

“But Mrs. Moore, you didn’t even tell us we had to use math!” How I made math fun in my 2nd Grade Classroom

Question:

“What happens to my gifted second grade students when I engage them in Guided Math and independent math stations?” AND “What happens to my 2nd grade gifted students when I implement differentiated instruction and problem-based learning experiences?”

Sub-Questions:

1. What happens to students’ views of themselves as mathematicians?
2. What happens to self-regulation/monitoring during independent work time?
3. What happens to student motivation?

Rationale:

Coonley prides itself in being a school that caters to the “whole child” with lots of enrichment activities and little focus on “test prep” like many other CPS schools. As a faculty we are, however, spending the year focusing on Guided Math groups and how we can align our instruction to the Common Core State Standards in order to provide the highest level of instruction for our students. In addition to differentiating our lessons for students, we are encouraged to provide hands-on and interactive approaches during lessons as much as possible. One day a week for 45 minutes I meet in a Math “Cluster” that is comprises of two third grade neighborhood teachers, and three teachers who teach fifth grade math (one of which is the fourth grade gifted teacher). Our meetings are led by the Principal Intern and focus on finding, sharing, and creating ways to best align our current curriculum with the CCSS.

In my 2nd grade gifted classroom, I use a 3rd grade math curriculum called *Everyday Math*. This program easily lends itself to dividing the math lesson into at least three sections including:

1. guided math instruction
2. practice of the skill being taught (math journal)
3. review of previously learned math skills using worksheets (math boxes) and games

However, without using supplemental materials, students are only instructed on the 3rd grade level without many resources provided for differentiation. My students’ math ability levels, as determined by the NWEA Math Assessment, range from third grade to well into 4-8th grade and therefore relying solely on this math program will not meet the math needs of all of my students. With standardized assessments such as NWEA teachers are now being held accountable for meeting students’ needs, regardless of grade level, and moving them through at least one year of growth. This means if a group of students in my 2nd grade class is working on 4th grade concepts in math in September then by the end of the year they should have masters those concepts, along with some 5th grade concepts, even though they are still in the 2nd grade classroom. This accountability, as well as my ethical responsibility to providing the best possible education for my students, lead me to question how I could best engage my students during an 1-1.5 hour long math block where they received instruction at their math ability levels and were given time to practice the newly learned skills independently or in small groups in meaningful, real-world ways that challenged their critical and analytical thinking.

The independent station activities that are provided by the math curriculum do a wonderful job at reviewing learned concepts in a “drill” way having students do multiple number sentence problems but do not provide as much real life application or critical thinking through a problems-based approach (word problems, scenarios, “Where is the error?”, etc.) as I would like. In addition to my need to supplement during independent math stations, I also need to analyze the skill being taught and determine how to take it to the next level of understanding of some students as well as how to break it down for others to better understand.

My class is highly motivated, with the exception of five students (DN, John, HR, KS, NR), who are motivated but tend to need more guidance and encouragement throughout the course of the math block. These students fall into my lowest math groups for nearly every unit and their social/emotional issues hinder their ability to work successfully 100% of the time when we are not together. For example, there can be a lot of arguing in this group and if John or KS are having a bad day, for any reason, they can easily derail the work of the whole group by arguing, being ugly to members, or getting them off task. There is also a subset of students who work so quickly through the independent activities that they end up saying that they are “done” before their station time is up. These students usually begin reading to fill in the time but then, because reading is their preferred hobby, have a hard time transitioning back into math once it is time to move on to their next math station. On more than one occasion, Adrian has missed an entire math station because he has been so enthralled in his 8th grade reading level book. Another group of students, many of which fall into my middle tier group, work through their math stations in the time allotted usually needing no more or less time to complete the activity but may go home and tell their parents that they still do not understand something. MG and LN, both in this group, are notorious for seemingly “getting it” during guided groups yet struggling at home and having breakdowns with their parents. I receive emails from their parents in the afternoons asking if I noticed the issue at home. In order for students to push themselves in the classroom I know that I must create activities that are challenging, relevant, and engaging. I must also provide opportunities for students to share with me where they believe their greatest needs are so that I can help remediate problems and so that they are able to feel positive about themselves as mathematicians.

Consideration of ethics and permissions needed:

I will need the permission of the parents of the students and the students who are participating in the research (all students in my 2nd grade classroom.) I will send home a permission slip for parents to fill out and send back. The permission slip will describe the research I am doing, and inform families that students will be videotaped, interviewed, and written about in my final paper and presentation (with their names changed of course.)

Data Collection:

1. I will collect baseline math scores (NWEA MAPS) in November/December to determine activities during guided math. I may not collect updated math scores at the end of the year because I will be missing the final quarter due to maternity leave.
2. I will collect samples of student work during guided math and independent stations.

3. I will monitor students' self-evaluations of guided math and independent/small group work throughout the year. I will use the same collaborative group work rubric to record my observations and evaluations.
4. I will photograph and interview students.
5. Surveys for students and parents
6. Exit slips for students
7. Teacher Journal

Timeline:

1st Quarter-

- Collect beginning of the year data (Unit pre-tests until NWEA is completed, anecdotal notes, observations, etc.)
- Introduce math station CHAMPS expectations, collaborative group work self-assessment, friendly-sentence starters, and collaboration sign language
- Distribute and collect permission letters
- Begin writing in my teacher journal
- Begin Guided Math and Independent Math Stations utilizing teaching created student daily menu
- Begin differentiating guided math lessons
- Introduce "Above and Beyond" activities and organization
- Introduce the "Master Mathematician" wall/activities

2nd Quarter-

- Have students complete a survey concerning feelings, motivation, etc.
- Begin creating Math Menus and schedule for students to select their own activities to do when they are not meeting with me (allowing for heterogeneous groupings)
- Continue writing in my teacher journal
- Collect student work including videos and interviews
- Analyze student surveys and work in order to evaluate data and modify my practice
- Introduce and begin incorporating Singapore math, "Where's the error?", and other problems based activities.
- Begin implementing at least one math project per unit

3rd Quarter-

- Continue implementing ideas from Quarter 2 as well as modifications to ideas and new practices based on what I see as students' needs
- Re-administer student surveys, re-survey parents, and collect new math scores (if available)
- Begin having my maternity sub come in to observe students in guided math and independent groups
- Involve maternity sub in planning for and implementing activities and practices aligned to my action research

4th Quarter-

- Begin the final draft of my paper
- Present findings

School Context

My Northside urban school enrolls over 700 students in pre-kindergarten through 8th grade. This year, our school is so over populated that our two pre-kindergarten classes have to meet off site. In November 2012 CPS will begin building an addition to our building which will add 6 classrooms. Before the addition is complete, another grade, or two, will have to move off campus. This is a “problem” that the greater majority of CPS schools do not face and for that reason, we consider our increased enrollment a blessing.

In the early 2000’s our school’s enrollment was declining so they added programs which include a Regional Gifted Center and an Instructional Special Education cluster program to the neighborhood program. In 2008 the Regional Gifted Center began with only one first grade and one kindergarten class. Each year a gifted class has been added and as of September 2013, there are seven gifted classrooms in K-6th grade. Today, students in these programs still attend Coonley and there is a wait list of students who would like to be accepted into the programs.

In 2009, the population of neighborhood children began to increase and the school moved from having only one classroom per grade level to multiple classes in each grade level in addition to the gifted classes. During this time the school completed a \$3.25 million renovation which included the addition of a state of the art science lab and library, new bathrooms, updated floors throughout the school, and an outdoor classroom, ball field, and playground. Every classroom space, and sometimes even the extra large cubbie and closet areas, are used for classes and offices. Special Education classes are doubled up and utilize smaller repurposed office spaces. Many of the wrap-around services including speech and pull out tutoring meet in “rooms” created with removable walls in the hallways. Many enrichment classes travel to the homerooms and even the Principal shares his office with three other people.

