Making Assessment Meaningful in Math Class

by

Adam M. Glodowski

Field Project

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Date:

This field project paper has been examined and approved.

Review Committee:

_____
Professor Jeffery Wiechman, Chair

_____
Professor John Meyer

_____
Professor Paul Tess

Approved:

_____
John Meyer
Director of Graduate Studies

Abstract

The following document details a field project focused on making assessment meaningful for students. The purpose of this project was to improve student motivation and foster a growth mindset through a planned program of formative and summative assessment strategies.

The 7th grade math students at Trinity Lutheran School in Kiel, WI participated in this project. The students completed a survey exploring their attitudes towards math at the beginning of the project and again at the end. The students continued working through their regular math lessons; however, they were exposed to different formative assessment strategies during their class time.

Results indicated that formative assessment strategies which allowed for more time to explore a new concept, or to further expand a previously taught concept, led to greater understanding and enjoyment for the students. These strategies were implemented with unit-based instruction and expanding traditional Saxon math lessons with two days of instruction. Students with a growth mindset were able to weather their struggles and believed they could achieve even when achievement was elusive.

Acknowledgments

As I reach the end of this journey, I must first thank God for the many blessings He has showered on me. I had a supportive congregation that helped finance this endeavor, an Education Committee that was committed to the accreditation process and understood the importance of this degree, and wonderful students who played along as I tried different assessment strategies out on them as I worked through this paper.

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Chapter I: Introduction

Identify the Issue

It became apparent to me one day as I watched my students correct their math homework that this activity had little value for them. They dutifully checked over their papers and marked the errors. They wrote the number wrong on the top of the page. Then, they turned the paper in without giving it a second thought. I witnessed this pattern continue during the next several days and I was led to wonder: "How can correcting math become more meaningful for these students?"

A quick Google search will provide many quotable quotes reflecting on the importance of learning from mistakes. Many will recall being taught a similar lesson while growing up. Humans learn more from mistakes than success. I considered this as I watched my students look over mistakes and move on the next lesson, ready to make those same mistakes over again.

Assessments, especially formative assessments such as daily math lessons, have great potential to help students learn. Marzano (2006) wrote about classroom assessment and outlined four principles of effective assessment. Marzano's second principle of classroom assessment basically states that assessment should encourage students to improve. This reinforces the idea that assessment should lead to learning not just judge whether learning has taken place or not. Boaler (2015) wrote that assessment for learning "tells students where they are in their learning path, where they could be, and what they need to do to get there" (p. 94).

Therefore, the main issue is encouraging students to examine their assignments and learn from them – both what they know and what they need to learn. This would

make the formative assessment in math class, the daily math lessons, more meaningful for the students.

Importance of the Project

Student engagement is crucial to education. Engagement – being attentive, committed, persistent, and seeking meaning – is closely related to motivation (Brunsell and Fleming, 2014). Students who are motivated to learn will gain more from their education. "Motivation influences how much effort students expend and how long they persist in working on tasks" (Dean, Hubbell, Pitler, and Stone, 2012, p. 20). This idea reflects on student interest and motivation. Boaler (2016) wrote, "When students develop interest in the ideas they are learning, their motivation and their achievements increase" (p. 147).

Teacher feedback plays an important role in student motivation and therefore achievement. Schweinle and colleagues (2006) found that "when [teacher] feedback was frequent, elaborative, positive, and used to help students develop understanding . . . students reported higher affect, efficacy, and importance" (p. 273). This feedback will also help students understand what they have mastered and where they can improve.

Building on that research, Brunsell and Fleming (2014) wrote that "self-reflection leads to deeper understanding, mastery-goal orientation, and stronger self-regulating behaviors" (p. 13). In other words, meaningful feedback from assessment will have a positive result on student motivation and engagement. Feedback is also intimately related to goal setting (Marzano, 2007) If this feedback can increase the students' engagement with the assessment, then students will be able to learn from the assessment. They will be able to learn from their mistakes.

American education can benefit from an evaluation of common math instructional practices. Current math education in America is creating negative experiences for too many students. Boaler (2015) wrote, “Far too many students in America hate math and for many it is a source of anxiety and fear” (p. 3). Boaler went on to cite some troubling facts regarding math education in America:

- In a survey of middle school students, more than half said they would rather eat broccoli than do math. Forty-four percent would rather take out the trash than do math.
- In a recent international assessment of mathematical performance conducted in sixty-four countries across the world, the United States ranked a lowly thirty-sixth.
- An Associated Press/America Online (AOL) news poll showed that a staggering four out of ten adults said they hated math in school. Twice as many people hated math as any other subject.
- In September 1989, the nation’s governors gathered in Charlottesville, Virginia and set a challenge for the new millennium: American children should top the world in science and mathematics by the year 2000. Now, fifteen years after that time goal, the United States sits near the bottom of international rankings of mathematical achievement. (p. 3-4)

Many agree that math education needs change, but there are some troubling ideas on how best to change math in American schools. Bennett (2011) concluded that schools should simply stop requiring math in middle school and high school. His proposal does not solve the problem of math anxiety, but simply bypasses it. Math is challenging. That

is not a negative. The question is: how can educators help students understand and even enjoy this challenging subject?

Meaningful assessment can help. Allowing students the time – and teaching them how – to reflect on their assessments and learn from them will improve their engagement and their mathematical mindset.

Project Purpose or Goal

The purpose of this project was to improve student motivation and foster a growth mindset through a planned program of formative assessment strategies.

