruction, required me to look beyond homework assignments. I completed many informal observations of events in my classroom. I wrote about these events in my weekly journal and reviewed them at the end of my project. I also transcribed the interviews that assessed student learning and used the surveys to determine how student learning was affected by the project. The third research question focused on my teaching and was analyzed by careful observation of the classroom happenings and my teaching techniques. Again, my journal was consulted to obtain much of the data to support my findings for this particular question.

Findings

Before reporting my findings in this project, I will first describe my average day, which serves as a scenario of my stories. My sixth grade mathematics class is 60 minutes long. While teaching during this action research project my day in the classroom followed a pretty set procedure. Of course, different types of formative assessments were implemented on various days, but some of them remained pretty constant throughout the project. As students entered the room, a "How-To Warm Up" was displayed for them. They all sat down, got out their warm up sheets and began working. On Wednesdays I would have their journals ready and they would pick up their journal and complete it instead of doing a "How-To Warm Up."

I took care of attendance while the announcements were being read and went through the classroom checking for completion on homework, which should have been set out on the students' desks. If a student did not have the assignment completed they would write their name on my "Lunch

Date" board which signified that they will give me 15 minutes of their lunchtime that day. This gave me an opportunity to work with them on the assignment.

As soon as I finished checking for homework completion I drew students' names from the sticks to complete the "How-To Warm Up." The students chosen approached the board individually to work the problem and explained how to complete it as the class observed. If an error was made the observing members of the class knew that they needed to raise their hands to identify the error. The student would then fix his or her mistake and we would move onto the next warm-up problem and complete it in the same fashion. On Wednesdays the students were given about 10 minutes to complete the journal entry and turn it in as soon as they were done.

When warm up or journals were completed I would ask that the students to look at their homework assignment from the previous night. I asked if there were any questions on any of the problems. If there were questions, I addressed them and even worked the homework problem in front of the class. After no more than five minutes, when the questioning session was completed I asked them to get out of their seats to turn in their homework to the inbox. On Tuesday and Thursdays, I would then hand out the quiz for them. They would take about five minutes to complete the quiz and turn it in to me once everyone was finished.

When the students returned to their seats the daily lesson began. During this time I reminded the three assigned "Questioners" of the day to select a colorful ruler, which helped in identifying them from the rest of the group. I gave the class a quick rundown of our goal or objective of the day and depending on the lesson we may have had an opening activity that we completed before moving into taking notes in our spiral notebooks. I gave them the notes on the overhead projector and they were expected to write the definitions and example problems into their notebooks just as I did on the overhead. As I was instructing, I moved through the room checking on each student to see whether they were keeping up with the lesson. After I had demonstrated a few problems I would ask the group to

complete a few problems in their notebooks and look to their table group members or myself for support if needed. I typically found myself working next to the students who took a little extra practice in understanding concepts to be sure that they had the support that they needed. I would call volunteers up to the overhead to solve the problem for the class to make certain that everyone was on the same page. During the instruction my three questioners would interject their questions and other members of the class would answer them. After my formal instruction of the lesson I would quickly go back through the notes to review what was discussed as our objective for the day. I would then assign a summarizing formative assessment. I would use the summary ball/questioning strategy, or this assessment also could have been exit tickets, once sentence summary, or summarization pyramid. I either would ask them to complete the assessment in their spiral or on a small piece of paper that they would hand to me on their way out of class. The last five to 10 minutes of class were used for them to start their homework assignment. They had the opportunity to ask me questions or work with their table groups to finish the assignment. What they did not finish when the bell rang was considered homework.

Having a structure or routine to follow was beneficial in implementing my action research project. I believe that I could have felt very overwhelmed or at least more than what I did feel during the research process, had I not been as organized. Building in routines for data collection was helpful and kept me on track so that my project would be purposeful. The many types of formative assessment that I used needed to be applied logically so that it still made it possible for the typical business of the day to be carried out in the classroom. Without carefully planning which type to use and when to use it the project would have been too random to report the results from my students.

During my research process I analyzed the data that I had collected and found some interesting happenings that occurred during my research process. These findings are described according to each of my three research questions in the following sections.

What Will Happen to the Students' Understanding of Mathematical Concepts When Multiple Formative Assessments are Implemented and Descriptive Feedback is Given by the Teacher?

The first finding that I found in regard to this research question was caused by the use of descriptive feedback with my students. My students analyzed their homework more when written descriptive feedback was given to them on assignments compared to when it was not. The first piece of evidence that I have collected to support my finding is that I have noticed that the students take the time to read the comments in class. They used to get their assignments back from me, look at the grade and put it away (sometimes in the trash can). During the research project I witnessed the students looking at the comments, which leads them to analyzing their work. One day during instruction, Leslie was deeply involved in looking at the comments I had written on her homework. She was so drawn into the comments that she did not notice that the rest of the class was already engaged in an activity. I called on her to answer a question and she responded, "I'm not sure. I was looking at my homework." Leslie was doing exactly what I wanted her to do. How could I be upset? Several other students approached me in class and in the hallway wanting clarification on my comments on their homework.

Another piece of evidence that supported this finding was that I had more students fixing the mistakes on homework and turning the assignment back in for a better grade. The students always had the opportunity to fix their homework and turn it in for a better grade, in attempts to strengthen their mathematical understanding. However, not many students took advantage of it. During my project, I had more and more students each week correcting their errors. They used the comments that I gave them and fixed their assignments. They took the time to understand their mistakes and corrected them, in most cases, without my assistance. This was extremely powerful to them as learners. Their self-analysis of their work was helping them establish a strong base in mathematics that could be built upon.