In addition to the diversity that we see because of the combination of gifted, special education, and neighborhood, our school’s demographics are diverse in many ways. The breakdown of the school is: 53% white, 2% black, 35% Hispanic, 4% Asian and 6% other. Thirty-three percent of the students receive free or reduced lunch. Fourteen percent of the students have limited English proficiency. Twenty-six percent of the students receive special education services. The school ISAT growth in the past four years has been 13.2%. Based on the 2013 ISAT scores 86.7% of students meet or exceed the state standards.

Parent involvement at Coonley is excellent. Each classroom has two room parents who assist in getting parent volunteers, spreading news to families via email and website updates, and anything else that the teacher may need. I communicate with my parents mostly through face-to-face communication or the Internet. Most parents asked that I not send home paper communications. I, as well as all of the other teachers at Coonley, update a classroom blog with information, important dates, and pictures each week for parents to stay abreast of classroom happenings. There is a PTO and organization called “Friends of Coonley” which fundraise throughout the year. Last year their efforts were able to fund the purchases of 13 SMART boards in addition to over \$30,000 worth of new reading materials. The parents have also focused these funds on enrichment programs which allow the school to have a well rounded curriculum of Spanish, Music, Drama, Library, Computers, Physical Education, and Art. Each day my students attend one of these enrichment classes for 45 minutes and three days a week they attend two classes.

Coonley prides itself on exemplary, highly qualified, and professional staff. The majority of teachers have master's degrees and 8 faculty members have, or are pursuing National Board certification. Professional Development is built into the school day as well as time for collaboration. During three-four of my eight weekly prep times I am meeting with the principal, my grade level team, the third grade team, or the gifted team. These collaborative sessions each follow a specific format and include time for analysis of data, new learning, and planning. Last year the staff voted to have 14 hours of after-school professional development throughout the year rather than come back two days early at the beginning of the year. The Principal allows time for teachers to visit each other's rooms and last year began a process called, "Instructional Internal Rounds" where groups of teachers go into classrooms, observe good practices, and report out to the whole staff during professional development sessions. This year the process is going to include asking teachers to share resources, ideas, and strategies that were observed by the peer observers. The instructional leadership team has representatives from every grade level, special education, and enrichment programs. These things have made for a stable working environment where, last year, no teacher left and, because of increase enrollment, four teachers were hired.

There are three second grade classrooms, two neighborhoods and one gifted. I have 29 students in my gifted class while the neighborhood programs have approximately 34-35 students each. They share an instructional aid and a student teacher. Since our administration believes strongly in having student teachers in the building I will have a sophomore student teacher in my class one day per week for six weeks. I also have an instructional aide who comes into my room during literacy for one hour one day per week. I began my first year at Coonley this year teaching a grade that I had not previously taught before. I use second grade curricula for reading, grammar, writing, science, and social studies and third grade curricula for math and vocabulary. I use a Daily 5 approach to my literacy block and as well as Math Stations and Guided Group to provide lots of opportunity for differentiating instruction.

In my classroom, all but three of the students have been in the same Coonley gifted class since kindergarten. Three students were able to join the class this year from the waiting list after spots were added to the classroom roll. One student has been diagnosed with ADHD and two students are also being evaluated. At least three students see an outside social worker or therapist each week to discuss social and/or emotional issues. One of these students is easily upset and yells out, buries his head in his jacket, or cries 2-3 times per week over various issues. He has told me that he can feel when his medicine isn't working and that it causes him to feel funny. I am working with his mom and doctor to help him regulate his emotions. Another student has refusal issues, which have not been seen at school, where he will refuse to go to school, get out of a space, or do other task asked by an adult. One student is undergoing medical observation to determine a cause to her sickness which causes her to miss 1-2 days of school each week. Even though I teach the gifted class, there are four students who are performing at the second-grade level in both reading and math. I have students who range from the second grade reading level to the tenth.

All students in my class are eager to learn and love coming to school each day. They often bring in "show and tell" items as well as gifts for me to wear. Students in my class follow my directions/requests consistently throughout the day and when I do have to address them, they quickly correct their behavior. I use a behavior management tool called ClassDOJO which

rewards students with positive points for all of the good things that they do throughout the day and then takes away points when rules are broken. Each day students end with at least a few positive points instead of simply harping on the negative like most other behavior color-coded systems do. This new system has been very popular with my students and other teachers in the school have begun to use it too. Since they can download the app to their phones and monitor progress throughout the day, parents have raved about the improvements that they have seen in their child both in school and at home. At Coonley, tools for productive shared inquiry and communication are important so I am teaching students how to work together. Students are learning to be respectful to each other and have begun to utilize “friend sentence starters” to expand on each other’s ideas, give feedback, and invite peers into conversations. They also use a set of discussion “sign language” signs that allow them to silently inform the current speaker as to whether they have a comment that agrees or disagrees and/or if they believe that the conversation should conclude and move on to the next topic. I have noticed a dramatic difference in their collaboration behaviors since implementing these conversation starters and sign language. Students self-assess themselves often and rely heavily on their own assessments and reflections of their participation and work.

Literature Review

“The U.S. Department of Education’s National Mathematics Advisory Panel (2008) reports that students’ beliefs about learning are directly related to their performance in mathematics. Studies have shown that when they believe that their efforts to learn make them smarter, they are more persistent in pursuing their mathematics learning.”

-Guided Math: A Framework for Mathematics Instruction by Laney Sammons (pg. 34-35)

I am a person who has labeled myself as “not a math person.” I have seen my 7 and 8 year-olds already doing the same as they become frustrated and eventually give up or half-heartedly complete a task. As I have learned throughout my research, being a “math person” does not necessarily mean that you can quickly solve every advanced problem in the world or that you are able to solve a problem off of the top of your head, rather it means that you are capable of employing your ability to think critically, problem solve, and, when needed, communicate and collaborate with others (Gasser 2011, Garcia). The Common Core State Standards, learning standards which are currently being implemented in nearly every state, breaks this idea down even further by bringing a focus to five process standards: communication, reasoning and proof (another form of communication), problem solving, representation, and connections.

Throughout my action research, I hope to implement these process standards through: incorporating problem-based instruction, fostering student-led solutions, encouraging risk taking, having fun, and providing ample collaboration time for students. Three sections of my math block, 1.) morning message 2.) guided math and 3.) independent math stations will encompass these changes in order for me to help my student develop into confident mathematicians capable of doing things in the real world that are relevant, innovative, and cannot be done better through outsourcing or by a computer.

Guided Math:

In many classrooms today the model of teaching being used is very much direct instruction and includes: “I do, you watch. I do, you help. You do, I help. You do, I watch.” This format, while helpful for some, has left my students feeling as if they are not capable of problem solving without me first teaching them how they should do something. Though I will be present for this part of my students math block, I will be a facilitator of questions and discussions that lead to deeper understandings rather than the “keeper/holder of knowledge.” Instead of beginning the math block with me providing definitions and new rules, students are presented with an open-ended question, called a Math Message, that lends itself to the day’s skills. Lockhart, in his paper “A Mathematician’s Lament” (2002) says that doing this will “allow students to see the beauty of mathematics before becoming bogged down with its details.” He reminds teachers that we would not ask a child learning to play an instrument to learn everything there is to know about reading and writing music before picking up the instrument and playing around with it. This is also true for mathematics so we must empower students to take risks in their learning and to pull from background knowledge as they learn new skills and concepts.

This idea of allowing students time to think through their problems and invent their own possible solutions is more time consuming than traditional methods. Teachers themselves must buy into the benefits of this model as it takes great patience and thinking on the teachers’ part as she generates questions that will guide misconceptions, discussions, and students’ feelings of failure. De Garcia, in her article *How to Get Students Talking*, reminds teachers that it also becomes important that students are given adequate “wait time” so that the norm of student discussion rather than teacher solutions are created in the guided group. She also suggests using the NCTM Standards to create guiding questions for teachers to use in order to get various responses from students:

1. **Help students to work together to make sense of mathematics:** “So you are saying that... Can you repeat what he just said in your own words? What do you think about that? Do you agree or disagree? Why? Would someone like to add on?”
2. **Help students to rely more on themselves to determine whether something is mathematically correct:** “How did you reach that conclusion? Does that make sense? Can you make a model and show that?”
3. **Help students to learn to reason mathematically:** “Does that always work? Is that true for all cases? Can you think of a counterexample? How could you prove that?”
4. To help students to learn to conjecture, invent, and solve problems: “What would happen if? Do you see a pattern? Can you predict the next one? What about the last one?”
5. **Help students connect mathematics, its ideas and applications:** “How does this relate to...? What ideas that we have learned were useful in solving this problem?”