The assessments sought to motivate students to improve and learn from their mistakes, as well as track student achievement. Discussing student mistakes has a goal of fostering strong conceptual understanding (Boaler, 2016) and leading to greater motivation and self-efficacy. These discussions of formative assessment can make those assessments more meaningful to students. Students will hopefully use assessments to learn from their mistakes, gain confidence in their ability to improve, and grow in their understanding of mathematics.

Chapter II: Literature Review

Introduction

Much has been written on student efficacy and mindsets. It is important that students believe they can be successful in order for them to be engaged. “Identity and self-efficacy affect whether learners think they can succeed” (Brunsell and Fleming, 2014, p. 18). It is also necessary that students believe they can grow as learners. They cannot see themselves as a fixed product when it comes to learning. “A growth mindset equips students to be willing to tackle hard problems and persevere until they reach a solution” (Seeley, 2016a, p. 5).

Student Self-Efficacy

“Self-efficacy is a measure of students’ confidence in their ability to master a new skill, task, or content” (Brunsell and Fleming, 2014, p. 7). This is a key concept in a classroom where students will examine their mistakes to enhance their learning. Student self-efficacy will impact their approach to challenging material – like the material they will encounter in a math classroom. Students who possess a high self-efficacy, a belief that they can be successful, will perform better with challenging tasks than those who have a lower self-efficacy (Dweck, 2015). Students who doubt their ability to succeed will often avoid the challenge all together. Bandura (1993) further noted that students with a high efficacy visualize success scenarios, while those with low efficacy dwell on what could go wrong.

Many people – parents and teachers – point to the apathy of modern students (Marshall, 2016). Apathy primarily displays itself in a student’s disengagement or unwillingness to perform beyond the bare requirements. This may very well be a

symptom of low self-efficacy. The typical response to this is to lower expectations, but classroom research and experience point to a difference solution.

Lowering expectations until a student finally “gets it” can result in mind-numbing exercises that do not promote engagement or challenge. Most likely, these students will fail to engage in these simple tasks and see education as irrelevant. These students need to build confidence through appropriate challenge. They need higher self-efficacy.

Students will develop efficacy in math through their experiences in the math classroom. “The most effective way of creating a strong sense of efficacy is through mastery experiences. Successes build a robust belief in one's personal efficacy. Failures undermine it, especially if failures occur before a sense of efficacy is firmly established” (Bandura, 1994, p. 72).

The key phrase from Bandura is to ensure failures do not occur before a sense of efficacy is established. Students must experience success in order to develop confidence in their abilities as a math learner. “More important, as their confidence starts to improve, they increase their performance because they don’t want to let themselves down” (Marshall, 2016, p. 54). It becomes easier to deal with and learn from failure after an individual has experienced some success. That success will breed confidence and subsequent failures will not be as demoralizing.

“A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high assurance in their capabilities approach difficult tasks as challenges to be mastered rather than as threats to be avoided” (Bandura, 1994, p. 74). This is a vital component to establishing a culture where students are willing to

examine mistakes and learn from them. Students need some belief in their own abilities. "Confidence is critical to learning" (Dueck, 2014, p. 5).

Importance of Growth Mindset

Dweck (2006) described two types of mindsets in her book, *Mindset*. A fixed mindset represents the idea that what someone is able to learn is limited by that person's genes. "I'm just not a math person." A growth mindset represents the idea that genes are just the beginning and that their intelligence can grow. Mindset will impact what a student believes they can achieve and their motivation. "With a growth mindset, both successful and less successful students can become motivated" (Seeley, 2016b, p. 6).

Boaler (2016) agreed with this idea and applied it directly to the mathematics classrooms. She pointed out the importance of embracing mistakes. Growth mindset allows for students to learn from failure and grow as individuals. Similarly, Seeley (2016a) wrote, "From what we've learned about how intelligence can be effected by experience, we now know that not only is making mistakes normal, it may actually represent an important component to learning and growing intelligence" (p. 6).

One challenge is to teach the students that mistakes are normal and are embraced in the classroom. Willingham and colleagues (2018) noted this challenge when they wrote, "Many students see mistakes as flaws for which their teacher will judge them" (p.326). Teaching students about growth mindset will help them understand that they are growing and that they will gain skills and achieve more than they thought they could. These are important conversations to have in the classroom. The teacher can also model mistakes and how a learner can grow after examining their mistakes.

It is possible to change the mindset of students. Blackwell (2007) studied a group of junior high students to examine why some students thrive under a challenge and others with equal ability do not. In the study, students in the control group were taught about the stages of memory and study skills. Students in the experimental group were taught the same material with the additional teaching on intelligence.

The experimental group learned that intelligence was malleable and could be developed. There were clear differences in the results of the two groups. "Students who endorsed a [growth mindset] increased in math grades relative to those who endorsed [fixed mindset]" (p. 258). The results were very revealing of the importance of mindset. Three times as many students in the growth mindset group showed an increase in effort and motivation compared with the control group. After the training, the control group continued to show declining grades, but the growth-mindset group showed a clear rebound in their grades (Blackwell, 2007).

Both students and teachers need to understand the importance of growth mindset. These mindsets have an impact in student learning. "When students view intelligence as fixed, they tend to value looking smart above all else . . . Students with a fixed mindset do not like effort. They believe that if you have ability, everything should come naturally" (Dweck, 2010, p. 17). This fixed mindset will lead to resistance to examine mistakes and learn from assessments. These students will not reflect and try again, rather they will see any difficulty as proof that they are just "not math people" and give up.