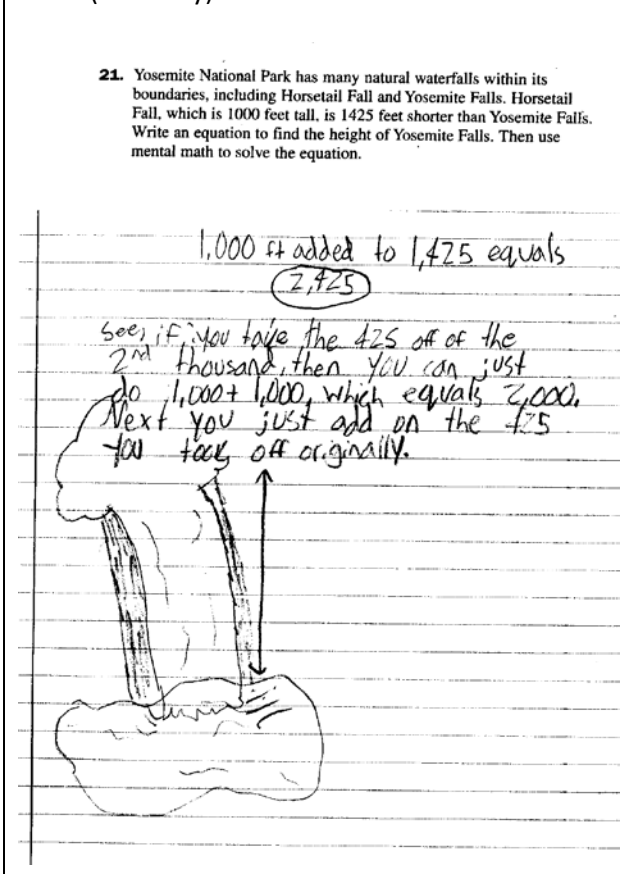
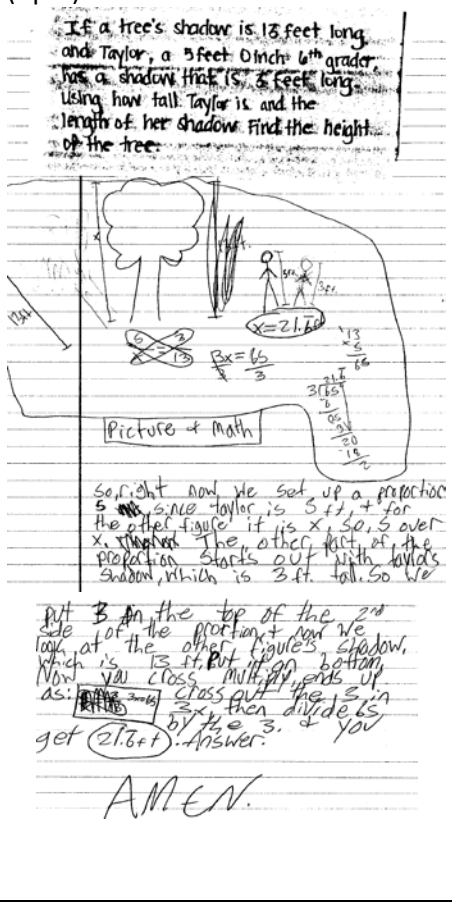
Finally, a third piece of evidence that defended my claim was that I had less students that had to fix sections on a test then before, when I was not implementing the descriptive feedback. During first semester I would have about six students out of 25 on average fixing sections on their tests. On the Chapter 7 test I only had three students out of 25 that needed to fix various sections on the test; for the entire second semester this statistic remained constant. I had on average about three students out of 25 that needed to retake one or more sections on a chapter test. I also found that the average passing rate for summative assessments during the first semester, before I implemented my strategies, was a 73.89%. The average passing rate for summative assessments during second semester, during and after I implemented my project was an 87.5%. This is not the average score received on the test but the percentage of students that did not have to retake one or more sections of the test. There was over a 13% increase in the passing rate before the implementation of my project compared to after. This showed me that my students were addressing their misconceptions before the test, and, therefore, the amount of errors was decreased on the summative assessments. The overall average formative grade for the class increased from a 76.6% on February 24, 2009, to an 83.1% on May 1, 2009. Although the formative grades were not impressive, the students were able to demonstrate mastery on summative assessments. This led to making my teaching more meaningful to the students. I had a precise purpose on focusing on identified weaknesses. Although the strategies I implemented were more work for me, they bolstered the achievement of my students. When I put myself in their shoes, their workload was also increasing. The old adage, “The only place success comes before work, is in the dictionary,” is ringing true for my sixth graders.

The second finding I had based on this research question was that the students were able to identify their own weaknesses on mathematical concepts. The students found that by reading my descriptive feedback and getting pointed in the right direction during class time with oral feedback, they were able to see where their misconceptions lay. I had students that had said to me, “I need help. Can I

come up at lunch?" At the beginning of the year, I had to make a request for struggling students to get help with their areas of confusion. After the project, the students were able to identify when they did not understand because they had more opportunities to see themselves making errors in their mathematical thinking. Results from the April survey indicated that 23 out of 24 students appreciated the descriptive feedback that was written on daily homework assignments. When asked if the feedback was helpful on assignments a student responded, "I think the comments are helpful because you point out what we did wrong, rather than just seeing that we got wrong and not know why. I also think you have been grading very fairly." Another student remarked, "Yes, (the feedback is helpful because) then I have to think more about what I did wrong." These comments were proving that students were using the descriptive feedback on the formative assessments to strengthen their understanding of the material. Since I was implementing multiple formative assessments within a class period, the students did not have to wait for their homework to be handed back to them before they decided on their confidence level with the material. Victoria struggled with making computation errors on a homework assignment. She said to me, "I understand how to do this, the cross multiplying stuff to solve a proportion, but I keep making errors with division. I don't know what I was thinking." I thought that this was so powerful. She could identify the source of her mistakes and realized that she understood the process, but just needed to slow down so that careless computation errors could be eliminated. She was able to identify her weakness and work to fix it. Prior to the research project, I would have simply counted the problem wrong and Victoria would have thought that she was not proficient in this skill. Through the intervention of my descriptive feedback, Victoria knew that she understood the mathematical concept and was only making silly errors.

Another piece of evidence that supports my second finding was discovered when I graded a particular round of journal assignments. I asked the students to give explanations that included words, math, and pictures to display their understanding of the concept that they were journaling about.

Several students, particularly Blake and Jonathan, improved upon this method as we completed entries. These two specific students struggled with doing all three methods of explanation at first, but after I had given them feedback, they made improvements upon their weaknesses. They were not considered to be experts at it by the end of the research period, but were able to identify the fact that their entries were weak and needed further clarification. Their beginning journal entries only included the mathematical explanation, and limited explanation, if at all, was given. However, by the final entries during research the two young mathematicians were comfortable with writing about their solution and were able to draw a picture to represent the process or solution. Figure 1 shows the before and after journal entries of these two students and the growth that occurred.