The idea behind my guided math will be that I am in the group to be a guide. This, along with other improvements to my practice, should encourage my students to become risk-takers. Rather than focusing on getting a “right” answer or solving a problem the correct way, I will be able to “produce a climate where failure is viewed as an experience from which to learn and not one of which to be ashamed” (Gasser, 2011, pg. 112).

Problem-Based Learning:

I, along with many teachers, have used this term loosely over the years but as I learn more about more about what it means to create real-world problems for students to apply their knowledge of learned skills, I see how important it is to create projects that really are meaningful to students. For example, reflecting on the “Precious has 24 stickers to share among her 4 friends. How many stickers will each friend receive?” questions that I initially posed as “problem-based and real world” questions, I now see the error in my ways. Questions like this do not generate “interest-driven investigations” which is what recent brain research suggest as being a key to engaging students in active processing of “information in the constructions of knowledge” (Wills, 2008 pg. 425) In recent years, Singapore, China, and France seem to have found success in using the problem-based models as they strive to create problems that are not only meaningful to students but are also relevant to their current and future lives. While being able to equally share belongings with a friend is a starting point and a skill that will be used down the line, it is important that we continue to build on these types of questions. “By immersing students in problems that contain much information to sort through and many components that can be solved in a variety of ways, they will be able to create more meaning to any learning that takes place throughout the problem-solving process” (Jensen, 2000, pg. 110). Jensen attests that when content is intertwined with context, learning is enhanced. In my classroom, having students tackle problems that include, for example, designing and presenting plans for a new playground after interviewing an architect and learning about area and perimeter or designing a bridge out of toothpicks while staying within budget constraint will allow students to work with more complex problems. While these types of projects may take more time than traditional methods of one lesson from the math book per day, research has supported my belief that my students will be more successful in solving more difficult problems than their peers who receive conventional math lessons and that with will “show a better understanding of key concepts,” along with a “greater ability to apply the strategies they have learned” (Gasser, 2011, pg. 113).

Differentiation:

This education “buzz word” is widely talked about but extremely difficult to manage. When thinking about differentiation in an hour and a half math block for 29+ students, 5 days a week, in addition to doing so in the other 5 hours of the day, most teachers’ eyes cross and, if they are like me, they cry. As teachers, we must find ways to realistically (i.e. meaningfully and manageably) differentiate for our students without spending hours upon hours of planning. Marian Small (2010) writes that in order to do this, teachers must step away from two widely held beliefs: 1. that students should work on the same problem at the same time and 2. that each math problem should have a single answer. She suggests, rather, that teachers utilize open questions, “a single question that is broad enough to meet the needs of a wide range of students while still engaging each one in meaningful mathematics,” and parallel tasks, “problems that focus on the same big ideas but have different levels of difficulty, thus taking into account the variation in student readiness. (pg. 32)” When teachers use open questions, they are providing choice to their students as they are able to answer in a way that is appropriate for their level. Additionally, everyone in the class benefits because the multitude of ideas and strategies are then shared with the whole group. Teachers may worry that students will not challenge themselves, but Small assures us that when given the latitude to do so, students will push

themselves. She also suggests using phrases such as, “That’s a good answer, but I noticed that several people thought of this...could anyone think of a more interesting way? (pg. 29)” Parallel tasks in the problem-based projects that my students complete will be important as well. Small suggests that I let students choose between two problems and pose common questions for all students to answers. In our toothpick bridge project, for example students will be able to choose between a million, thousand, and hundred dollar budget based on their comfort level with place-value and multi-digit subtraction. Regardless of their budgets, I will be able to use the same sets of questions for each group regardless of their level of proficiency with the skills.

Collaboration:

We all become masterful at task and develop better understandings of concepts when learning is a social process. Child development expert and educational trailblazer, Vygotsky, expressed the importance of students verbally express their ideas in the process of reasoning for themselves. He stresses that their ability to generalize their ideas through oral communication with a teacher or fellow student helps improve their language and deepens understanding. Additionally, when students collaborate with each other and engage in reflective conversation, they are engaged in dialogue that serves as a tool that promotes the construction of hypotheses, strategies, and concepts. (Sammons, pg. 35)

My Research Study

I have been teaching in CPS for the past 7 years, each year taking countless hours of professional development, challenging myself to earn my master’s degree, and achieve National Board certification in addition to writing grant after grant in order to purchase resources that I felt my students needed. All in all, I think that one would say I was a pretty good teacher. This year, however, my perspective on teaching was impacted more than any other professional experience has ever changed me because, this year, I became a mother. As many can attest and as my mother, a veteran teacher, has told me since I began my teaching journey, becoming a parent changes the way you teach. While I had always wanted the best for my students, this year I became much more concerned about *how the things that were happening in school would affect not only their brains but their hearts, how the things and the ways they learned would impact them outside of school, and how they would carry that knowledge and those feelings with them throughout their lives*. To say that I had never considered these things before would make me sound harsh, but as I began seeing my own child as my students, something that you truly cannot do until that becomes a reality, the thoughts had not persisted to a point of what has become an obsession.

This summer as I wrote my research proposal I was also in a small group at my new school about Guided Math. The statement, quoted earlier in the paper that states, “**The U.S. Department of Education’s National Mathematics Advisory Panel (2008) reports that students’ beliefs about learning are directly related to their performance in mathematics. Studies have shown that when they believe that their efforts to learn make them smarter, they are more**

persistent in pursuing their mathematics learning. (Sammons, pg. 34-35)” became something lurked into my mind throughout my preparations for the coming school year. It is a quote that quite honestly bothered me and pulled on my heart strings because I knew it to be true. While I did not yet know the students in my new class I did know that I had seen the quote proven with my previous students, quite frankly in myself, and especially in a special little boy named Duff Ray.



Duff Ray, like myself, had been “held back” a grade in elementary school. He was slightly dyslexic and had a poor vision of himself as a “school-learner” from a very young age. When he was in middle school the only way that he would read the required summer reading was when his mother purchased the audio tapes and listened to them with him. By high school he had dubbed himself as “not a school person” but luckily found a school based outlet for his talents when he discovered automotive classes at the Vocational and Technology component of the school. After a math class his junior year where the teacher told him and others in his class that they would never make it in college because they could not keep their notebooks organized and solve the problem the way that she told them to, he decided to take summer school and graduate early vowing to get out of high school as quickly as possible. Ole Duff Ray was, unfortunately, a common type of student in American schools. He did not see the purpose in the things he was being taught and therefore did not “buy in” to them. He also had a poor image of himself as a learner because from an early age actions, not even so much words-until later in high school, made him believe that he didn’t have the smarts that he needed for school. The summer that he spent taking the steps to “get out of high school fast” was the same summer that I was home for my wedding. As I helped him work through the summer school classes along with all of his frustration of “why do I need do this...how is this helping me...when will I even need this in my life?” I began to understand that he, like many other students, had never, or seldom, been given

real world tasks in school that helped them to understand the "hows" and "whys" of their learning and because of this they viewed school as just a thing that they were not "good at" and that was of little value to them. Later that summer I looked out the kitchen window to see this...



The kid who could not "do" math had single handedly designed, measured, tested, modified, and created this ramp that would catapult him through the air. When I asked him how he made it, Duff went into a long explanation of the angles, measurements, and design aspects that he knew were needed to make the ramp work. Why, I thought, would this kid think that he was not smart enough for school when in reality very few of his Honor Roll friends would have been able to analyze and evaluate the components needed to do what he had just done? Duff later told me that what he had done wasn't math, it wasn't school related, it was, rather, something he built because it was a challenge and it made sense to him.