"Students with a growth mindset, in contrast, value effort; they realize that even geniuses have to work hard to develop their abilities and make their contributions" (Dweck, 2010, p. 17). This mindset will encourage students to learn from their mistakes

and rise to the challenge. They will be able to achieve more because they believe they can learn and grow. “Students’ beliefs concerning their abilities to do mathematics and to understand the nature of mathematics have a significant effect on how they approach problems and ultimately on how well they succeed” (Van de Walle, Karp & Bay-Williams, 2010, p. 47).

Motivating Students to Achieve

All this comes back to student motivation. Self-efficacy is needed to have confidence in one's’ abilities. Growth-mindset is needed to take risks as a learner (Dweck, 2010). The teacher has an important role to create a classroom culture that allows for these mechanisms to thrive. Teaching growth mindset to ones’ students will enable them to rise to the challenge, not shrink from it. There are many different ways to encourage confidence and growth mindset.

“One way to create such a culture is by providing the right kinds of praise and encouragement” (Dweck, 2010, p. 17). Students will benefit from teachers who praise effort and hard work. Telling students they are “smart” will only continue to foster the fixed mindset culture. “Teachers should also emphasize that fast learning is not always the deepest and best learning and that students who take longer sometimes understand things at a deeper level” (Dweck, 2010, p.18).

Assessments, both formative and summative, can serve to motivate students. Curwin (2014) defines educational motivation as “the desire to learn” (Curwin, 2014, p. 39). He wrote that challenging students will lead to motivation. Marshall (2016) agreed when he wrote, “The natural inclination when a student does not know the answer or

shows that a fundamental skill is missing is to progressively reduce the difficulty of the questions or assignments" (p. 54).

Marshall (2016) went on to say that simple exercises will not motivate students. No one feels pride when they accomplish a simple task. Curwin (2014) compared it to an adult defeating a 3-year-old in a game of Candy Land. This intuitive idea was expanded on when Anderson (2016) wrote, "Students learn most when they are appropriately challenged" (p. 14). Students will experience greater benefit receiving guidance and encouragement from a knowledgeable teacher as they attempt something within their "Zone of Proximal Development".

Vygotsky (1978) explained that a student's Zone of Proximal Development as a way to get from the unknown to the known. He defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p.86). How does this apply to assessment? "Assessments should encourage students to keep trying, whatever their level of achievement" (Curwin, 2014, p. 38).

Not only do assessments need to challenge students, but what the teacher does with that assessment is also important. The teacher's role is providing that guidance to help connect the unknown with the known. "From a Vygotskian perspective, the teacher's role is mediating the child's learning activity as they share knowledge through social interaction" (Dixon-Krauss, 1996, p. 18). After this mediation, the teacher's role shifts to providing feedback from both formative and summative assessment. When done correctly, this feedback can foster student growth.

Effective feedback may need to look different from what is traditionally done in classrooms. “The use of both marks and comments is probably the most widespread form of feedback . . . [but] it is no more effective than marks alone” (Wiliam, 2007, p. 25). In other words, it is a waste of the teacher’s time to include both. Students only focus on the grade, or mark, and ignore the comments. “Giving marks alongside the comments completely washed out the beneficial effects of the comments” (Wiliam, 2007, p. 25). Effective feedback may need to separate these elements.

Students will benefit from effective feedback. Assessments can motivate students to grow and learn. Assessments can provide this type of feedback if used properly. “In addition to providing students with feedback . . . we should also create opportunities for students to collect and analyze their own data” (Jackson, 2009, p. 135). The benefits of students tracking their own progress was observed by Jackson herself in her own classroom. “. . . simply having the information about their grades helped my students take more ownership for their success in the classroom” (Jackson, 2009, p. 136). Students can benefit greatly from the ability to self-assess. “The capability and willingness to assess their own progress and learning is one of the greatest gifts students can develop. (Stenmark, 1989, p. 26).

Making assessments meaningful and motivating will lead to student engagement, self-efficacy, and achievement. Allowing students to collect and analyze their own data will give students ownership of their learning. Creating a culture where mistakes are the norm will allow students the confidence to examine their own errors and grow from them.

Summary

Valuable feedback is foundational to student growth. This feedback needs to foster a growth mindset in students and encourage them to learn from their mistakes. The teacher needs to praise effort and hard work, not focus on results. The teacher also needs to turn mistakes into a positive learning opportunity, not make students experience negative feelings about them. This will allow students to examine their errors and improve because of them.

Chapter III: Implementation

Introduction

The purpose of this project was to improve student motivation and foster a growth mindset through a planned program of formative assessment strategies. These formative assessment strategies used daily practice to motivate student learning and build that growth mindset. Since achievement is linked with motivation (Dean, Hubbell, Pitler, and Stone, 2012) student achievement was measured with a summative test. The assessments were used both as a tool for learning as well as a measurement of learning.

Procedures

The seventh grade math students were exposed to different formative assessment strategies during three separate windows of time. Each window focused on a different formative assessment strategy for three weeks. Marzano (2007) found that the frequency of formative assessments is related to student academic achievement, so formative assessments were implemented every day, unless that was a summative assessment day.

The first window began on January 3, 2018. The students began correcting their daily math lessons and recording the number of the problem they got wrong along with the math lesson that problem reviewed. The students then found a problem in the new lesson that corresponded to the same lesson. This new problem was starred as a "focus problem" for their new lesson and allowed for individual student error analysis, a formative assessment strategy to help them to see what they needed to do to improve (Frey & Fisher, 2011).