Blake (February)	Blake (April)
	

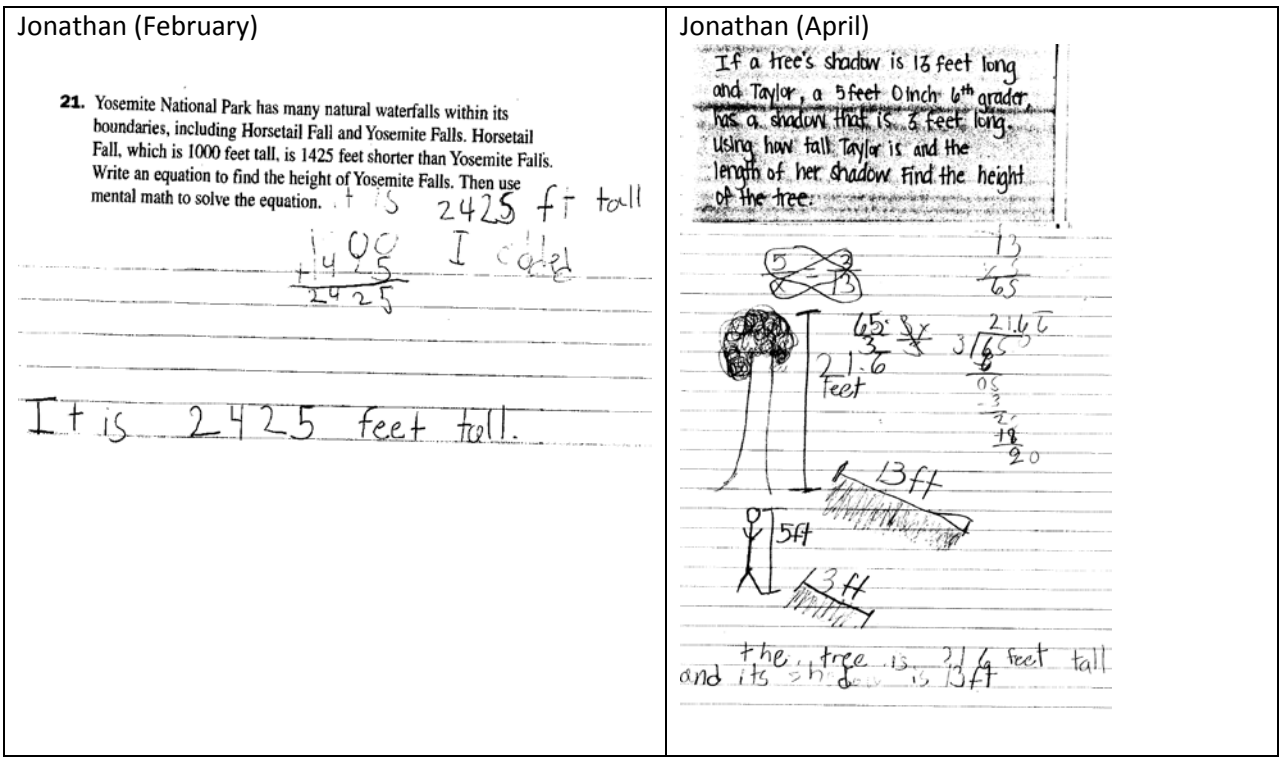


Figure 1. *Evidence of Progress in Journal Assessment*

My third piece of evidence that proved that students were able to identify their own weaknesses in their mathematical proficiency came from my own journaling that I completed during the action research process. I had commented that, "Exit tickets give students an opportunity for immediate feedback. I was able to tell them whether they have it or not before they walk out of the room." I can address students that need assistance immediately because of this strategy. The students were able to pinpoint where they needed to focus when their weaknesses were detected. The use of exit tickets gave my students the opportunity to catch mistakes early so that they could practice a mathematical skill accurately. This was especially beneficial considering that they would still need to complete problems on their nightly homework assignment.

This research question brought about another important discovery about the impact of the Wednesday journals. My claim was that writing about math helped students understand concepts. I used weekly journals as a type of formative assessment. The students were encouraged to give their

solution to the journals entries in mathematical terms, in words, and by a picture representation. In an interview with Scott I asked if he felt that math had gotten easier for him over the past few weeks and what he thought the difference was. He explained, "We started journals and those kind of make you think a little bit more." Making the students think about mathematical concepts a little bit more leads to an increased understanding of the skill. My second piece of evidence to support this assertion came from a survey that I had given my class on Tuesday, April 13, 2009. I recorded the number of student responses to each question and then computed the corresponding percentages for both times the survey was presented to the students. Table 3 illustrates the results.

Table 3.
Results of an in-class survey addressing student opinions of assessment

Question	Time	Agree	Neutral/No Response	Disagree
Students should be assigned homework.	January (n=25)	52%	36%	12%
	April (n=22)	50%	45%	5%
I spend too much time on homework each night.	January (n=25)	16%	56%	28%
	April (n=22)	28%	54%	18%
I don't spend enough time on homework at night.	January(n=20)	0%	35%	65%
	April (n=22)	5%	18%	77%
Homework helps me remember how to do problems on a test.	January (n=23)	83%	17%	0%
	April (n=22)	82%	13%	5%
I feel comfortable sharing answers from my homework with the class	January (n=25)	36%	32%	32%
	April (n=22)	39%	30.5%	30.5%
Writing about math concepts helps me to understand it better.	January (n=25)	60%	24%	16%
	April (n=22)	73%	23%	4%

The questions on the survey asked the students to mark their responses, agree, neutral/ no response, or disagree. The final question on the survey asked if writing about math concepts helped in their understanding the concepts better. According to the results of the April survey, which was taken at the conclusion of my action research, 16 out of 22 students (73%), marked that they agreed with this phrase, five out of 22 (23%) marked neutral/no response, and one student out of 22 (4%) marked disagree. This shows that the majority of the class felt growth through the use of journal writing. The same question was asked at the beginning of my project. I gave this same survey, and four out of 25 students (16%) said that they disagreed with the statement and six responded with a neutral/ no response. Three of the four students changed their way of thinking and decided over the course of the few months that journals were helpful. These three students now understood the benefits of writing about mathematical processes. The data that I collected showed that the number of students could see the value behind writing about mathematical concepts in my classroom was increasing after I implemented my project.

For another piece of evidence that supports the claim that writing about math assists students in understanding the concept came from my own journal entry. I was quoted in my journal as saying,

> "I had always hesitated in doing journals, but my experience in Math in the Middle has assisted me in understanding the importance of writing about math. It is important that you can communicate what you know with others when carrying out mathematical functions. I think that by communicating them, better understanding is achieved" (March 22, 2009).

This quote shows that I have changed my methods of teaching and thinking about learning. I now see a greater value in writing about mathematical concepts.

What Will Student Learning Look Like When Multiple Formative Assessments are Applied to Classroom Instruction?