"It was a challenge and it made sense to him..." Wow. What powerful words. Why hadn't his teachers been able to hone in on that simple phrase? After all, aren't those key words and phrases in every teacher's vocabulary, "challenge" and "made sense"? If a teacher had helped Duff to see the connection between what he was learning in school and his life would he have had a better image of himself as a learner? If I focused more on helping my students see this connection would they feel differently too? I began obsessing over how I could make changes in my practice that would put me closer to ensuring that I was never a teacher that made my

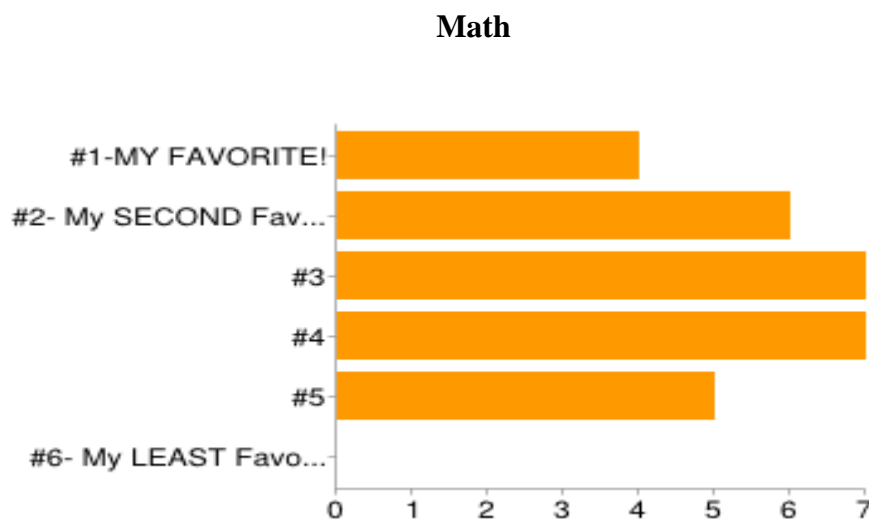
students feel like they weren't "good" at something because they didn't understand how it applied to their lives.

With a new school year at a new school starting and the fact that I was in my first trimester of pregnancy, I knew that I needed to start at a realistic place and modify as I became proficient in my teaching changes and as I learned more about my new group of students. I decided to begin with **(1.) simply figuring out a way to implement and manage guided math and math stations in my classroom. This progressed to identifying better ways to differentiate including (2.) open ended questions and (3.) RIT band focused groupings and also included my use of (4.) project based learning. Along the way I also began implementing an approach that included math lessons being student-led with teacher assisted guiding questions to supplement and me being overly supportive and encouraging.**

This is my journey:

Beginning-Of-Year Surveys and Analysis

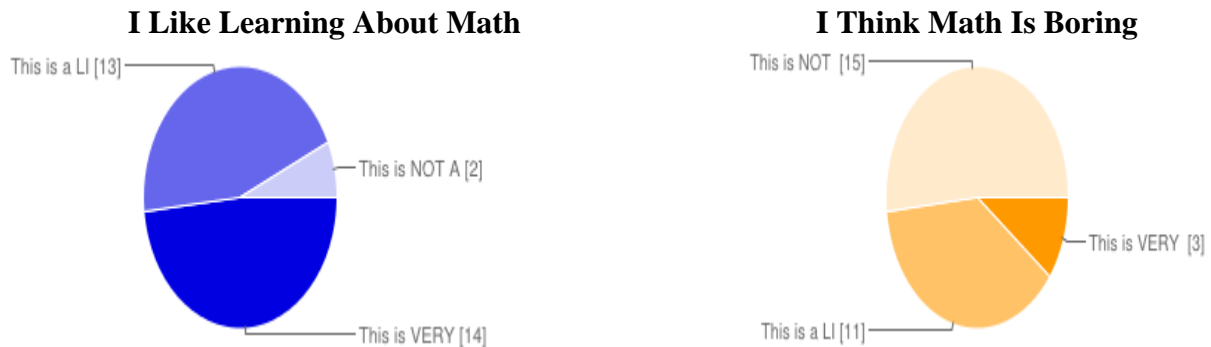
Since my focus was also on helping to improve students' views of themselves as mathematicians, I asked them to complete a short survey. I found that the majority of students' ranked math as their third and fourth favorite subject while reading and science lead the way as students' favorite. Many students mentioned the independence that came from reading and the experiments that they were able to do in science as reasons for their choices.



More students actually chose math as their fifth favorite subject than they did as their favorite. Students who chose math as their third favorite or lower made comments like:

- There are others things I like to do more than math.
- Math is hard and I cannot understand it
- I like it but I am not very good at it.
- I listed math last because math is beginning to run against me, fight me, and sometimes I don't have enough time to finish and I get 0 minutes left.

When asked if they “liked learning math,” 48% of students responded that this was VERY true of them, while only 2% answered that they did not like learning math. Furthermore, when asked how much they believed the statement, “I think math is boring” applied to them, only 10% of students agreed.



This beginning of the year data told me that while math may not be students’ absolute favorite subject, most were open to learning about math. In hopes of changing the minds of those 14 students who somewhat or absolutely agreed that math was boring, I asked all students to give suggestions about how we might make math more engaging. I reminded students that THEY were in charge of their learning and that if they wanted changes to happen in our classroom and their learning that they had to speak up. This was empowering for many as they listed ideas for improving the math lessons, including:

- “I want to do more projects and experiments like we do in science.”
- “Maybe we could use computers and do are in Mine Craft.”
- “We should try to make inventions and use blueprints.”

Categories of Students and a snap shot of each

For the purpose of being able to take snapshots of my class as a whole, I began to analyze my students based on my observations, their math grades, and the information that I was able to take away based on the survey and started to categorize them into groups.

Above Average	High	Very HIGH
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AS BA KS MG DN EP LN HR John*	NN RR FH NR Anthony* SW LW ET	EK LK. VM MW AN ER AY Adrian* SG AL GA
9/28	8/28	11/28

*All names have been changed to protect the identity of students.

Adrian represents the “very high” group of students in my class. He is sensitive, emotional, and highly intelligent. He maxed out the verbal comprehension portion of the IQ test. His cumulative score was 141. He did better as the questions got more difficult. His mind is quick and complex, but he is only 7 and it is overwhelming for him. He ends up with high anxiety and very strong reactions to anything uncomfortable.

Anthony represents the “high” students in my classroom. On the beginning of the year survey, he was very confident in his own ability stating, “Math is so, so, so fun and we get to do cool stuff! It is cool and it makes me learn a lot!” However, at the beginning of the year, he rarely shared his strategies with others or took the lead to mentor his friends in ways other than to simply give them the answer. He was highly motivated to do the task at hand but did not always take things to the next level without my guidance or suggestion.

John represents my “above average” group as well as those students whose social and emotional anxieties greatly impact their ability to function in collaborative and guided group settings as well as independent tasks each day. His mood dictates his willingness to participate as well as his overall feelings of self worth in relation to math specifically. During math time, I see a sharp change in his behaviors depending on the activities that we are doing, whether he is interested in the concept, and how easily he is able to comprehend new learning. John recorded that the statements “I like to learn math” and “I think math is boring” both were a little bit true of him. He wrote, “Math is hard and I cannot understand it.” At the beginning of the year, John made this comment throughout the majority of the math lessons.

