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IMPROVING STUDENT ACHIEVEMENT THROUGH FEEDBACK

by

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## IMPROVING STUDENT ACHIEVEMENT THROUGH FEEDBACK

Jennifer L. McLachlan

This paper reviews the current research that exists on feedback given to students in an educational setting. Questions examined were what characteristics make feedback effective, what are the effects on student achievement if feedback is available to students in a math classroom and does timing of the feedback given play a role in its effectiveness. Results showed that feedback is effective if it is descriptive, including both strengths and weaknesses. Feedback given in small doses throughout the learning process, so as not to overwhelm students, has also proven effective. The research shows that the effect of feedback on student achievement is significant. Meta-analysis done by Hattie (1999) shows that typical schooling has an effect size of 0.40 while feedback has more than twice that, an effect size of 0.95. With regards to timing of feedback, research does not lead this author to conclude that immediate is any more or less effective than delayed feedback.

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## Chapter 1: Introduction

### *Statement of the Problem*

Teachers plan lessons driven by standards and each day embrace the teachable moments that take place during discussions and activities. Teachers teach and students learn. So, how do I know if students learned the concept I set out to teach today? Where do I start with my lesson tomorrow? These questions have driven my development as a professional throughout my teaching career.

It is not uncommon for teachers to provide students with lessons and lectures for a week then give a quiz on the content taught, only to find out that half the students failed. But what if each student earned an “A” on the quiz? Does this mean that the teacher highly effective or did he spend a week “teaching” students something they had mastered last year? Where was the feedback along the way to guide instruction and learning?

The discussion of formative vs. summative assessment has educators seeking ways to collect information on student learning in creative ways.

Garrison and Ehringhaus (2007) defined formative assessment as:

.... part of the instructional process. When incorporated into classroom practice, it provides the information needed to adjust teaching and learning while they are happening. In this sense, formative assessment informs both teachers and students about student understanding at a point when timely adjustments can be made. These adjustments help to ensure students achieve targeted standards-based learning goals within a set time frame. (p. 1)

One key piece of formative assessment is feedback. Think for a moment about the minute-by-minute feedback we collect daily. On a snowy drive to work, your vehicle

is giving you feedback about the road, and you choose to reduce your speed. Your child impolitely asks for money to see a movie and the feedback he is given from you causes him to rephrase his request. We encounter different forms of feedback daily, helping us make better decisions.

What if teachers could continue to provide feedback to students as they work on assignments outside of the classroom? Some students go home to an empty house. Parents are working two jobs or night shifts in order to provide for their families. There is no one home to consult when students are struggling to complete their work, whereas other students have a parent physically present but are unsure of how to help their child with math concepts and problem solving. When meeting parents for the first time at conferences, many state, “I was never really good at math,” as if to explain why they will not be much of a resource for their child when completing homework. Without parents available to provide immediate feedback, there needs to be a way for teachers to provide corrective feedback outside the classroom.

### ***Research Questions***

- What characteristics make feedback effective?
- What are the effects on student achievement if feedback is available to students in a math classroom?
- Is there a best time for providing feedback to students?

### ***Significance of the Research Problem***

Feedback as defined by Shute (2008) is “information communicated to the learner that is intended to modify his or her thinking or behavior for the purpose of improving learning” (p. 153). All too often teachers of mathematics take the position that if students paid close attention during lesson time and are fully engaged in classroom



activities, they would not have difficulties in math. While I agree these strategies are beneficial to learning, students require the teacher be engaged at the same level.

Teachers often fail to pay close attention to their students during lesson time, making the learning very one-sided. Some teachers are not fully engaged during classroom activities missing out on opportunities to nudge students into rethinking their conclusions or encouraging them to explore beyond the lesson's objective.

In the same respect, as students work at home they often struggle through homework alone. The phrase "practice makes perfect" has been replaced with "practice makes permanent" for good reason. Students who incorrectly complete math assignments at home have hindered their understanding of mathematics. While teachers encourage students to use textbook examples and notes from the day's lesson for guidance, errors still occur. There are different ways teachers can connect their students to descriptive, task-level feedback in an effort to support learning outside of the classroom. As many school districts move to 1:1 technology initiatives, I intend to determine if computer based feedback also has merit.