Achievement and motivation are linked – "motivation influences achievement" (Dean, Hubbell, Pitler, and Stone, 2012, p. 20). The students had an opportunity to

examine incorrect answers, learn from those mistakes, and apply them to problems on the new lesson. The students took two summative assessments during this window.

The second window began on February 5, 2018. During this window, the students were taught math concepts in a unit-based structure instead of Saxon's spiral method of instruction and review. This instruction allowed for students to focus on one area of mathematics, graphing for example, instead of learning a different concept every day with the spiral curriculum. This strategy provided opportunities for scaffolding instruction as the concepts built on the previous lesson and building on background knowledge from earlier lessons (Frey & Fisher). The students were able to deepen their understanding of one overall concept and learn more about it every day. The students took two summative assessments during this window.

The third and final window began on March 6, 2018. The students returned to Saxon's instructional method, but with a greater focus on the procedure of solving the math problems. Two days were spent on each lesson with extra time given to practicing the new concept along with a shorter assignment, the odds on one day and the evens on the next. This formative assessment strategy allowed for the students to spend more time learning the new concept, before another new concept was introduced in the spiral curriculum. Students also had a shorter assignment and therefore more time to work through each problem they were expected to complete. They completed three summative assessments during this window.

During all three formative assessment windows the students were exposed to a growth mindset. This was accomplished by praising effort and focusing on the procedure instead of results. Students were reminded they can learn anything with enough work and

practice. Students were also encouraged to look at mistakes differently. Boaler (2016) wrote, “When we teach students that mistakes are positive, it has an incredibly liberating effect on them” (p. 15). The researcher discussed the growth mindset with the students and led them in peer assessment and self-assessment to foster this mindset. The students completed an attitude survey at the beginning of this research and again at the end to measure their attitudes towards math.

Population and Sample

This research took place at Trinity Lutheran School in Kiel, WI. The seventh grade math class participated in this research. There were six students in that class: three boys and three girls. 100% of the students were Caucasian. Student age ranged from 12 to 13. Using the STAR Math Assessment tool, this class all fell “at/or above benchmark” during the 2017-2018 school year.

The class average from the 2016-2017 third quarter was 87 percent. The highest score in the class during that same quarter was a 92 percent while the lowest score was a 78 percent. These grades include retakes on all tests with a score lower than 80 percent.

Their class average from the fourth quarter of that same school year was 86 percent. The highest score was a 93 percent while the lowest score was a 77 percent. These results include retakes on all tests with scores lower than 80 percent.

This class of students understands math concepts and had a class average of 86.5 percent for the second half of the previous school year. Now the task was to determine what kind of mindset this class had and examine how they would respond to the formative assessment strategies implemented in this field project.

Results

The students began this project with an understanding of the importance of math in their lives and a belief that they can improve as math students. They were asked to complete a survey regarding their attitudes and feelings towards math class at the beginning of the first formative assessment window.

The results of the Student Attitude Survey (Appendix A) that was given on January 2, 2018, are summarized in the table below:

Table 1

Student Attitude Survey Results (January 2018)

0 Strongly Disagree	**1** Disagree	**2** Was Undecided	**3** Agree	**4** Strongly Agree

Statement Evaluated	**Responses**				
	0	**1**	**2**	**3**	**4**
1. Math is important for my life.			|	|||	||
2. My math teacher listens to what I have to say.				||	||||
3. I learn more about math working on my own.	|	|	|||	|	
4. Math is my favorite subject.		|||	|	||	
5. I am good at math.			|||	|||	
6. I have the ability to improve in math.				|||	|||
7. Math will always be difficult for me.	||||	|	|		
8. In the past, I have had bad experiences in math class.	||	||		||	
9. Math doesn't make sense to me.	||	|||	|		
10. Math does not apply to my life.	|||	||	|		
11. I am a mathematician.		||	||	||	
12. I like to figure things out on my own.		|	~~||||~~		
13. Math is boring.	~~||||~~		|		
14. I enjoy figuring out how to solve problems.			|||	|	||
15. I enjoy math more now than I did at the beginning of the year.	|	||	||	|	
16. Math is interesting to me.		|	|	||	||

The students' attitudes toward math were split. Fifty percent of the class disagreed with the statement "math is my favorite subject". Fifty percent of the class was undecided

if they were good at math. However, this group of students believes in the growth mindset model of intelligence. One hundred percent of the class either agreed or strongly agreed that "[they] have the ability to improve in math". Eighty-three percent disagrees that math will always be difficult for them. I was left with the question of how to continue to encourage their growth mindset. I wanted to see how meaningful formative assessments would impact motivation and their self-efficacy.