For this research question the first finding that I constructed from my analysis of the work being completed in my classroom was that students learned from listening to and witnessing other students' interpretations of the lessons during formative assessments in class. The students were able to pick up strategies to use from one another and used them to increase their own understanding of mathematical concepts. I copied extraordinary journal entries from the students one week. I noticed that several students were struggling with explaining concepts with words, math, and pictures. I made transparencies out of the copies and displayed the quality work to the class. After sharing these examples with the class I noticed that the next journal entries were of higher quality. The students witnessed other students' work and were then striving to meet the same quality in their own work. Another piece of evidence is a quote from Colby. We were implementing the "3 Questioners" formative assessment strategy and Colby was a "Questioner" for the day. He was struggling with determining slope and asked about it. Andy was called upon to answer his question and did a phenomenal job of wording it so that Colby could understand. Colby responded with, "Oh, that's all? I get it now." By listening to his classmate, Colby improved his understanding during the learning process. The final piece of evidence for this assertion is the work that happened when the "3 Questioners" assessment was used. The students were now helping each other come up with questions to ask the class. As I stated in my journal,

> "The kids are treating it as, 'I'm going to ask a question that everyone should know the answer to.' This has made it into a kind of inside joke among the class. They come up with questions that everyone should be able to answer. Even though it is not the exact strategy I was going for here, I believe that confidence levels are rising in students because they can answer the, sometimes silly, questions" (March 13, 2009).

A second finding that came from this research question about students' learning outlook was that students tended to effectively use small group and large group formative assessments. Supportive evidence of this claim included student survey responses, student work examples and my own journal responses. In the homework and assessment survey, students were asked to name strategies that have helped them gain better understanding in mathematical concepts (see appendix F). Eight out of 22 students mentioned group work or being able to work with someone near them as a response to the prompt. Although this is not a majority of the students, it sparked recognition for me because I did not prompt them at all. I simply asked the phrase from above and allowed them time to write a response. Other responses to this prompt included "going over homework in class," "taking specific notes in class," "taking quizzes on Tuesday and Thursday," "the math journals," and "getting help at lunch." Since the question was so open, the results seem to be debatable. However, evidence still exists that over one third of the class believed that group work was advantageous. Moreover, the other strategies named were formative assessment techniques, which show that my students valued the use of the techniques that I implemented into my instruction.

To encourage the learning process from peers during whole group instruction I implemented the "Three Questioners" technique. This was my next piece of evidence to support my finding. Three students were assigned a questioning stick each day. During instruction the questioners had to ask a meaningful question. I chose another student in the room to answer the question for their peer. This question and answer process provoked conversation among classmates during the daily lesson. I feel that allowing them to ask and hear a solution from a peer in this situation also might have been less intimidating. Another piece of evidence to support this claim was student test scores. Patsy and Darrin were both absent for three and two days, respectively, during the instruction of Chapter 10 part I test. I asked them to work with me during class one day, in a small group setting, as well as at lunch for one day. The material that they missed included many new vocabulary words. I was worried that when the

two would take the test that they would struggle not only because they had been absent but also because they have histories of struggling on tests. However, when the pair took their tests they outperformed their classmates who were there for the whole group instruction. I reasoned that working with the two in the small group setting improved their understanding and allowed them to perform better on the assessment. I can quote myself for the third piece of evidence. In my journal I had said,

> "I noticed that working with small groups of students is benefitting their understanding. In class during independent work time I have pulled over small clusters of students to work a few problems with. This seems to benefit them as I am now seeing a higher rate of homework completion" (April 13, 2009).

I also discussed that I overheard a conversation going on during group work time. I had overheard Oliver explaining a concept to Michelle. He had a confidence that radiated from him as he explained the transformation of the polygon to her. Since the students are having more opportunities to work in groups they are becoming more confident in their mathematical abilities.

What Will Happen to my Mathematics Teaching When I Utilize Descriptive Feedback on Formative Assessments in Attempts to Decrease the Number of Retakes Needed on Summative Assessments?

The third research question led me in developing several findings. With the first finding I was able to adapt my teaching to the needs of my students because of the information that I collected from formative assessments. As I graded the homework on proportions I noticed that a common error was occurring among the class. I then changed my plans the next day to review the concept for the first 10 minutes of the class period. I even went as far as deciding to change the structure of how homework was discussed to be sure that students were getting another chance of getting feedback before turning in an assignment. Instead of just checking for completion and turning in the work, I changed to allowing a question and answer session to occur before the assignment was turned in to be graded. Another

piece of evidence that showed my adaptation to students' needs was that I was able to address individual problems in class with struggling students. Darrin had been struggling to get homework in and after many stern conversations and parent contacts I finally decided that I needed to make a conscious effort to address him several times in a class period. This change in my teaching led to a more attentive Darrin, who did better at getting assignments turned in. Gavin, another student in class, had a mild breakdown after not being able to complete a summarization pyramid at the conclusion of a lesson. He teared up and since it was because of his limited understanding of the lesson and inability to complete the assessment that I wanted him to do, I was able to adapt my teaching to help him. Before I could even suggest that he come in for help, he asked if he could see me after school. When he came in, we sat down and I changed my method of showing and the student doing, to him explaining what he knew first. Then I moved on to explain the misconceptions that he had about the lesson.

My third piece of evidence came from the ability to ascertain from the furrowed brows of my students and amount of questions that they asked on the lesson on finding rates of discount and markup that a change in teaching was necessary. I had taught them one method to solve the problems that I understood, but they could not fully comprehend. This caused frustration levels to increase and so they next day I implemented another method to solve the problems. Casey was quoted with saying, "Thank you Mrs. Lubash! I understand it so much better now!" I adapted my teaching because of the information that I collected from their formative assessments that day. A final piece of evidence that explained the adaptations that occurred in my teaching process resulted from the use of descriptive feedback on homework assignments. Andy always found time to catch me in the hall to discuss the feedback on his homework assignments. One day he reported to me, "Mrs. Lubash, I keep doing this problem over and over and I get the same answer. You wrote that I have a multiplication error on this problem, but I can't find it." After carefully going through the problem with him, during transition time between classes, I assisted him in finding the simple error. Andy was taking the time to analyze his work

and I loved it! Homework that was getting turned in was becoming a sort of communication system between my students and me. I could give one-on-one advice and even had students writing back comments to me when they fixed their errors and turned their assignments back in for re-grading. On one of Victoria's homework assignments she commented on her misconceptions on the assignment. The sample of the homework is shown below in Figure 2. This communication system allowed me to understand the students' errors as well as alerted me to problem areas in the lesson that needed to be discussed in more detail.