### ***Limitations and Assumptions***

Formative assessment is a very broad term, regarding an ongoing process implemented by teachers. I am limiting my research to one part of this process: feedback from teachers to students. Although I may include evidence of feedback from students to teachers, I will not be researching the effects of this type of feedback on achievement.

I will not be including research on students with severe learning disabilities or those with significant hearing or sight impairments. I will assume that the research on

feedback to students in areas other than math will be applicable to the math classroom in some way.

***Definition of Terms***

Formative Assessment – the continuous process of collecting data about student learning through assessments and observations. Both the teacher and student use the data collected to make adjustment in the learning process. Formative assessment is typically not graded.

Formative Feedback -

Descriptive Feedback -

## Chapter 2: Review of Literature

### Formative Assessment

Formative assessment is incorporated into instruction and is an ongoing process that occurs at key moments throughout the learning process. The resulting assessment allows teachers to determine the student's progress and guide instruction accordingly. By making small adjustments during lesson time, teachers are better able to guide students in achieving targeted standards (Garrison & Ehringhaus, 2007). Teachers are able to realign their teaching to respond to the students needs as they are occurring. Juwah, Macfarlane-Dick, Matthew, Nicol, Ross, Smith, (2004) argue that formative assessment is an essential part of teaching and learning. "Feedback and 'feed-forward' should be systematically embedded in curriculum practices" (p. 3). There are three conditions identified by Sadler, as cited in Juwah et al (2004), that are necessary for students to benefit from feedback. The students must:

- Understand the concepts of goals or outcomes being sought.
- Identify their current level of understanding in relationship to the goal.
- Take action to advance their learning of concepts and goals.

Garrison & Ehringhaus (2007) provided an analogy to better understand formative assessment. The formative assessment process within this example illustrates how feedback is critical during key moments of a new driver's practice. They describe a student learning to drive and the way in which they receive a driver's license. The practice provided means for receiving informal feedback along the path of learning and would not influence their final summative assessment. A driver's license is issued after the final drivers test, which is evidence that the student has mastered a set of skills. The

authors ask readers to imagine a slightly different scenario where students are given grades during each practice session. These grades are then averaged and would determine whether or not you receive a driver's license. The grades provided during driving practice would provide minimal guidance on what needed improvement. Averaging these practice scores would not provide an accurate representation of the students driving ability.

Formative assessment is an important part of the learning process, but just how powerful is it? After meta-analysis of more than 250 studies, Black and William (1998) speak of its implications:

The research reported here shows conclusively that formative assessment does improve learning. The gains in achievement appear to be quite considerable, and as noted earlier, amongst the largest ever reported for educational interventions. As an illustration of just how big these gains are, an effect size of 0.7, if it could be achieved on a nationwide scale, would be equivalent to raising the mathematics attainment score of an "average" country like England, New Zealand or the United States into the "top five" after the Pacific rim countries of Singapore, Korea, Japan and Hong Kong. (p. 37)

### **Effective Feedback**

The foundation of most research in the area of feedback concludes that feedback can significantly improve learning if done properly (Shute, 2008). Hattie (1999) agrees, "...the most powerful single moderator that enhances achievement is feedback. The simplest prescription for improving education must be 'dollops of feedback' –providing

information how and why the child understands and misunderstands, and what directions the student must take to improve” (p. 9).

The rationale for providing feedback to learners lies in its ability to reduce discrepancies between performance and the end goal. Effective feedback must seek to answer the following questions for the teacher and student: What are the goals, what progress is being made toward the goal, and what activities will lead me to better progress? In order for feedback to take on instructional purpose, the feedback given must provide the learner with information relating to the task or concept that is to be learned (Hattie, 2007).

Table 1

Variable	Number of	Number of	Number of	Effect size
Cues	3	89	129	1.10
Feedback	74	4,157	5.755	0.95
Reinforcement	1	19	19	0.94
Video or audio feedback	1	91	715	0.64
Computer-assisted	4	161	129	0.52
Goals and feedback	8	640	121	0.46
Student evaluation feedback	3	100	61	0.42
Corrective Feedback	25	1,149	1,040	0.37
Delayed versus immediate	5	178	83	0.34
Reward	3	223	508	0.31
Immediate versus delayed	8	398	167	0.24
Punishment	1	89	210	0.20
Praise	11	388	4,410	0.14
Programmed instruction	1	40	23	-0.04

Note: From “The Power of Feedback,” by Hattie, John and Timperley, Helen, 2007, *Review of Educational Research*, 77, p.84. Copyright 2007 by the American Educational Research Association. Reprinted with permission.