Implementing Guided and Independent Math Stations

This part of my research was quickly implemented and then extended to better meet the needs of my students. Using the Everyday math curriculum I began having students rotate through three math stations each day including, guided math, master math, and math journals. I also created

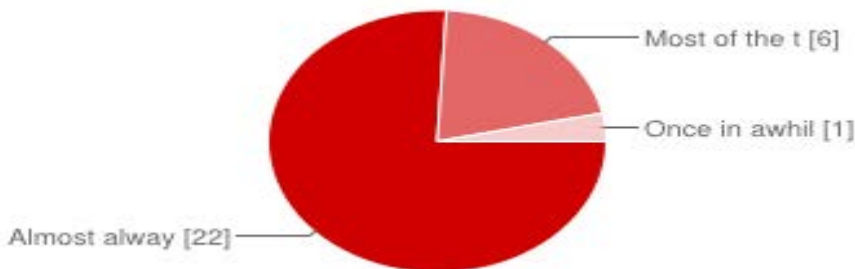
Guided Math

C	Partner Voice; Voice Level 2
H	<ol style="list-style-type: none"> 1.) Think back to what you learned in the mini-lesson 2.) Ask a neighbor (Voice Level 1) 3.) Ask Mrs. Moore 4.) Look in your student reference book
A	<p style="text-align: center;">Guided Math (15-20 minutes)</p> <p>Bring your Math Journal to the library rug and read/listen to Mrs. Moore's direction. Complete the activity page with your partners. Ask Mrs. Moore questions about things that you may not understand. Share "ah-ha's!" and strategies for solving the problems.</p>
M	<p>PLEASE do NOT leave your seat unless you have an emergency.</p> <p style="text-align: center;">Bathroom = NO New Pencil = Yes Bleeding or Injured = Yes</p>
P	<p>Looking at and listening to Mrs. Moore and friends who are sharing, working on MATH, being prompt to the meeting with ALL needed supplies, sharing ideas, strategies, asking questions to help improve your understanding</p>
S	<p>When CHAMPs expectations are met, you will be successful. Rate yourself on your Math Stations Schedule using the smiley faces. Write any successes or areas of improvement if needed.</p>

Over the course of a few weeks students had become proficient in the routines necessary for me to meet with small groups to differentiate instruction. Within these small groups I began to focus on student-led conversations about strategies and problem solving techniques. In my teacher journal dated October 9, I reflected:

The "above average" group continues to argue instead of discuss. Their feedback is often times negative in nature and hurts the other person's feelings causing them to shut down and no longer want to participate. I need to implement shared inquiry sentence starters and ways to respectfully give feedback. In the other two groups, students end up working on their own as fast as they can and never stopping to talk to each other or they simply tell others the answer. How can this be combated?---> modeling, during small group discussions I will ask a student to explain to another using the word BECAUSE..., give lots of praise for appropriate "help" and discussions, lots of practice with student-led discussions, lots of encouraging taking TIME.

I Work on Math Problems During Class Time With Other Students



Based on the beginning of the year survey, I could tell that students knew they should be/were given the opportunity to work with others. I began doing the things that I brainstormed in my journal and became more conscious of the emphasis that I placed on collaborating. These techniques became skills that I had students practice throughout the year.

Since I was able to manage the math stations and guided math, both components of my initial question, I began thinking of how I could expand my research. When asked to comment on the statement, "In math class, our teacher gives us worksheets that have many short math problems," 90% of students answers that it is mostly to always true. On the other hand, when given the statement, "In math class, we work on one big math problem for a long time," only 66% of students said this was true all or most of the time. I began to think about what this said of me as a teacher of gifted students since both best practice and their requests should have been guiding me toward creating more real world tasks in which they could apply the skills that they were learning. I also knew that in introducing this teaching style with second graders I would need to make sure that I was able to differentiate effectively. I realized that my question was beginning to shift towards gaining a general understanding of: What happens to my 2nd grade gifted students when I implement differentiated instruction and problem-based learning experiences?

Problem Based Questions/Real World Projects



currently working on and did not have to look much further than my classroom window to find an answer. Our school was undergoing construction as we received an addition right outside of our classroom. Both the boys and the girls spent a good bit of time each day checking out all of the machinery and materials that were being used on the site and quite a

As the first quarter neared an end and I began to feel more confident in simply being able to manage the math stations, I began to reflect on my desire to implement problem based and real world activities to my students' daily tasks. *After all, my students had told me that they would enjoy math more if we were to do these things!* I started thinking of a project that would go along with the perimeter and area unit that we were



bit of conversation had already come about surrounding the architecture and design. I created a project where students could build on their interest of the building addition as well as help them to see how the things that they were learning about area and perimeter were used in day to day life. “The Playground Project” was born and required students to design their dream playground, since the old one was being modified due to the construction. They would create a blueprint, figure out the kinds and amounts of pieces of equipment that would fit so that children could still play, and use their knowledge of area and perimeter to present their designs. Before the project got underway a student, LK, asked if her father, an architect, could come in to talk to her friends about design. She thought that he might be able to help everyone as they started to think about their projects. Talk about a student driven enrichment activity! Mr. K, who also happens to own a design firm, came in to show students some of his designs and to answer questions about the process that he takes when creating and building.

In my Teacher Journal dated December 9, I wrote:

“Students wanted to know about the programs that he used, the buildings that he had designed, and how/why he made the choices that he did. Never once did the kids get sidetracked by off topic questions about his daughter or other normal 2nd grade goofy questions. They were truly engaged in learning from an expert. Many times Mr. K looked at me and made a face as if to say, “Are they really asking this?!” WOW! The questions that come in the face of interest and challenge!”

As students worked on their designs and the math to rationalize it, I caught one student staring out the window for a rather long period of time. *My initial thought was to tell him that he*



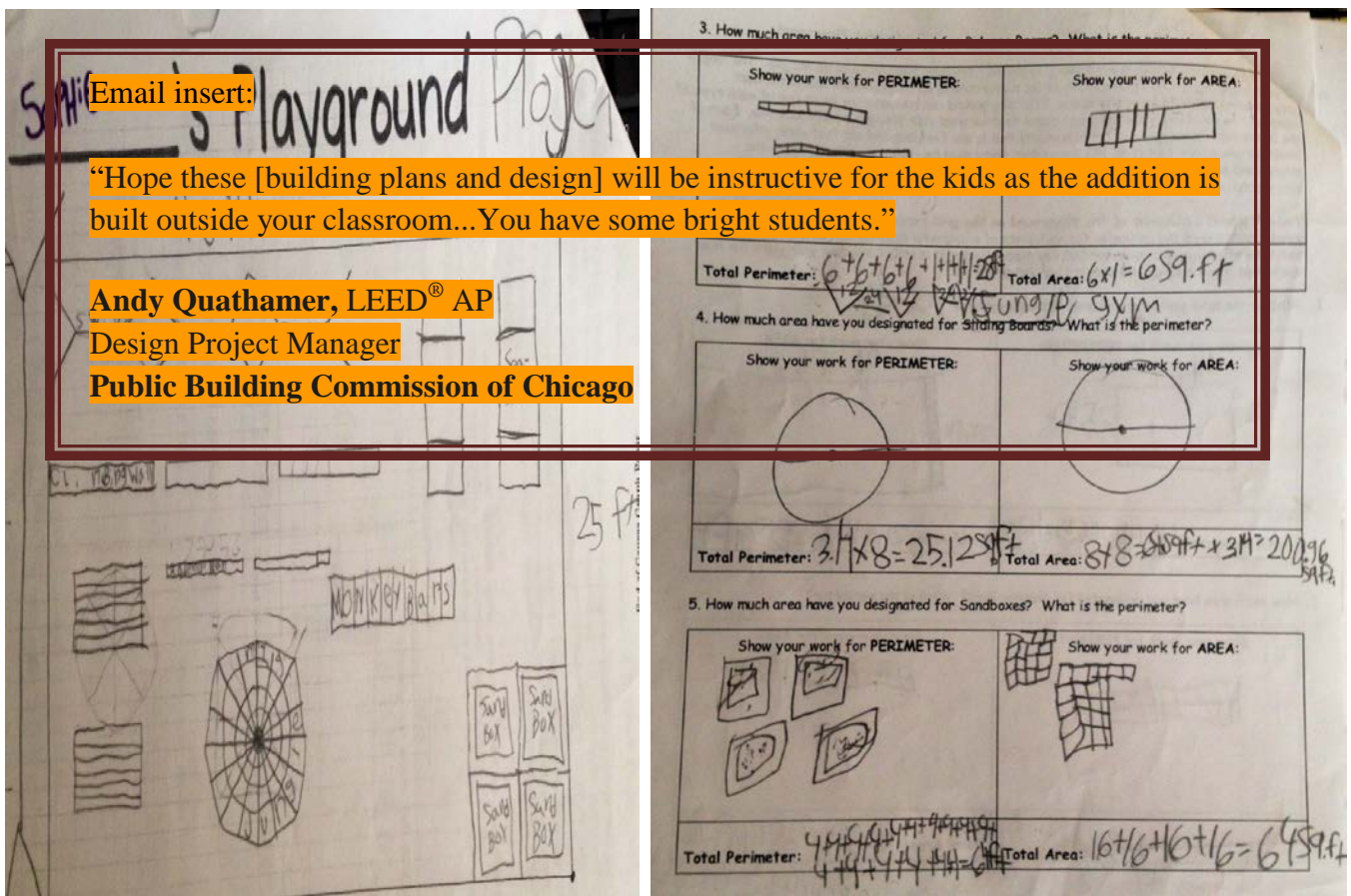
needed to go back to his seat to work, but something told me otherwise as I remembered how I wanted my students experiences with math to be more positive this year. As I engaged in a conversation with him about what he was looking at, he told me that he thought that seeing the blueprints for the new addition might help him as he designed his play ground. Luckily the engineers were having a walk through the following day and when I asked for a copy they were more than excited to share their work with a group of 2nd graders. One would have thought that John was receiving gold as he carefully handled and pursued the designs. I am not sure of what specific benefit they were to him, but he felt validated in his request to see them and I know that it made the