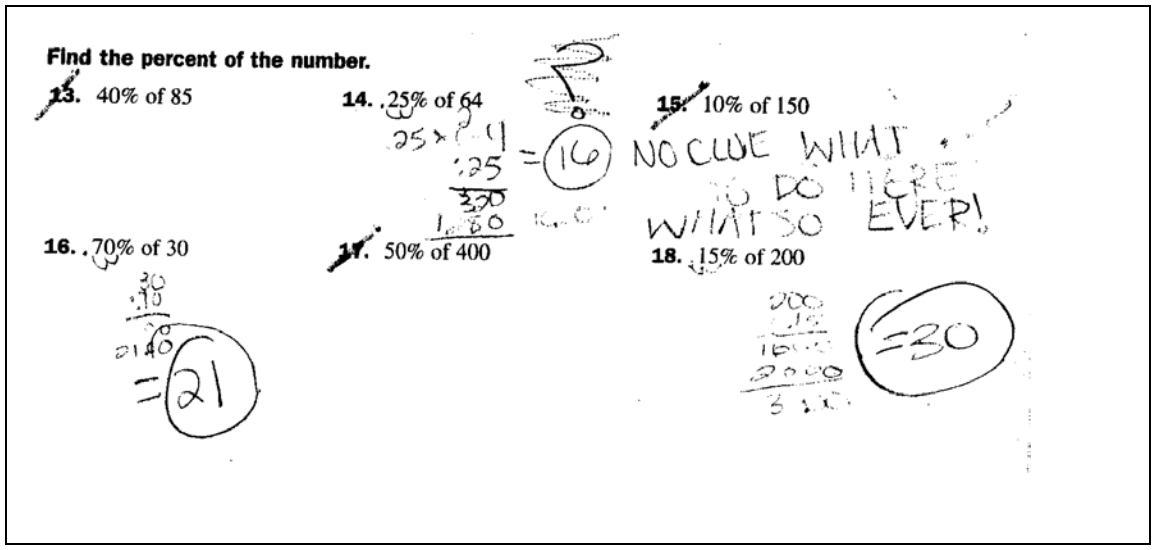


Figure 2. *Communication from a student on a daily homework*

The second finding that presented itself in my research was that I was finding myself caring so much more about students' conceptual understanding before the summative assessments were given. Since I had invested so much time into implementing my action research I had a higher level of expectation of student learning. My first piece of support for this claim was from an action that I now take. I used to use the last five to 10 minutes of class to prepare for my next class period while the students started on their homework assignment. Now I find myself wandering from table group to table group checking for understanding. I also pulled clusters of students who were struggling and needed direct attention and instruction. I also spend at least 15 minutes of my lunch time daily working with

students who requested help. My second piece of support for this was the results of my summative assessments over the semester. On February 2, 2009, the average student summative assessment grade was an 84%. In just over three months the average student summative assessment increased to 91%. The increase of seven percentage points was very rewarding to me as a teacher. I had worked on developing and implementing multiple formative assignments and had invested so much time in the process that it was fulfilling to see it reflected in the students' ability to perform well on tests. I showed the care that I had for their conceptual understanding and mathematics achievement, and it transferred to them. They became stakeholders in their own education. My last piece of evidence was a journal entry that I made that described my frustrations in grading homework. I wrote, "I'm feeling like I can't keep my head above water. This week I had several evening activities that cut into grading time." This showed my dedication in setting aside time to give the descriptive feedback on formative assessments. It would make me upset if I did not get the homework graded and back to them the next day. I wanted to be more efficient in this process. I expected that giving them the descriptive feedback would improve their summative scores and limit the need for retakes.

Conclusion

In my processes of reflection and data collection I arrived at several conclusions regarding the research project. When I implemented this project into my own classroom I took on the role of teacher and researcher and felt the full gamut of trials and tribulations in filling both positions. I built a rapport with my research subjects over the course of the project that no onlooker could replicate. I was emotionally invested in this project and wanted to see my students succeed as well as execute my intended plans. I had full control over what I decided to implement into my classroom as the teacher and researcher. Along with that I was in charge of collecting and analyzing the data that the research yielded. The work of implementing this project was immense, yet rewarding and worthwhile.

My findings showed me that my students were better prepared for summative assessments when multiple formative assessments and descriptive feedback were implemented and when I utilized information from the formative assessments to frame the teaching and re-teaching of concepts in my classroom. These findings echoed previous studies that emphasized the significance of formative assessment. William and Black (1996) discussed that a teacher must make adaptations to their teaching to use formative assessments effectively. After grading daily homework assignments I noticed problem areas among groups of students and adjusted my teaching the next day based on that formative assessment. This was effective in that I could catch struggling students instead of moving through the curriculum when they were still having difficulty with previous concepts. Another formative assessment connection comes from the authors Tunstall and Gipps (1996). They explained that a positive result of formative assessments in the classroom was an increased amount of communication between the teacher and students. I witnessed this each time a student corrected a daily homework assignment or wrote a comment on his or her paper to let me know about his or her thinking on a problem. The use of formative assessments in the classroom led to a deeper understanding of my students' mathematical proficiency. I was given more chances to communicate with them about their strengths and weaknesses. My students also learned from one another through small and large group work. They gained valuable lessons in confidence and leadership in the group work that took place. My students did not fully interact with one another until I began my project. The formative assessments that I used encouraged discussions about mathematics. My students not only seemed to be more confident with the material but also they were more attentive during class. The students knew that they would be held accountable for the information by the end of the class period because some type of formative assessment would be given.

There were also connections between my findings regarding feedback and that of the scholarly literature sources that I researched. Nicol and Macfarlane-Dick (2006) described what descriptive

feedback yields when used effectively. Each item on the list of attributes of quality feedback could be related to a finding that I discovered in my own research project. I used quality examples and had students who completed quality pieces of work display their solutions which helped to "clarify what good performance is" (Nicol & Macfarlane-Dick, p.205). The students were becoming more aware of their own mathematical understanding which was referred to as "development of self-assessment in learning (p.205) by Nicol and Macfarlane-Dick. I was able to give detailed information to each student about their proficiency on individual objectives through the use of feedback, and the more confident students were engaging in conversation with me and their own classmates regarding the material of the day. Since my project of 12 weeks was not an adequate length of time to see a major change in student learning, I was not able to see a significant positive change between the practice prior to the project and after on formative assessments. However, Nicol and Macfarlane-Dick did explain that feedback aids teachers in supplying information that can have an effect on the teaching process. An important finding that I reached in my project was that I was adapting my teaching to the students instead of them adapting to my teaching. Brookhart (2008) also offered insight into the impact of feedback. It was acknowledged that in order for it to be effective feedback, it must give a path toward the solution that does not tell what the answer is but instead encourages the student to reflect on his or her errors. I found that each time I gave descriptive feedback on daily homework assignments I followed Brookhart's protocol for feedback.

Comparing my findings with the scholarly literature on retention, I noticed the role of formative assessment and descriptive feedback in helping students retain newly obtained information. As Kiewra (2002) concluded, it is essential for students to self-test or for instructors to pre-test so that students can learn to "monitor their understanding" (p. 77). Throughout this project, my multiple types of formative assessments assisted in the monitoring process for my students who were aware of their individual levels of mathematical proficiency before summative assessments were given. Because of this

awareness, my students were able to be better prepared on the day of the test. Nicol and Macfarlane-Dick(2006) explained research by Gibbs and Simpson (2004), that informed us that when feedback is given on a regular basis, students keep watch over their own progress more efficiently. Based on research by Kiewra (2002), when students monitor their learning, retention of concepts is increased. When my students were monitoring themselves as learners they were enhancing their retention as well.