During the first formative assessment window, where students starred problems they got wrong on the previous lesson and found corresponding problems on the new assignment to focus on, the class as a whole averaged 78.8 percent on their daily work and 67.6 percent on their tests. These scores do not reflect any retakes that were available. The scores are broken down in the table below:

Table 2

Window #1 - "Focus Problems" Assessment Averages

	Daily Work	Tests
Student 1	70%	64%
Student 2	79%	60%
Student 3	84%	66%
Student 4	81%	76%
Student 5	75%	60%
Student 6	84%	80%

During the second formative assessment period, the students were taught in a unit-based structure. This is different from the spiral curriculum used in Saxon math. The class average was 90 percent on daily work and 81.6 percent on tests. The individual student results are recorded in the table below:

Table 3

Window #2 - Unit-Based Instruction Assessment Averages

	Daily Work	Tests
Student 1	79%	80%
Student 2	93%	85%
Student 3	90%	78%
Student 4	97%	85%
Student 5	87%	76%
Student 6	94%	86%

During the third and final formative assessment window, the students spent two days on each new lesson. This allowed for shorter daily assignments (odds on day one and evens on day two) and for two days practicing the new concept instead of just one. The class as a whole averaged 80.2 percent on their daily lessons and 76.5 percent on their tests. The individual student results are recorded on the table below:

Table 4

Window #3 – Two Days Per Lesson Assessment Averages

	Daily Work	Tests
Student 1	76%	69%
Student 2	80%	68%
Student 3	88%	77%
Student 4	82%	93%
Student 5	75%	75%
Student 6	80%	77%

Comparing the achievement data from each window demonstrates that on average the students were more successful with the unit-based instruction and the two day lessons than the focus problems. The class average of 68 percent during the first window is not

much better than the average from the previous year (67.6 percent) when no formative assessment modifications were made. The highest class average test score of 82 percent was earned in the unit based instruction window. However, the greatest individual growth (Student #4 increased from 76 percent to 93 percent) was earned with the two day lessons. This student earned 100 percent on the final two summative tests taken in that window.

Table 5

Average Summative Assessment Scores

	Window #1 Test Avg.	Window #2 Test Avg.	Window #3 Test Avg.
Student 1	64%	80%	69%
Student 2	60%	85%	68%
Student 3	66%	78%	77%
Student 4	76%	85%	93%
Student 5	60%	76%	75%
Student 6	80%	86%	77%
Overall Avg.	**68%**	**82%**	**77%**

This data tracks the impact these formative assessment strategies had on student achievement, and there is a link between motivation and achievement. Before that correlation is examined further, the goal of the formative assessment strategies was to impact student motivation and attitudes towards math class. How did these strategies impact attitude and self-efficacy?

At the end of the three formative assessment windows, the students were again given the Student Attitude Survey (Appendix A) on May 7, 2018. The results of the second survey are recorded below:

Table 6

Student Attitude Survey Results (May 2018)

0 Strongly Disagree	**1** Disagree	**2** Was Undecided	**3** Agree	**4** Strongly Agree

Statement Evaluated	**Responses**				
	0	**1**	**2**	**3**	**4**
1. Math is important for my life.				|||	|||
2. My math teacher listens to what I have to say.				||	||||
3. I learn more about math working on my own.		|	~~||||~~		
4. Math is my favorite subject.		|	||	|||	
5. I am good at math.			||	||||	
6. I have the ability to improve in math.			|	||	|||
7. Math will always be difficult for me.		|||	||	|	
8. In the past, I have had bad experiences in math class.	|	|||	|		|
9. Math doesn't make sense to me.	|	||||	|		
10. Math does not apply to my life.	|||	|||			
11. I am a mathematician.	|	||	|	|	|
12. I like to figure things out on my own.			|||	|||	
13. Math is boring.	|	||	||	|	
14. I enjoy figuring out how to solve problems.			|||	||	|
15. I enjoy math more now than I did at the beginning of the year.		|		||	|||
16. Math is interesting to me.			|	|||	||

In May, 100 percent of the students agreed that "math is important for my life". The students are undecided about group work versus working individually. The different strategies had a positive impact on the class as 83 percent reported they "enjoy math more now than [they] did at the beginning of the year". Did their attitudes and opinions about math class change from January? How did this experience influence these students' attitudes and motivation?

The table below compares the results of the January survey with the one taken at the end of the formative assessment windows in May:

Table 7

Student Attitude Survey Comparison (January/May **2018)**

0 Strongly Disagree	**1** Disagree	**2** Was Undecided	**3** Agree	**4** Strongly Agree

Statement Evaluated	**Responses**				
	0	**1**	**2**	**3**	**4**
1. Math is important for my life.			I	III	II
1. Math is important for my life.				III	III
2. My math teacher listens to what I have to say.				II	IIII
2. My math teacher listens to what I have to say.				II	IIII
3. I learn more about math working on my own.	I	I	III	I	
3. I learn more about math working on my own.		I	~~IIII~~		
4. Math is my favorite subject.		III	I	II	
4. Math is my favorite subject.		I	II	III	
5. I am good at math.			III	III	
5. I am good at math.			II	IIII	
6. I have the ability to improve in math.				III	III
6. I have the ability to improve in math.			I	II	III
7. Math will always be difficult for me.	IIII	I	I		
7. Math will always be difficult for me.		III	II	I	
8. In the past, I have had bad experiences in math.	II	II		II	
8. In the past, I have had bad experiences in math class.	I	III	I		I
9. Math doesn't make sense to me.	II	III	I		
9. Math doesn't make sense to me.	I	IIII	I		
10. Math does not apply to my life.	III	II	I		
10. Math does not apply to my life.	III	III			
11. I am a mathematician.		II	II	II	
11. I am a mathematician.	I	II	I	I	I
12. I like to figure things out on my own.		I	~~IIII~~		
12. I like to figure things out on my own.			III	III	
13. Math is boring.	~~IIII~~		I		
13. Math is boring.	I	II	II	I	
14. I enjoy figuring out how to solve problems.			III	I	II
14. I enjoy figuring out how to solve problems.			III	II	I
15. I enjoy math more now than I did at the beginning of the year.	I	II	II	I	
15. I enjoy math more now than I did . . .		I		II	III
16. Math is interesting to me.		I	I	II	II
16. Math is interesting to me.			I	III	II

Examining the changes in attitudes, it is encouraging to see more students agree with the statement "I am good at math" (+1 from January). More students agree with the statement "math is important for my life" (+1 from January). Unfortunately, some negative changes occurred during the time of this field project as well.