The table provided includes data from more than 7,000 studies about feedback. The studies reveal that the most effective types of feedback provide learners with cues or reinforcement that can be in the form of video, audio or computer-based instructional feedback (Table 1).

Hattie's (1999) analysis examined many factors that influence educational achievement. He found that the typical effect size of school was 0.40. This effect size was used as a benchmark from which to compare other influences on achievement. The effect sizes reported in the Hattie (2007) meta-analyses of feedback indicate that some types of feedback are more effective than others. Studies in which students received feedback in relation to a task showed the highest effect sizes. Whereas, lower effect sizes appeared in studies where students received praise, rewards, and punishment.

Descriptive feedback has been shown to be the most beneficial in moving students forward. Students who receive descriptive feedback have a better understanding of what they have done well and how it relates to the learning goals (Garrison & Ehringhaus, 2007). According to Brookhart (2011) effective feedback focuses on strengths and weaknesses. Students need to hear what is going well, as it relates to the learning target, because they may not recognize their own strengths. In order to take learning to the next step students must also receive suggestions for improvement.

Kluger and DeNisi (1996) conducted an extensive study on the effects of various types of feedback, however many of the studies included were not classroom based. From the 131 studies, it appears that feedback is most effective when it provides the recipient with information on correct answers or procedures and when it builds on prior attempts (Kluger and DeNisi, 1996). Shute (2008) states that descriptive feedback

is best utilized as a corrective function. It should indicate if a student's answer is right or wrong and provide clues to guide them to a correct answer.

Students need both guidance and feedback, but it is important to understand the difference between the two. The student is more likely to be open and receptive to feedback if given before guidance. Feedback will provide the student with descriptive information about what he/she did. Guidance supplies students with information about what they can do to improve. As students become familiar with the process of feedback and guidance, they should be able to reflect on their work and learn how to guide themselves in making improvements. (Burke, 2010)

Brinko (1993) reviewed literature from a variety of disciplines including education, psychology and organizational behavior. The data revealed a number of feedback practices can be used to increase its effectiveness. One overarching theme is that feedback is more effective the more concrete it is. Providing the student with data as evidence of progress towards the learning goal, providing specific content needed to move forward, and focusing the feedback around one specific skill increases the effectiveness of feedback (Brinko,1993).

Some research suggests that much of the feedback teachers are giving to students have little or no impact on learning. Grades have become so important in our schools, that teachers may believe a grade or score is an acceptable form of feedback. In 50 of the studies reviewed by Kluger & DeNisi (1998) where performance got worse, the feedback given focused on the person instead the quality of work. Feedback that draws attention to the self in a negative way has a weak or negative effect on performance (Kluger & DeNisi, 1998). Similarly, tangible rewards and praise give little feedback back about the

educational goal. Deci, Koester, and Ryan (1999) revealed data surrounding other external motivators and determined that they weakened a person's ability to motivate and regulate themselves intrinsically.

Effective feedback should not be related to the student personally, but instead to the learning outcome. The feedback seeks to compare student work to a set of criteria or goal, often by means of comparing previous work to current work. However, effective feedback rarely compares work between students (Brookhart, 2011). Instead, drawing attention to the gap between the ideal self and a set task or goal, leads people to work harder to achieve said goal (Kluger & DeNisi, 1998). The most effective feedback varies based on what students need to hear in order to make improvements on their work. Effective feedback follows some general characteristics during the active learning process. Feedback for more complex work needs to be given while the student remembers what the goal was (Brookhart, 2011).

Hattie (2007) concluded that the impact of feedback was also affected by its level of difficulty. Feedback had the greatest effect when goals were specific and challenging yet low in complexity (Hattie, 2007). Furthermore, if feedback is complicated and lengthy, the learner may not internalize the feedback and put it into action, making it ineffective as well (Shute, 2008). Feedback must be clear to the student in order to be effective. Whether the feedback is written or verbal, teachers should be sure to express their confidence in the students' ability to learn. (Brookhart, 2011)

When helping struggling learners, descriptive feedback about the learning goal in which they are engaged is especially important. Many students who are struggling need descriptive feedback in small, manageable pieces. One step at a time will ensure good



progress towards the learning goal. (Brookhart, 2011) Struggling learners can become overwhelmed during the learning process. Feedback can help to reduce the amount of effort needed to understand the concept being taught (Shute, 2008). Struggling students will benefit more if simple vocabulary is used in the feedback. If your feedback contains words and sentences that are too complex for students the feedback will not be effective in moving the student towards the goal. Brookhart (2011) suggests you check for understanding by using probes such as "What is the most important thing you see here?" or "What is the very next thing you're going to do?"