Along with my students being able to monitor their mathematical understanding, I am monitoring my teaching, which has changed for the better through the course of this project. I feel like I know my students mathematically better than I ever have gotten to know my previous students. Since I was able to give them descriptive feedback on all homework assignments plus determine their level of understanding through the use of in-class assessments, I could give a description of the mathematical proficiency for each student in my room. The research completed by Tunstall and Gipps (1996) made me aware of the possibility of collaborative teacher-student relationships that would build through the effective use of feedback on assessment. I know that sometimes average students fall through the cracks. This occurs because they do not need the attention from the teacher to learn all of the concepts nor do they receive the recognition that high achieving students do. This project allowed me to comment on and learn about every child's understanding of each mathematical concept over several weeks.

Implications

In looking back at my action research project I understand that there have been many positive effects of my practices upon myself and my students. Using multiple types of formative assessments in my teaching practice, along with incorporating descriptive written and oral feedback with my students, has been a positive experience for the students and me. I noticed a greater sense of awareness of their individual mathematical proficiencies in my students. They held themselves more accountable for mastering the objectives. They utilized me and their peers more as they successfully made gains in their

mathematical proficiency. They improved their communication capabilities through the many different types of interactive opportunities during the class period.

My own teaching practice changed as a result of this opportunity. I learned how to effectively analyze student formative assessments in more depth and to communicate the strengths and weaknesses to them. I realized that I can observe understanding without looking at a piece of homework through my use of multiple types of formative assessment. I will implement these very strategies into regular classroom routine in the future because of the positive impression that it had on my sixth grade mathematics class over a period of 12 weeks. I encouraged my students to become more aware of their proficiency in mathematical concepts by using of the numerous opportunities to check for their own understanding.

I will continuously look for places to improve my teaching throughout my career. This project has supported me in finding a number of ways to benefit student retention of material. Retention of mathematical concepts eventually will lead to an increase in student achievement. Strategies that support the recall of material for students are beneficial for short- and long-term goals. Formative assessments can assist in a student's ability to remember because of the repeated exposure to the material. When this formative assessment is paired with descriptive feedback I believe that students have a greater insight to their strengths and weaknesses. Identifying areas of specialty as well as limitations allows these individuals to develop their mathematical proficiency.

References

Anderson, R.C., Kulhavy R.W., & Andre, T. (1972). Conditions under which feedback facilitates learning from a programmed lesson. *Journal of Educational Psychology*, *63*, 186-188.

Black, P. & Wiliam, D. (2003). In praise of educational research: Formative Assessment. British *Educational Research Journal, 29,* 623-637.

Brookhart, S. M. (2007). Feedback that fits. *Educational Leadership*,*65*(4) 54-59.

Brookhart, S., Andolina, M., Zuza, M., & Furman, R. (2004). Minute math: An action research study of student self assessment. *Educational Studies in Mathematics, 57*, 213-227.

Buss, A. H., Weiner, M., & Buss, E. (1954). Stimulus generalization as a function of verbal reinforcement combinations*. Journal of Experimental Psychology, 48,* 433-436.

Gibbs, G. & Simpson, C. (2004). Conditions under which assessment supports students' learning? *Learning and Teaching in Higher Education, 1,* 3-31.

Kiewra, K. A. (2002). How classroom teachers can help students learn and teach them how to learn. *Theory into Practice, 41*(2), 71-80.

Kulhavy, R.W. (1977). Feedback in written instruction. *Review of Educational Research, 47*, 211-232.

National Council of Teacher of Mathematics (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

Nicol, D. & Macfarlane-Dick, D. (2006). Formative assessment and self regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*, 199-218.

Peladeau, N., Forget, J., & Gagne, F. (2003). Effect of paced and unpaced practice on skill application and retention: How much is enough? *American Educational Research Journal, 40*, 769-801.

Rodgers, C. (1996). Teacher feedback to young children in formative assessment: A typology. British *Educational Research Journal, 22*, 389-404.

Shepard, L. (2000). The role of assessment in a learning culture. *Educational Researcher, 29*(7), 4-14.

Torrance, H. & Pryor, J. (2001). Developing formative assessment in the classroom: Using action research to explore and modify theory. *British Educational Research Journal, 27*, 615-631.

Tunstall, P. & Gipps, C. (2008). Attending to student voice: The impact of descriptive feedback on learning and teaching. *Curriculum Inquiry, 36*, 209-237.

Wiliam, D. & Black, P. (1996). Meanings and consequences: A basis for distinguishing formative and summative functions of assessment? *British Educational Research Journal, 22*, 537-548.

Wormeli, R. (2005). *Summarization in any subject*. Alexandria, VA: Association for Supervision and Curriculum Development.

Appendix A

Formative Assessment & Descriptive Feedback Check Sheet

Week of _____

Type of Assessment	Monday	Tuesday	Wednesday	Thursday	Friday
Daily Homework					
	Yes No	Yes No	Yes No	Yes No	Yes No
"How to" Warm up					
	Yes No	Yes No	Yes No	Yes No	Yes No
Journal					
	Yes No	Yes No	Yes No	Yes No	Yes No
Think Pair Share					
	Yes No	Yes No	Yes No	Yes No	Yes No
Exit Tickets					
	Yes No	Yes No	Yes No	Yes No	Yes No
One Word Summary					
	Yes No	Yes No	Yes No	Yes No	Yes No
One Sentence Summary					
	Yes No	Yes No	Yes No	Yes No	Yes No
Partner A Partner B					
	Yes No	Yes No	Yes No	Yes No	Yes No
White Board Checks					
	Yes No	Yes No	Yes No	Yes No	Yes No
Other:					
	Yes No	Yes No	Yes No	Yes No	Yes No
Other:					
	Yes No	Yes No	Yes No	Yes No	Yes No