There was a shift in the mindset questions (specifically question #7) that indicates students are not as certain of their ability to improve in math as they were in the first survey. This shift will be examined in greater detail in the conclusion to this study.

One question I was left with at the end of this field project was the impact achievement had on motivation and self-efficacy. Basically, would a student stay motivated if achievement was lacking? Two students in the research group provide a window into this question.

Student #1 struggled on both formative and summative assessments during the third window. Did this impact motivation or belief in ability? The results for some key questions are recorded in the table below:

Table 8

Student Attitude Survey Results (Student #1)

0 Strongly Disagree	**1** Disagree	**2** Was Undecided	**3** Agree	**4** Strongly Agree

Statement Evaluated	**Response (Jan)**	**Response (May)**
4. Math is my favorite subject.	1	1
5. I am good at math.	2	2
6. I have the ability to improve in math.	4	3
7. Math will always be difficult for me.	2	2
8. In the past, I have had bad experiences in math class	3	2
11. I am a mathematician.	1	1

This student's attitude seems unaffected by his struggle to achieve mastery. The student moved from "strongly agree" to "agree" (-1) when responding to the statement "I have the ability to improve in math". However, most of the responses involving mindset are unchanged. While the student doesn't enjoy math (question #1), the growth mindset of this student seems to persist through difficulty. This supports current research as Frey and Fisher (2011) noted that although students with a growth mindset "may suffer setbacks, they are more resilient" (p.23) than those who see intelligence as fixed.

Student #4 saw the greatest individual gains during the third window. This student even said, "I love spending two days on each lesson. I feel like I really understand this and it is getting easier." This student scored 100 percent on the final two summative assessments taken during that window. Did this achievement impact motivation and self-efficacy? See the results in the table below:

Table 9

Student Attitude Survey Results (Student #4)

0 Strongly Disagree	**1** Disagree	**2** Was Undecided	**3** Agree	**4** Strongly Agree

Statement Evaluated	**Response (Jan)**	**Response (May)**
4. Math is my favorite subject.	0	2
5. I am good at math.	2	3
6. I have the ability to improve in math.	4	4
7. Math will always be difficult for me.	3	3
8. In the past, I have had bad experiences in math class	2	1
11. I am a mathematician.	2	3

This student moved from "strongly disagree" to "undecided" (+2) when evaluating math as a subject area (question #4). This student moved from "undecided" to "agree" (+1) when responding to the statement "I have the ability to improve in math".

This indicates some correlation with achievement as this student was fresh off two perfect scores on summative assessments. Student #4 moved from “undecided” to “agree” (+1) when reflecting on the statement “I am a mathematician” while Student #1 continued to “strongly disagree” with that statement.

The question of motivation and its relationship to achievement is an interesting one and one that educational researchers have been examining for decades. Bandura (1993) wrote, “Personal accomplishments require not only skills but self-beliefs of efficacy to use them well” (p. 119). This illustrates the important concept that both skills and a belief in ability are needed to achieve and succeed.

Chapter IV: Reflective Essay

Introduction

Assessments, especially formative assessments such as daily math lessons, have great potential to help students learn. The purpose of this project was to improve student motivation and foster a growth mindset through a planned program of formative assessment strategies. To accomplish that purpose, daily math practice was used to motivate student learning, build a growth mindset, and guide students towards success in the math classroom.

Conclusions

It was my intent to make daily correcting a more meaningful exercise for my students. I wanted them to learn from their mistakes and eliminate some of those mistakes on their work in the future. I wanted them to experience success and see the growth they believed they could achieve in math.

Following the first survey, the students' attitudes toward math were split. Fifty percent of the class disagreed with the statement "math is my favorite subject". Fifty percent of the class was undecided if they were good at math; however, every student in the class believed they had the ability to improve at math. I was curious if they would continue to believe in their ability to improve if they experienced struggles in the assignments, both formative and summative.

Comparing the three formative assessment strategies employed during the field study illustrated the unit-based instruction and two-day lessons were the most successful. Summative assessment averages were higher for all but one student in the second window, which was unit based instruction. Spending two days on a new concept also

proved effective for the students as their average scores were higher than the first strategy. One student experienced the most success in the third window.

The table of results is reprinted here for easy reference:

Table 10

Average Summative Assessment Scores

	Window #1 Test Avg.	Window #2 Test Avg.	Window #3 Test Avg.
Student 1	64%	80%	69%
Student 2	60%	85%	68%
Student 3	66%	78%	77%
Student 4	76%	85%	93%
Student 5	60%	76%	75%
Student 6	80%	86%	77%
Overall Avg.	**68%**	**82%**	**77%**

How did these result impact students' attitudes towards math? The attitudes of the students and their growth mindset did not seem to change from one formative assessment window to the other. While there were some small shifts from individual students, overall their attitude and mindset remained consistent through their success and struggles. This supports the research on growth mindset. "Students with a growth mindset keep going even when work is hard and are persistent" (Boaler, 2016, p.6).