Successful students need much of the same descriptive feedback as students who struggle. These students tend to get overlooked because the teacher is focusing on the needs of others in the classroom. Brookhart (2011) cautions teachers to avoid generic praise, as this does not help students progress towards their learning target. Students who meet the learning goal early should continue to be pushed to the next step, even if it is an extension activity beyond the learning goal.

Brinko (1993) reviewed data on the effectiveness of how feedback was delivered. She concluded that the method of delivery is more effective when the recipient is able to help select the method. "Different modes of feedback will be more informative, meaningful, and relevant than other modes to different individuals". (PAGE) Brinko (1993) also concluded that feedback is more effective when it takes into consideration the student's self-esteem. Feedback should be more positive than negative and negative feedback is best received when strategically placed between two complementary statements. It is important to note that the language chosen during

negative feedback must not be inflammatory because negative feedback is already difficult to hear.

### **Technology Assisted Feedback**

Mendicino, Razzaq, and Heffernan (2009) conducted a study on the effects of Web-based homework, using the ASSISTments system, versus traditional paper-pencil homework to review previously taught math concepts. The purpose of the study was to determine if fifth grade students would learn more by using an online program to review when compared to students doing paper-pencil homework. The online ASSISTment program used for this study provided students with hints and scaffolding questions to guide them in the problem solving process when needed.

The scaffolding questions within ASSISTments were developed with the help of middle school teachers. The teachers were presented with math problems and discussed the different skills and knowledge base required to solve each problem. It was these conversations that drove the development of hints and tutoring within the program. Some advantages of the ASSISTments program, as cited by Mendicino et al., (2009) included immediate feedback on answers and tutoring for the questions that were incorrectly answered. The disadvantages noted by Mendicino et al., were lack of student work when teachers tried to help which in turn made cheating on assignments easier.

The study included 76 fifth grade students from 4 different classrooms in a small, rural town. Each of the four classes had a typical mix of students with varied math abilities. Twenty-four students did not have Internet access at home and several more only completed part of the daily work. In the end, 28 fifth grade students fully participated in the study. Mendicino et al (2009) found that learning occurred in both

homework situations, however there was a statistically significant difference in the means for the two conditions. The mean gain for the Web-based homework was significantly higher than the mean gain for the traditional paper-pencil homework.

It is unclear what kind of relationship lies between homework and achievement. Many studies have noted positive effects of homework on achievement, however there are many variables that should be taken into consideration. Positive effects have been linked to the number of tasks completed and the percent of tasks attempted, whereas negative findings have been reported when measuring time spent on homework with achievement.

In the study conducted by Kolovou et al (2013), 236 sixth grade students were placed in one of two groups. The experimental group was given an online computer game to help students with early algebra skills. Students in the control group did not participate in the online game. Those in the experimental group were given problems sets for 3 consecutive weeks and were encouraged to spend time online playing the game, although it was not part of their mandatory homework. The pre and post-test data collected revealed that the intervention was statistically significant. "Students in the experimental group outperformed their peers in the control group after controlling for pretest scores, general math ability, and gender" (p. 533).

Corbalan, Paas and Cuypers (2010) gathered data through two studies. The first examined nine Dutch university students' perceptions on three types of feedback given by a computer while working on linear algebra problems. Feedback was given one of three ways: 'on the final solution step' where the feedback informed the student if their solution was correct or incorrect but did not contain any feedback along the way; 'on all

the solution steps at once' where the feedback given was a complete sample of work necessary to answer the question correctly and a final solution; and 'on all the solution steps successively' where the feedback was step-by-step as responses at each step were submitted by the student. The second study investigated the effects on thirty-four Dutch university students' learning and motivation when feedback was given either at the final solution step or on each step along the way (Corbalan, 2010)

The perception survey contained 10 questions that required students to rate on a 5 point scale; 1 strongly disagree to 5 strongly agree. The final questions asked "How would you rate the overall usefulness of this type of feedback?" Again, students rated the usefulness on a 5 point scale; 1 very poor to 5 excellent. Students completed the survey three times, once for each type of feedback used during their problem solving process. Results from the first study found that there were significant differences between the perceived overall usefulness of the 'on the final solution step' delivery of feedback, where only the correct solution is revealed, than the other feedback methods.