project all the more “real” to both he and his friends in the class. Hearing from an expert that he thought they were “bright” didn’t hurt my students’ egos either.

One of the observations that I was most pleased with was when I saw a group of students huddled around Sophie quietly listening as she explained how to find the area of a circle. I approached the group to listen in and after she finished asked her how she had learned this. Sophie told me that she and Adrian had been talking about it the day before and that she had gone home and asked her Dad about it. Together they did some research, figured out the formula and practiced it a few times, and then she had come back with a “cheat sheet” for finding the area of a circle. She said that since we had learned about diameter, radius, and circumference it made sense, plus she had wanted to include a jungle gym that she designed in the shape of a circle...that she NEEDED to know for her blueprint.

From student work during the task and after completion, I was able to analyze that:

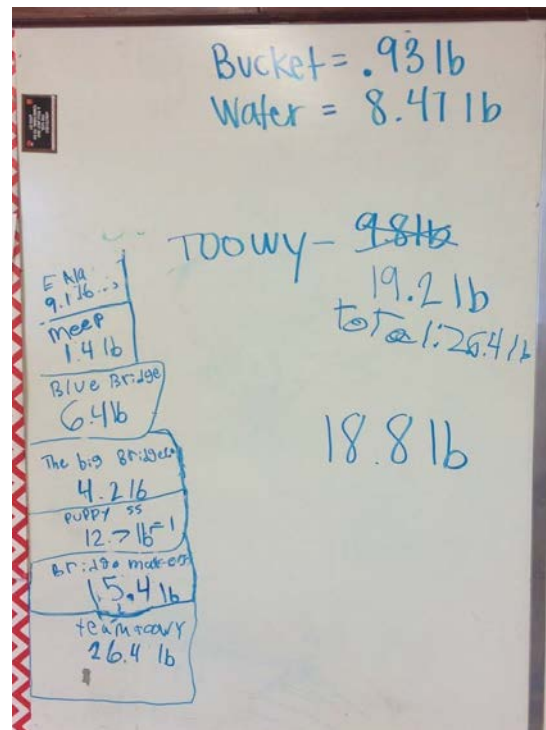
- 4 out of 29 students completed the minimum requirements by following the directions and only using equipment that was suggested (one of the students was absent for two days leading up to completion of the activity)
- 25 out of 29 students went above and beyond by creating their own equipment, adding special featured to the blueprint and included area and perimeter, or sought out additional resources during the designing period.
- Only 1 out of 29 students seemed to not enjoy the project as much as the other students though he did complete the project and did quite well. He voiced a few times that the project was too hard for him.



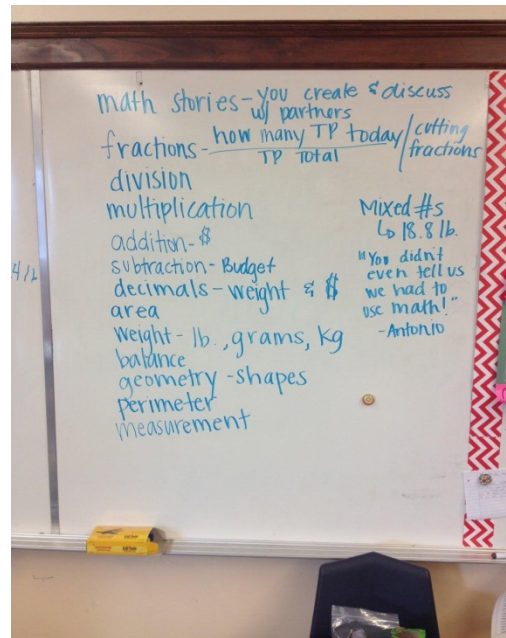
Project-Based Learning #2: The Toothpick Bridge

The second project based activity that my students participated in was the research, designing, and building of a toothpick bridge. I knew that we would be covering angles in a geometry unit as well as place value and real world applications of budgeting and thought that this activity would cover all of those things and more. This interdisciplinary unit required students to research various types of bridges, choose one, and report out on it covering the main points of what type of bridge it was, who built it, etc. Though this piece of the unit was meant to be brief and introductory to bridge designs in general, my overzealous crew went above and beyond the communicated expectations creating technology driven presentations and scaled models of their chosen bridge.

As they begin designing and budgeting for the bridges they had to collaborate with their partners. My tough love came in the form of charging groups for my guidance. In other words, if I had to step in to get a group back on track, settle a disagreement, correct unkind words, or anything of that nature, I charged \$1000 and that was deducted from the groups' overall budget. I also allowed members from other groups to be "hired" as consultants for other groups who needed assistance. In the picture, Anthony was being paid to teach members of another group how to secure their bridge in the most cost effective way. I overheard him talking to his employers by explaining his thinking, why he would do it one way and not the other, and how it would save the group money in the end. His conversation showed me that he was using the skill of explaining his thinking on his own!