The experience was beneficial to the researcher. I found that I had a greater focus and was more mindful of the formative assessment I was doing in my class. I gave more attention to collecting and analyzing data on my students' attitudes towards math and the class I was teaching. I was gratified that all of my students "agreed" or "strongly agreed" when responding to the statement "my math teacher listens to what I have to say".

My focus on formative assessment helped me realize how little attention that type of assessment often gets from teachers. I had never been so intentional about formative assessment before and my research allowed me to implement different strategies and provided me with even more strategies to use in the future. This focus on formative assessment will stay with me as a teacher as I continue to make assessment meaningful for my students.

Recommendations

The focus on formative assessment is a good one for every classroom teacher to have. I will always remember the difference between assessment *for* learning and assessment *of* learning. Students need both. Teachers need both. My experience with this field project and my research before and during the project provided me with recommendations that will make assessment meaningful in all classrooms.

Recommendation One:

Begin the school year discussing growth mindset with your students. My research clearly demonstrated the negative impact a fixed-mindset has on a student. Use the attitude survey (Appendix B) and modify to fit your class or your classroom in general. This survey, or one like it, will provide you with insight into your students' attitudes and mindset at the beginning of the school year. You can then foster a growth mindset in your students through praising effort, not ability, and teaching them how the brain continues to grow as they learn.

Recommendation Two:

Use formative assessment to provide meaningful feedback to your students. I read so much about feedback in my research and this is an area I know I need to improve in as

a teacher. During this field project, I took time to meet with students individually to discuss their math grades and how they could improve them. Admittedly, I did not do this enough, but the few conversations I had illustrated how important feedback was when removed from a final grade. I did not collect any data on my conversations, but just listening to the students comments gave me a window into their perspective. My comments in return gave the students insights on how to improve.

Boaler (2016) wrote about the importance of this diagnostic feedback independent from a grade. "Students needed only to *think* they were working for a grade to lose motivation" (p. 143). One of my goals for the coming school year is to offer feedback without a grade attached and to better use formative assessment to motivate students.

I discovered this too late to try it during my research, but in an online lecture for her class *How to Learn Math (For Teachers),* Professor Boaler cited an interesting study. A simple sentence was written at the end of diagnostic feedback given to students. The sentence "I am giving you this feedback because I believe in you" achieved significantly higher than those who received the feedback without the sentence. While this cannot be used after every assignment or assessment, it does illustrate the importance of meaningful feedback and how that feedback can foster a growth mindset among students.

Recommendation Three:

Embrace the mistakes your students make. The question that began this research project for me was: "How can correcting math become more meaningful for these students?" I wanted to help my students learn from their mistakes. The formative assessment windows I implemented during this field project allowed for me to present information in different ways to my students. It also allowed me to try different

approaches to examining student mistakes. The first window directed students to examine their mistakes and find similar problems in the new lesson. My goal was to embrace student mistakes. Student achievement results did not illustrate the effectiveness of this strategy, but I am not certain I implemented it long enough to alter the students' belief about mistakes. Did they truly see mistakes as learning opportunities or did they feel they were being judged? Perhaps an additional question on the student attitude survey would help with this uncertainty.

The teacher plays an important role in creating a classroom culture where mistakes are embraced. A teacher can create a classroom where students are not afraid to take risks. That culture will continue to enhance and foster a growth mindset and build self-efficacy.

Recommendation Four:

Do not allow your students to earn a failing grade. When grading summative assessments, use the grade *"not yet"* instead of an *"F"*. "If you get a failing grade you think, 'I'm nothing, I'm nowhere.' But if you get the grade 'not yet' you understand that you are on a learning curve. It gives you a path into the future" (Dweck, 2014). This is another way to foster a growth mindset among students and use assessment *for* learning. I have been offering retakes in my math class for years and requiring them for all students who score below an 80% on a summative assessment, but I have never used this verbiage in my comments to students. I plan on implementing this change next year.

Recommendation Five:

Explore the relationship between motivation and achievement. As I reached the end of this field project, I became more interested in the resiliency of the growth mindset.

Would a student remain motivated in a class where they were not seeing success? More research can be done in this area and I would encourage any educator who shares my interest to explore this relationship further.

These recommendations are a great place to start for teachers looking to make assessment meaningful in their classrooms. These recommendations will hopefully empower any teacher to create an environment where all students believe they can grow in their understanding of any academic subject.

References

Anderson, M. (2016). *Learning to choose choosing to learn.* Alexandria, VA: ASCD.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Physiologist 28,* 117-148.

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior 4,* 71-81. New York: Academic Press.

Bennett, J. (2011). *John Bennett: Why math instruction is unnecessary* [Video file]. Retrieved from: https://ed.ted.com/on/G452sxac

Blackwell, L. (2007). "Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development 78*(1), 246-263.

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages, and innovative teaching*. San Francisco, CA: Jossey-Bass & Pfeiffer Imprints.

Boaler, J. (2015). *What's math got to do with it?: How parents and teachers can help children learn to love their least favorite subject*. New York: Penguin.

Brunsell, E. & Fleming, M. A. (2014). *Engaging minds in science and math classrooms: The surprising power of joy*. Alexandria, VA: ASCD.

Curwin, R. L. (2014). Can assessments motivate? *Educational Leadership 72*(1), 38-40.

Dean, C., Hubbell, E. R., Pilter, H., & Stone, B. (2012). *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: ASCD.

Dixon-Krauss, L. (1996). *Vygotsky in the classroom. Mediated literacy instruction and assessment.* White Plains, NY: Longman Publishers.