During the second study, students used a computer to work on two sets of 10 linear algebra problems. They were told that once those sessions were completed that they would be asked to complete a third session on paper and pencil, where feedback would not be given at anytime during the session. Results showed a statistical significance between students' scores in the third session. Those students who received correct/incorrect feedback on the final solution scored significantly lower on the third session than those who received feedback at each step or received a worked solution at the end of the problem (Corbalan et al, 2010).

## Chapter 3: Results

### What characteristics make feedback effective?

Researchers agree that feedback must be descriptive to be effective. Descriptive feedback gives the student an accurate picture of where they are at with their current understanding of the concept being taught and what they must do to reach the learning goal. Identifying the specific skills or procedures used to reach the outcome is important to student success. Providing students with concrete evidence of progress towards the learning goal increases the effectiveness of feedback. One way teachers can collect data is by giving a pre-test on math concepts before they are taught. By collecting information from each student on their knowledge of concepts before they are taught, teachers will be able to better provide feedback to students about their progress towards the learning goals.

Descriptive feedback should include both strengths and weaknesses. Teachers must tell the student when they are performing tasks correctly, as they may not be able to identify their own strengths. Likewise, it is important for teachers to point out errors in the students' work, if we expect them to continue moving towards the learning goal. In a math classroom, teachers can teach students how to check their partner's work during independent practice. Encouraging students to quickly identify correct answers drawing a star next to the answer and further analyzing incorrect answers by looking for the error in the work and circling it. This exercise allows students to think critically about the math needed to solve the problem and aids the teacher in knowing who needs help as they circulate.

Research also has shown that feedback should be given in small doses throughout the learning process. As each student moves at their own pace towards the learning goal, manageable pieces of information should be provide to the student to insure forward progress. Feedback that is difficult to understand or takes to long to deliver may not be adopted by the student and go unused. Researchers have found all students will benefit from small bits of descriptive feedback. Formative assessment has become key in many schools for this very reason. Research clearly supports the idea that a math teacher, who regularly provides opportunities for students to receive information about their problem solving skills or procedures, will see an increase in students reach the learning target.

Students who are struggling to make progress towards the learning goal need feedback to be simple to understand, so as not to overwhelm them. By addressing the struggling student with cues and probing questions, students will be able to progress. On the other hand, helping the high achieving student should not go overlooked as these students tend to meet the learning goal with ease. The classroom teacher should be ready with feedback and evidence of the students' problem solving skills that will aid them in completing an extension activity.

Generalized feedback is not effective in moving the student towards the learning goal. According to Hattie and Timperley (2007) praise and rewards are ineffective and can be detrimental to student achievement. Too often, praise and rewards draw attention away from the intended focus of the learning goal. Effective feedback will focus on the students' progress not how the student compares to others in the classroom. Grades given on assignments or practice should be considered generalized feedback. Students often compare their scores with one another but never fully investigate what went well

during the practice and where they need help. Using daily math assignments as a means of providing grades does little to move the student from their current level of understanding. True formative assessment involves a variety of feedback to students on how to better reach their educational goal.

**What are the effects on student achievement if feedback is available to students in a math classroom?**

The research shows that the effect of feedback on student achievement is significant. Meta-analysis done by Hattie (1999) shows that typical schooling has an effect size of 0.40 while feedback has more than twice that, an effect size of 0.95. In this meta-analysis, Hattie identifies several different types of feedback. Cues, reinforcement, video and audio feedback, computer-assisted instructional feedback, goals and feedback, and student evaluation feedback all had an effect size greater than that of schooling alone. While corrective feedback, timing of feedback, rewards, punishment, praise and programmed instruction did not have a significant impact on student achievement. Teachers of mathematics looking at these findings should be aware that the types of feedback that have the most impact on student achievement require thoughtful lesson planning and time management.