Appendix B

Rubric for Grading Journal Assignments

Relational Understanding Rubric		6th grade Math--Lubash	
Stronger than Weak		Weaker than Strong	
4 3		2 1	
• Handwriting is precise and grammar usage is generally correct. • Drawing is precise and is appealing	• Handwriting is neat and there are a few errors in grammar • Drawing is neat	• Handwriting is legible. There are frequent errors in grammar but meaning is maintained • Drawing is attempted	• Handwriting is illegible and there are many errors in grammar that detract from meaning • No drawing is included
• New vocabulary is used effectively and naturally. • Computation is exact and systematic, making the solution and thought process easy to follow. • Presents a compelling and informative explanation of the skill.	• Vocabulary is used in a familiar way. • Computation is correct but not sure how student arrived at solution. • Presents an explanation of the skill that takes steps toward the correct solution.	• Very little new vocabulary is used • Computation contains errors and there is little explanation for finding the solution. • Presents an explanation of the skill that is hard to follow	• No new vocabulary is used • Computation is incorrect and no explanation is given for the solution. • Presents an explanation of the skill that is vague or confusing.
• Drawing enhances and clarifies the explanation of the skill using math symbols or math related charts and tables. • Drawing is sound and demonstrates mastery of the concept	• Drawing is straight-forward and may simplify the explanation of the skill through the use of math symbols or math related charts or tables. • Drawing is complete and demonstrates proficiency in the concept	• Drawing is adequate but may not use appropriate math symbols or math related charts or tables. • Drawing is satisfactory and show progress toward proficiency of the concept.	• Drawing is confusing the does not use math symbols or math related charts or tables. • Drawing is incomplete and displays a weakness in the understanding of the concept.

Appendix C

DIFFERENTIATED GRADE 6 (MCDOUGAL COURSE 2) PACING AND ASSESSMENT CARD SEMESTER ONE

Student Name:_____ School:_____ School Year:_____

Teacher Name: _____

Course Objectives	Strand	Text Sect.	Min # Days	Initial Mastery	Final Mastery	Test Scores	Retest Scores
Students will be able to describe number patterns using whole number operations.	COMP	1.1	8	No	Yes No		
Students will be able to evaluate variable expressions.	ALG	1.2		No	Yes No		
Students will be able to use exponents.	COMP	1.3		No	Yes No		
Students will be able to use the order of operations.	COMP	1.4		No	Yes No		
Students will be able to solve equations. 2	ALG	1.5		No	Yes No		
Students will be able to use formulas to find perimeter and area.	GEOM	1.6		No	Yes No		
Students will be able to use a problem solving plan.	COMP	1.7		No	Yes No		
Students will be able to compare, order, and round decimals.	COMP	2.1	10	No	Yes No		
Students will be able to add and subtract decimals.	COMP	2.2		No	Yes No		
Students will be able to multiply decimals.	COMP	2.3		No	Yes No		
Students will be able to divide decimals. 2	COMP	2.4		No	Yes No		
Students will be able to read and write numbers using scientific notation. 2	COMP	2.5		No	Yes No		
Students will be able to measure and estimate using metric units.	MEAS	2.6		No	Yes No		
Students will be able to convert between metric units. 2	MEAS	2.7		No	Yes No		
Students will be able to describe data using mean, median, mode, and range. 2	DAP	3.1	5	No	Yes No		
Students will be able to make and interpret bar and line graphs.	DAP	3.2		No	Yes No		
Students will be able to display data using stem-and-leaf plots.	DAP	3.3		No	Yes No		
Students will be able to make and interpret histograms.	DAP	3.5		No	Yes No		
Students will be able to write whole numbers as a product of prime numbers.	NS	4.1	7	No	Yes No		
Students will be able to find the greatest common factor.	NS	4.2		No	Yes No		
Students will be able to write equivalent fractions.	NS	4.3		No	Yes No		
Students will be able to find least common multiples.	NS	4.4		No	Yes No		
Students will be able to compare and order fractions.	NS	4.5		No	Yes No		
Students will be able to compare and order fractions and mixed numbers.	NS	4.6		No	Yes No		
Students will be able to write fractions as decimals and decimals as fractions.	NS	4.7		No	Yes No		
Students will be able to add and subtract fractions with like and unlike denominators.	COMP	5.1	10	No	Yes No		
Students will be able to add and subtract mixed numbers.	COMP	5.2		No	Yes No		
Students will be able to multiply fractions and mixed numbers.	COMP	5.3		No	Yes No		
Students will be able to divide fractions and mixed numbers.	COMP	5.4		No	Yes No		
Students will be able to measure and estimate using customary units.	MEAS	5.5		No	Yes No		
Students will be able to convert between customary units.	MEAS	5.6		No	Yes No		
Students will be able to find probabilities.	DAP	13.1	3	No	Yes No		
Students will be able to use a tree diagram and counting principle to find all possible outcomes.	DAP	13.2 13.3		No	Yes No		
Students will be able to compare and order integers.	NS	6.1	9	No	Yes No		
Students will be able to add integers.	COMP	6.2		No	Yes No		
Students will be able to add subtract integers.	COMP	6.3		No	Yes No		
Students will be able to multiply integers.	COMP	6.4		No	Yes No		
Students will be able to divide integers.	COMP	6.5		No	Yes No		
Students will be able to evaluate expressions using the distributive property.	COMP	6.7		No	Yes No		
Students will be able to identify and plot points in a coordinate plane.	ALG	6.8		No	Yes No		
END OF SEMESTER ONE				**CRT SCORE**			