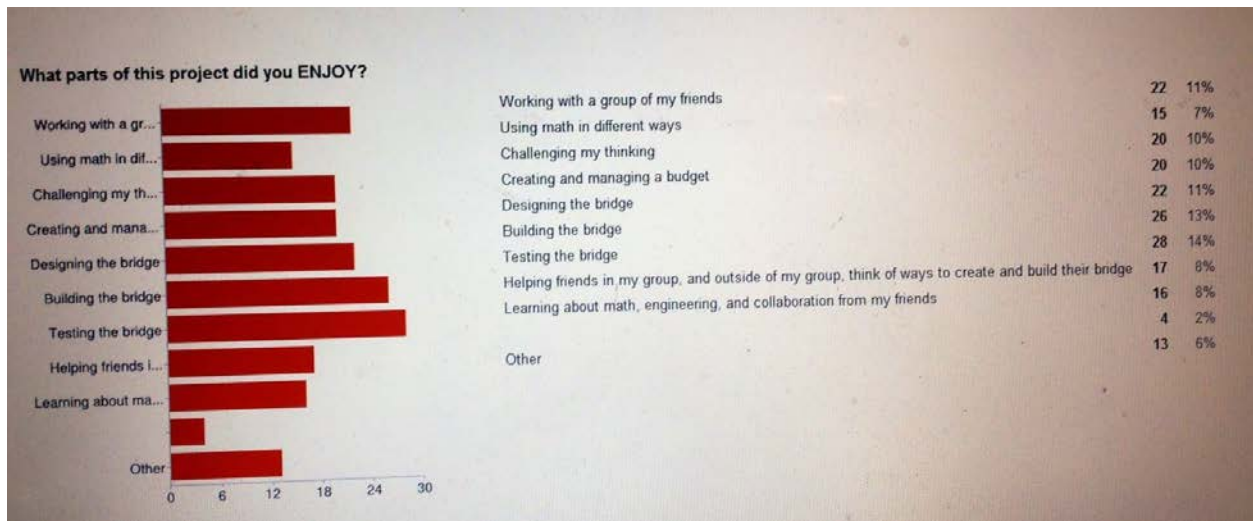


I was amazed at how sturdy each group's bridge really was. The team whose bridge held the most weight actually held a total of 26.4 lb! After the project, I asked students to reflect on their work as mathematicians. At first many of them seemed confused at why I would be asking about math when they had just finished doing this cool project. I prompted them by asking them to list the kinds of math that they used and the names of concepts started to flow. Before long they had nearly filled the whole board with ways that they had used math. Some of the things that they listed and explained using were things that I had not even thought to suggest they use.

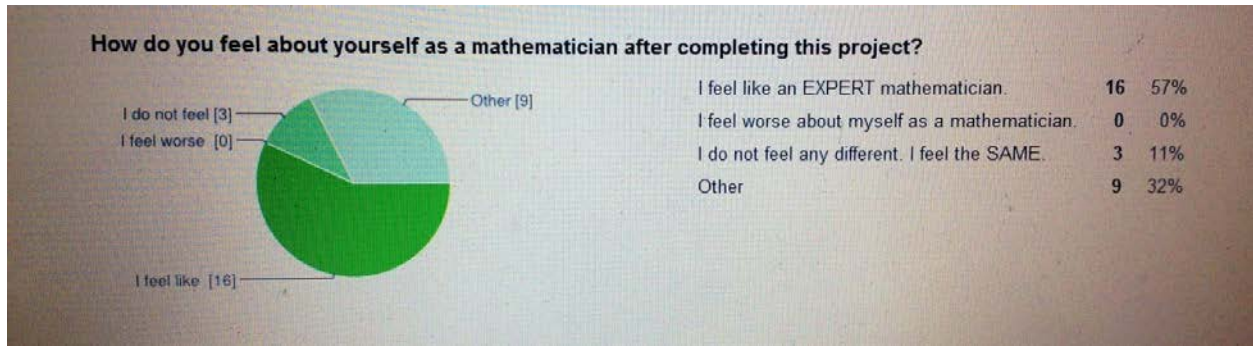


Anthony exclaimed, "You didn't even tell us we had to use math!"

Not surprisingly, 27 out of 28 students said that on a scale of 1-5 (5 being the highest) that they would rank their enjoyment of the project at a 4 or higher. All students reported that they would like to do a project like this in the future. I was also pleased to see that over half of the students reported that they ENJOYED the following aspects of the project.



Possibly more exciting than that data was what students reported about their feelings of themselves:



Differentiation

I knew that students still needed instruction on concepts before they would be ready to apply their knowledge during these real world problem solving projects and I wanted to find ways to meet students at their instruction level without killing myself in the process. Differentiation can be very difficult and with an already busy day in the classroom and being pregnant, I needed ways to differentiate that were practical and that I could maintain. I began to utilize open questions and parallel tasks (defined more clearly in my literature review) during the math message time of each lesson. Doing so allowed students to “get their feet wet” with the concept of the day while working at their own comfort level. Additionally, everyone in the class benefited because of the multitude of ideas and strategies that were then shared with the whole group.

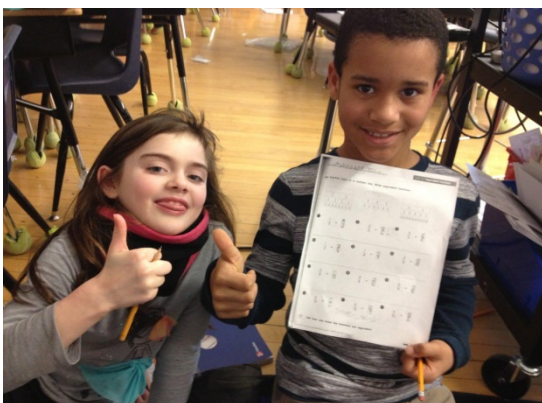
John, especially, would start off by fussing that the task was too hard or that he did not understand the question. In fact, at first he usually spent the allotted time to solve the problem complaining. As students began solving the problem they went to the board to explain their thinking and show their work. Having their peers explain their thinking challenged students to push themselves as they tried to have more than one way to solve problems. John began to catch on to the idea that he could solve the problems because he always knew *something* about each one. Even if he had not challenged himself initially he almost always had feedback to give to those who had and eventually adding another strategy, definition, or question to his work.



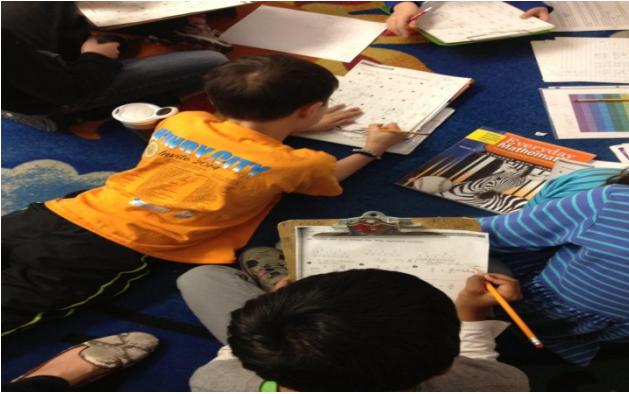
In this picture, three students volunteered to show their thinking and John, in blue, asked to give feedback to a solution that was inaccurate. Here he is explained why the answer was inaccurate and why another strategy would give an accurate answer. Maya, writing on the board, was listening to John's explanation, realized that her solution was inaccurate as well, and used yet another strategy to solve the problem.

I also saw those extremely high students, such as Adrian, become more engaged in the math message activities. Instead of rushing through the task and quickly saying, "I am finished...what should I do now..." and/or diving into a book (an activity that would then steal their attention for much of the math block) he, and others, were competing with each other. Many times these conversations and collaborative activities would last 10-15 minutes and always beautifully led us in to our mini-lesson for the day.

In addition to the open-ended and parallel tasks, I began RIT Band groupings and activities twice per week beginning in February. Though I was only able to oversee this until I left for maternity leave at the end of March, I did see much success with the leveled groupings. After determining which math strand we would be focusing on, I grouped students based on their RIT bands. Using NWEA resources I was able to focus in on specific skills that each group had mastered and most importantly what they were ready to learn. For example, for our fractions unit some students' RIT bands showed that they were ready to compare fractions with common denominators while other were ready to begin working with improper fractions and others needed to move into simplifying. I was able to find tons of activities including worksheets, games, art projects, and computer activities (TenMark.com) that aligned with each RIT band and created three stations for each RIT band. On these two days per week, I did not meet with a group rather I moved from stations to station listening in on students' conversations and offering guiding questions when needed. I tried not to explicitly teach students how to do the math at each station even though many of the concepts were new or were simply the next step in a concept that we had looked at during guided math. Instead I prompted students to use whatever strategies they could to work on their tasks. I also encouraged lots of talking and problem solving within their groups. I never told students that they were wrong but I did have them ask someone, besides me, in their group what they thought about their solution and by doing so they had rich conversations with each other about their strategies and understanding of new concepts.



As I was teaching students how to find equivalent fractions **they taught themselves** to simplify. Anthony and his partner bragged, "Mrs. Moore we wanted to challenge ourselves so we went down instead of up. When we went down we had to divide. We knew how to go up and that was easy so we decided to go down." Thumbs up indeed, friends.