The meta-analysis done by Black and William (1998) also shows that formative assessment, done properly, significantly improves learning. They suggest that if formative assessment were utilized in each and every classroom across our nation, our mathematics achievement would be similar to that Singapore, Korea, Japan and Hong Kong.

**Is there a best time for providing feedback to students?**

With regards to timing of feedback, research does not lead this author to conclude that immediate is any more or less effective than delayed feedback. Hattie and Timperley (2007) examined a few studies related to delayed vs immediate feedback. Their analysis of the research indicates timing of the feedback had little effect on increasing student achievement. Brinko's (1993) findings suggest that different types of feedback will impact each student differently. It would stand to reason that some math students will do better with immediate feedback that provides instructional support before moving onto the next practice problem. While other students will perform better if feedback is reserved until the practice has been completed before providing the instructional support.

Research by Brookhart (2011) indicates that the complexity of the task should be taken into consideration when determining the best time for providing feedback. He suggests when completing a complex task, feedback should be available to the student very soon after work is completed, while they still remember the learning goal. However, research surrounding computer-based feedback supports providing instructional feedback immediately following each task. Corbalan, Paas and Cuypers (2010) found greater transfer of knowledge from computerized practice to paper-pencil practice when instructional feedback immediately followed during computerized practice. When students are outside the math classroom, without access to a math teacher, technology certainly can provide an opportunity for immediate feedback with guidance for wrong answer choices.



## Chapter 4: Conclusions

### Author's Experiences

I currently teach in a middle school located in central Minnesota. The student population is comprised of 525 students, approximately 94% Caucasian, 44% receive free or reduced lunch, 15% are in Special Education, and 1% are English Language Learners (MN Dept of Education). Yearly mathematics scores from statewide testing shows that 55% of the middle school students pass Minnesota's Comprehensive Assessment III test in 2013, compared to 60% statewide.

I currently teach 6<sup>th</sup> grade. For the past 10 years we were seeing regression in MCA math test scores as students moved from 5<sup>th</sup> grade to 6<sup>th</sup> grade. I was able to collect some historical data from the Minnesota Department of Education's website.

Table 2

Historical MCA Data for Little Falls Public School District

Years Enrolled	5 <sup>th</sup> Grade Proficiency	6 <sup>th</sup> Grade Proficiency
2006 - 2008	56.5%	47.2%
2007 - 2009	63.1%	44.2%
2009 - 2011	74.1%	53.2%
2010 - 2012	58.3%	42.5%

*Note. More rigorous achievement standards were implemented in 2011 for Mathematics. Adapted from <http://education.state.mn.us>. This website is operated and maintained by the Minnesota Department of Education, 1500 Highway 36 West, Roseville, Minnesota 55113.*

In 2009, I asked to be moved from 8<sup>th</sup> grade to 6<sup>th</sup> grade, determined to try and solve the mystery of this regression. For the next two years my 6<sup>th</sup> grade students also suffered the same fate as the previous students. Many educators I spoke with attempted to brush off the data saying it was a transition time for students from an elementary self

contained classroom to a busy six period day middle school environment. Many also believed that the 6th grade test was much more difficult than the 5th grade test. However, 6<sup>th</sup> grade reading scores never suffered the extreme drop in proficiency that math scores did. My personal goal of minimizing the drop in proficiency had failed.

During the spring of 2012, I was in conversation with our building principal about the need for math interventions for our struggling students. He agreed that we should collect data on student progress and develop a plan. At that time, I fully embraced the idea that formative assessments could be beneficial to students in a math classroom but was having difficulty implementing the idea in a meaningful way. Through many more conversations we developed a plan for gathering data on student progress towards the Minnesota math standards and how to provide interventions during the school day.

The conversations I had with my building principal played a large role in selecting a topic for my research paper. During my summer break, I tossed around several ideas but quickly settled on effective feedback in the classroom. I was looking forward to reviewing the research on feedback in the classroom but was more eager to see if I would be able implement some of the strategies myself.

Upon returning to school in the fall our weekly PLC time transformed into a time for collaboration. This work time allowed us to discuss math content and pedagogy in a way we were unable to do in previous years. During the hour, we developed one or two standards-based formative assessments and summarization activities to use before our next PLC meeting.

In the classroom, I began posting daily goals on the board so students knew what our objective was for the day. Some examples of our goals included:

“I can use tree diagrams to help me write the prime factorization of a number.”