Dweck, M. (2014). *Grading smarter, not harder: assessment strategies that motivate kids and help them learn.* Alexandria, VA: ASCD.

Dweck, C. S. (2016). *Mindset: the new psychology of success.* New York, NY: Random House.

Dweck, C. S. (2010) Even geniuses work hard. *Educational Leadership. 60*(1), 16-20.

Dweck, C. S. (2015). The secret to raising smart kids. *Scientific American. 18*(6), 36-38.

Dweck, C. S. (2014). *Carol Dweck: The Power of Believing That You Can Improve* [Video file]. Retrieved from:

https://www.ted.com/talks/carol_dweck_the_power_of_believing_that_you_can_improve/discussion

Frey, N. & Fisher, D. (2011). *The formative assessment action plan*. Alexandria, VA: ASCD.

Jackson, R. R. (2009). *Never work harder than your students*. Alexandria, VA: ASCD.

Marshall, J. C. (2016). *The highly effective teacher: 7 classroom-tested practices that foster student success*. Alexandria, VA: ASCD.

Marzano, R. J. (2006). *Classroom assessment and grading that work*. Alexandria, VA: ACSD.

Marzano, R. J. (2007). *The art and science of teaching*. Alexandria, VA: ACSD.

Schifter, D. (2007). What's right about looking at what's wrong? *Educational Leadership*. *65*.3, 22-27.

Schweinle, A., Meyer, D, & Turner, J. (2006). "Striking the right balance: Students' motivation and affect in elementary mathematics." *The Journal of Educational Research. 99*(5), 271-294.

Seeley, C. L. (2016a). *Building a math-positive culture: how to support great math teaching in your school.* Alexandria, VA: ACSD.

Seeley, C. L. (2016b). *Making sense of math: how to help every student become a mathematical thinker and problem solver.* Alexandria, VA: ACSD.

Stenmark, J. K. (1989). *Assessment alternatives in mathematics: An overview of assessment techniques that promote learning.* Berkeley, CA: University of California.

Wiliam, D. (2007). *Keeping learning on track: formative assessment and the regulation of learning.* Greenwich, CT: Information Age Publishing. Australian Association of Math Teachers.

Willingham, J., Strayer, J. & Barlow, A. (2018). "Examining mistakes to shift student thinking." *Mathematics Teaching in Middle School*. *23*(6), 324-332.

Van De Walle, J. & Karp, K. S. & Bay-Williams, J. (2010). *Elementary and middle school mathematics*. Boston, MA: Pearson.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Appendix A: Consent Form

CONSENT FORM

Making Assessment Meaningful in Math Class

You are invited to be in a research study to examine effective ways to use assessment in a mathematics classroom. You were selected as a possible participant because you are a student in the math class taught by the researcher. Please read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by: Adam Glodowski (MLC Master's Program w/ Leadership Emphasis)

Background Information

The purpose of this study is: to examine effective ways to use assessment in a mathematics classroom. The assessment will be used to measure learning, but also to encourage learning from feedback itself.

Procedures:

If you agree to be in this study, we would ask you to do the following things: continue with your regular class work, including daily assignments and tests; participate in surveys provided by the primary researcher; give honest feedback when asked.

Risks and Benefits of being in the Study

The study has minimal to no risk: students will continue with regular class work as they have been during the school year so far. The researcher will include different forms of assessment and different procedures during the regular class.

The benefits to participation are: the student should become aware that they can learn anything and they can improve by studying and learning from their mistakes.

Compensation:

You will receive payment: students will receive class points for surveys and will benefit from different forms of testing and daily work. The goal of the study is to improve academic performance in a subject area that is traditionally challenging.

Confidentiality:

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records.

Voluntary Nature of the Study:
Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the Martin Luther College. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:
The researcher conducting this study is: Mr. Adam Glodowski. You may ask any questions you have now. If you have questions later, you are encouraged to contact him at Trinity Lutheran School, 920-894-3012, adglodowski@trinitykiel.com

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Director of Graduate Studies at Martin Luther College, 1995 Luther Ct, New Ulm, MN 56073; (507) 354-8221 ext. 398.

You will be given a copy of this information to keep for your records.

Statement of Consent:
I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature:_____ Date: _____

Signature of parent or guardian:_____ Date: _____
(If minors are involved)

Signature of Investigator:_____ Date: _____

Appendix B: Student Attitude Survey

Student Attitude Survey

0 Strongly Disagree	**1** Disagree	**2** Undecided	**3** Agree	**4** Strongly Agree

1. Math is important for my life.	0	1	2	3	4
2. My math teacher listens to what I have to say.	0	1	2	3	4
3. I learn more about math working on my own.	0	1	2	3	4
4. Math is my favorite subject.	0	1	2	3	4
5. I am good at math.	0	1	2	3	4
6. I have the ability to improve in math.	0	1	2	3	4
7. Math will always be difficult for me.	0	1	2	3	4
8. In the past, I have had bad experiences in math class.	0	1	2	3	4
9. Math doesn't make sense to me.	0	1	2	3	4
10. Math does not apply to my life.	0	1	2	3	4
11. I am a mathematician.	0	1	2	3	4
12. I like to figure things out on my own.	0	1	2	3	4
13. Math is boring.	0	1	2	3	4
14. I enjoy figuring out how to solve problems.	0	1	2	3	4
15. I enjoy math more now than I did at the beginning of the year.	0	1	2	3	4
16. Math is interesting to me.	0	1	2	3	4