Revised June 2006

Appendix D

DIFFERENTIATED GRADE 6 (MCDOUGAL COURSE 2) PACING AND ASSESSMENT CARD SEMESTER TWO

Student Name:_____School:_____School Year:_____

Teacher Name: _____

Course Objectives	Strand	Text Sect.	Min # Days	Initial Mastery	Final Mastery	Test Scores	Retest Scores
Students will be able to write variable equations and expressions.	ALG	7.1	11	No	Yes No		
Students will be able to simplify variable expressions.	ALG	7.2		No	Yes No		
Students will be able to solve additions and subtraction equations.	ALG	7.3		No	Yes No		
Students will be able to solve multiplication and division equations.	ALG	7.4		No	Yes No		
Students will be able to solve two-step equations.	ALG	7.5		No	Yes No		
Students will be able to write and evaluate function rules.	ALG	7.7		No	Yes No		
Students will be able to graph functions in a coordinate plane.	ALG	7.8		No	Yes No		
Students will be able to write and compare ratios.	COMP	8.1	10	No	Yes No		
Students will be able to use rates to compare two quantities with different units.	COMP	8.2		No	Yes No		
Students will be able to find the slope of a line.	ALG	8.3		No	Yes No		
Students will be able to solve proportions using equivalent ratios and algebra.	ALG	8.4		No	Yes No		
Students will be able to solve proportions using cross products.	COMP	8.5		No	Yes No		
Students will be able to use proportions with scale drawings.	COMP	8.6		No	Yes No		
Students will be able to find the percent of a number.	COMP	9.1	8	No	Yes No		
Students will be able to use proportions to solve percent problems.	COMP	9.2		No	Yes No		
Students will be able to write percents as decimals and decimals as percents.	NS	9.3		No	Yes No		
Students will be able to use percents to interpret and make circle graphs.	DAP	9.5		No	Yes No		
Students will be able to find discounts, markups, sales tax, and tips.	COMP	9.7		No	Yes No		
Students will be able to calculate simple interest.	COMP	9.8		No	Yes No		
END OF QUARTER THREE							
Students will be able to classify angles by their measures.	GEOM	10.1	8 TEXT	No	Yes No		
Students will be able to identify types of angles and lines.	GEOM	10.2		No	Yes No		
Students will be able to classify triangles.	GEOM	10.3		No	Yes No		
Students will be able to classify quadrilaterals and other polygons.	GEOM	10.4		No	Yes No		
Students will be able to use properties of similar and congruent polygons.	GEOM	10.5		No	Yes No		
Students will be able to use similar triangles to find lengths indirectly.	GEOM	10.6		No	Yes No		
Students will be able to identify transformations and symmetry in figures.	GEOM	10.7		No	Yes No		
Students will be able to evaluate expressions involving square roots.	COMP	11.1	10	No	Yes No		
Students will be able to find the length of a side of a right triangle using the Pythagorean Theorem.	GEOM	11.3		No	Yes No		
Students will be able to find areas of parallelograms.	GEOM	11.4		No	Yes No		
Students will be able to find the areas of triangles and trapezoids.	GEOM	11.5		No	Yes No		
Students will be able to find the circumferences of circles.	GEOM	11.6		No	Yes No		
Students will be able to find the areas of circles.	GEOM	11.7		No	Yes No		
Students will be able to classify solids and identify their parts.	GEOM	12.1		No	Yes No		
Students will be able to sketch solids.	GEOM	12.2	8	No	Yes No		
Students will be able to find surface area of rectangular prisms.	GEOM	12.3		No	Yes No		
Students will be able to find surface area of cylinders.	GEOM	12.4		No	Yes No		
Students will be able to find volume of rectangular prisms.	GEOM	12.5		No	Yes No		
Students will be able to find volume of cylinders.	GEOM	12.6		No	Yes No		
END OF SEMESTER				**CRT SCORE**			

REVISED JUNE 2006

Appendix E
Personal Weekly Journal Prompts
Dates _____ to _____

Write about 2 happenings this week in class that relate to giving feedback, formative and summative assessment, or confidence levels in students.

How are you doing with giving descriptive feedback? What are you doing to let each student know how they are doing in class?

Give examples of situations where you knew students were confident with the material. Was anything done to reinforce them?

Give example(s) of situations where you knew students were not understanding the material. What was done to assist them? How was instruction changed?

How many formative assessments were used this week? _____

Did any formative assessments work well this week? Explain.

Did any formative assessments seem to fail or not accomplish what you wished it would have? Explain.

How many students needed to fix their homework assignments this week?_____
Comments:

If a summative assessment was given, how many students had to retake sections of the assessment?_____
Comments:

Appendix F

Student Homework Survey

Question	Agree	Neutral/No Response	Disagree
Students should be assigned homework.			
I spend too much time on homework each night.			
I don't spend enough time on homework at night.			
Homework helps me remember how to do problems on a test.			
I feel comfortable sharing answers from my homework with the class.			
Writing about math concepts helps me to understand it better.			

Appendix G

Homework and Assessment Survey

1. When you hear the word homework what is one word that comes to mind? Why?

2. What is the purpose of homework? Why do teachers give students homework?

3. How much time should a 6th grader spend on homework each night?

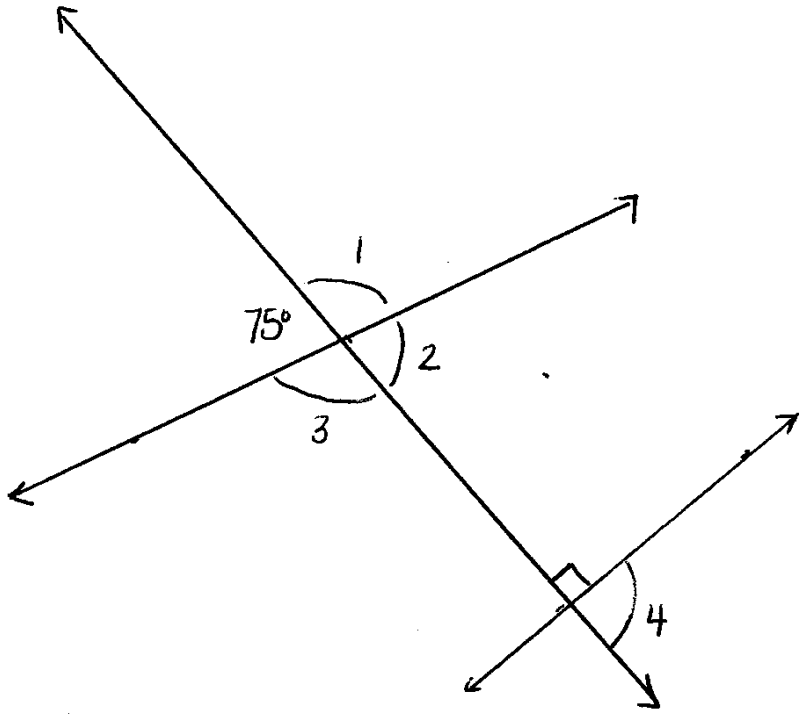
4. How much time do YOU spend on homework each night?

5. What helps you to remember math concepts? How do you learn best?

6. Do you like to share answers in class or explain concepts to the class? Why or why not?

7. Does homework help you be successful on tests? If yes, how does it help? If no, why doesn't it help

Appendix H
Interview Problem



Find the measure of the angles 1, 2, 3, and 4.

Appendix I
Student Interview Questions

I would like you to work on this problem, saying aloud whatever it is you are thinking as you work through the problem. I especially want to hear you talk about how you decide what to do to solve the problem.

- How would you do this problem?
- Why did you do it in that manner?
- What are you doing here?
- How do you know that you are right?
- How would you know if you are wrong?

I will ask the following questions to understand their beliefs of assessment and learning styles.

- Do you feel like mathematics has gotten easier for you over the past few weeks? Why or why not?
- How much time on average do you spend on homework assignments?
- What do you think is the purpose of math homework?
- When you don't understand a concept in class what do you do?
- If you are asked to fix a homework assignment do you? Why or why not? Do you think fixing mistakes is a good idea? Do you think fixing mistakes helps in any way? If yes, how?
- What makes you most upset about the process of school? Is there anything you can do to fix it? Is there anything a teacher could do?
- Is there anything you want to know from me?
- Is there anything else I should know about you to better understand your problem solving in math or your general math experience?