“I can convert decimals into fractions and fractions into decimals.”

“I can multiply mixed numbers.”

Each “I can” statement was a Minnesota math standard and much of the feedback used in the classroom, focused on this statement. I used a variety of data collection methods to determine where students were at with their current level of understanding.

One method of data collection I used was an exit ticket. Summaries were written by students on sticky notes and posted to the window as they left the classroom or submitted to me via email from their iPads. The data from these summaries helped me determine who was making adequate progress toward the learning goal. It also was an integral part of my lesson planning for the next day as I used the results to help me identify student needs.

Quizzes were another form of data collection I used. These formative assessments, that did not affect student grades, were given at the beginning of the hour, corrected by myself and then reviewed in small groups during the same class period. This was done because I wanted to provide timely feedback about progress towards our learning goal. Students appreciated reviewing their mistakes in a timely manner with guidance on how they could improve.

When content was delivered using direct instruction, lessons were built for use with a SmartBoard. Questions embedded into the lessons allowed students to receive immediate feedback on their process, with the help of iPads or Smart Response technology. Individual answers were compiled and displayed so the class could view

them. Results did not identify any one student but instead gave an overall picture of how the class was doing. We used the combined results to discuss common mistakes and misconceptions.

I brought my formative assessment data to our weekly PLC meeting. The data was then compared to pre-test data we collect before each unit. Teachers discussed data and chose a targeted population to receive additional interventions outside the normal class period. I decided to use the 5<sup>th</sup> grade MCA-III data to help in selecting students for such interventions. Students who scored 550 or higher in the 5th grade are considered proficient by the MN Department of Education. I first gathered a list of students whose score was between 548 and 552 for my watch list. Then, I checked those names against the data collected in my classroom. Students who were not making adequate progress toward our learning goals and were on my MCA-III watch list were selected to receive additional interventions. This was the group of students I felt had the most potential for improvement and would ultimately help us reduce the decline in MCA proficiency we experienced each year.

With our data in hand and our target population selected, the math interventions began. Our building principal announced a building directive: students would be pulled from classes throughout the day to receive math interventions. Much like students were scheduled for band lessons, our selected population would be scheduled for small group math sessions with a teacher. During math interventions, students were given additional feedback regarding their progress towards MN math standards and re-taught skills they failed to show progress in. Groups were no larger than four students and sessions lasted

approximately 30 minutes. Students were scheduled for small group sessions only as needed.

I was no longer just going through the motions. With all the data I was collecting, I was keenly aware of where each student was in regards to our daily goal. I began looking for activities that students could run themselves or required very little help, leaving me time to meet with a few students each day to provide meaningful feedback. Games that were chosen would strengthen previously taught math skills, the use of iPads and websites like Tenmarks.com provided a means for me to offer enrichment content with immediate feedback and hints when students were stuck.

### **Challenges in providing feedback to students**

Research shows effective feedback will improve student learning. Furthermore, descriptive feedback given to students has been shown to be the most beneficial to the student. So why aren't more teachers providing descriptive feedback to students in their classrooms? I believe the greatest challenge to providing effective feedback is lack of time.

As I have described in the classroom experiences, large amounts of data are being collected during student contact time. The challenge before me now is to turn the data around and provide effective feedback to each of the students. It was labor intensive see teachers use time to help the low achieving students in making progress towards the learning goal or in my case those students selected as my target group. However, time often runs out before I am able to move on to the rest of the students in the classroom.

### **Suggestions for Further Research**

Based upon our initial observations, feedback to students has had a positive affect on our students' achievement. In 2012-13 school year, the Minnesota Department of Education reported that 47.5% of our students were proficient in math. Whereas, 46.3% of the students, during their 5<sup>th</sup> grade year were proficient in math.

I would recommend that a more formal study be done to determine if the gains in student achievement were due to feedback or some other variable. The number of 5<sup>th</sup> grade students considered proficient by the MN Department of Education in 2011-12 was at an all time low. One could argue that improvement during the 6<sup>th</sup> grade year was inevitable.

From my research, I unable to determine if timing played a part in the effectiveness of the feedback. Much of the research focused on how to deliver the feedback and less on the timing of the feedback. As many school districts move towards blending classroom experiences with an on-line component, more research is needed to determine if the timing for feedback given to students increases its effectiveness.

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