Student collaboration and challenging each other:

Boys sat in a circle and created their own “challenge game” as they battled each other to see who could get the highest equivalent fraction.

Conclusions

Focus Students’ Outcomes

Over the course of the year I have seen many changes in the students that I chose to spotlight. While there have been up and down times for John and Adrian, I believe that each of the students have made great strides.

Positive side notes and comments about students from Teacher Journal:



End of October/Beginning of November: John has really started coming out of his shell and feeling more comfortable with me as he teacher. He now asks questions and do not just yell, “I don’t get it! It makes NO sense to me!!” His mother has noted a change in his behaviors at home too. She emailed me to say that he has become obsessed with designing models of crash dummies and that he has made tons of them. He came dressed as one for Halloween and after sending his mother this picture of him and one of the dummies he created, she replied: “Thanks - you are a Saint:) he is a funny guy - who by the way loves math - I asked why - 'because I have a smart teacher!!!!' Firsts for everything!!!!” On a survey that I gave students at the end of March, John shared that he not only felt more confident about math than he did at the beginning of the

year but that he also thought he was “smarter at math.”

Anthony

At the beginning of the year Anthony was enthusiastic about math but struggled when it came to teaching and learning from others. In an email from Mom after Anthony came down with the flu

in January during our toothpick bridge unit, she said: “He was so looking forward to doing his Forth Bridge presentation and will be hoping to still do it whenever this week it works out. Thank you for supporting his creativity and enthusiasm, he had a lot of fun and took a lot of pride in selecting, researching and building it!! Thanks again for all you do every day to inspire curiosity, learning and creative thinking....we are so very grateful for your positive influence and the environment you create and continue to reinvent all that fosters our young-uns growth and wellness!!!”

I observed positive growth throughout the year and in March Anthony reported feeling more confident about sharing his strategies with a partner in guided, partner, and whole group work.

Adrian:

In January, Adrian had quite the set back after returning from the Winter Break. Three times he refused to come to school and two of those times he had to be picked up and “delivered” into the classroom by an administrator. As I communicated with his mother about this she expressed concern over the change in routine (4 snow days in addition to other holidays off from school) as well as him being engaged in activities in the classroom. In my teacher journal dated January 23 I wrote, “While we have not been able to really get back into the swing of things with our disrupted schedule I know that the toothpick bridges are something that he is looking forward to as he asks about aspects of the project multiple times a day.”

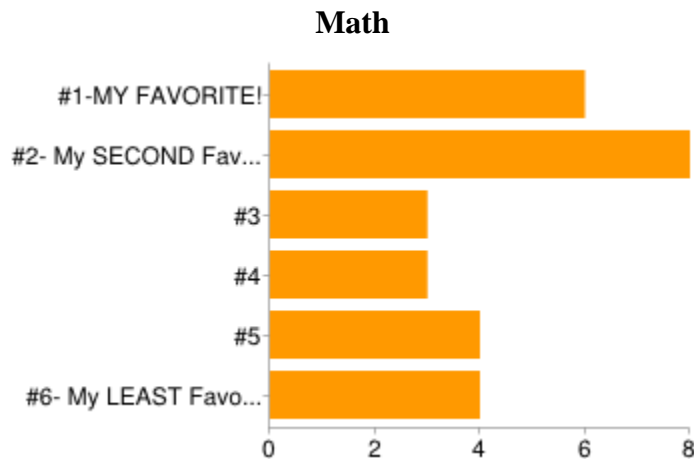
In an email from his mother on Feb. 5, where I was checking in with how Mom felt things were progressing she wrote, “He really thrives on information and things that keep his mind busy. His therapist seems to think that the crazy schedule of January threw him off along with his need for engaging activities at school. So I think the above and beyond and the bridge project are both very positive things for him.”

As the school schedule began to level out, I could see Adrian getting back into the swing of things. He regained his motivation and continued to grow in his willingness to collaborate. In February I overheard a telling conversation between Adrian and another student, Riley, during a differentiated math group activity. Riley was beginning to grow frustrated that he was running out of time to complete his work when Adrian piped in, “Riley, all you can do is your best...it’s not all about finishing if you are learning. You can do it!” Later that day I recorded in my teacher journal, “Not that Adrian is not compassionate, but I have never heard him speak this way or show signs of comfort to another student. He usually stays to himself unless prompted by me to do differently. He also encompassed my main goal with regard to math this year which is that it’s all about how the student is learning and that it makes sense to them in whatever format or time that they need.

Reflecting on sub-questions:

- 1. What happens to students’ views of themselves as mathematicians?**

At the end of the year I asked students to rank their favorite subjects and this time, half of the students ranked math as their first or second favorite tying with reading. I believe that this stems from their realization that math is something that they do day in and day out. It has become more fun for students because I listened to their desires and created projects and activities that met their wishes.



Students commented that they ranked Math where they did for reasons such as:

- “I can share out and not be afraid if I am right or wrong.”
- “I like ten-marks (RIT Band computer activity) because, I get to do some challenging stuff and refresh my mind on more things.

Moving forward, I will try to help students find the same pleasures in math that they do in other subjects. Project based learning, like those that my students did this year, allow students an opportunity to see math as more than just worksheets and more as something that they use every day to solve problems that are meaningful to them.

2. What happens to self-regulation/monitoring during independent work time?

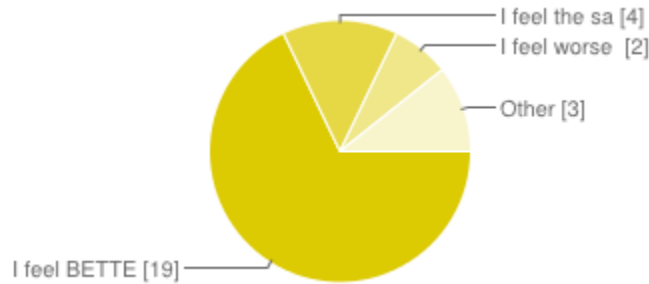
I observed students staying more on task during math stations after I gave them the schedules. Since students were able to check back to see what they were supposed to be doing and since that sheet also served as a checklist of what was to be completed and turned in, students were more likely to be successful in completing their work, even if they ran out of time initially. I noticed that on days when we did RIT band work as well as during the playground and toothpick bridge projects students were more on task than on days when we did other math activities.

I will continue to use the CHAMPS sheets and schedules next year as I saw great success with their implementation. I saw that the more interested in a task a student was, the better they were able to regulate/monitor themselves. Students also did this more when they were vested in the project that they were working on. For example, when students knew that they would have to pay me a “consulting” fee if they got into an argument or got off task during the toothpick

bridges, I rarely had to step in. They understood that my fee would take away from their ability to meet their over-all goal of building the best toothpick bridge due to the deduction from their budget. While this seems like an obvious realization, next year I will be more conscious of choosing projects and tasks that promote self regulation amongst my students.

3. What happens to student motivation?

Since the beginning of the year, how have your feelings about math changed?

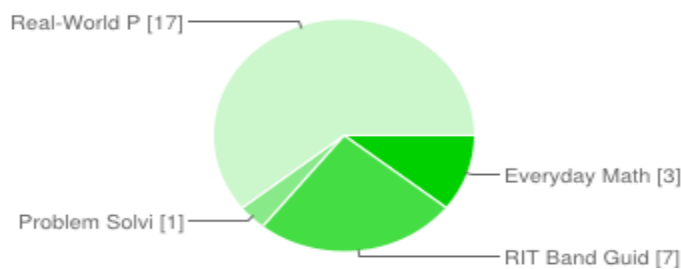


Students stated their reasoning for this choice:

- My feelings have changed because of toothpick bridges, they were SO FUN!!!!!!!!!!!!!!!!!!!!!!
- Because I am smarter.
- the rit-band and learning fun ways to learn/play math games. I don't really know. well I have more confident
- it is more fun than the beginning of the year
- They have changed from not wanting to share and now I feel very confident.
- Not Mach first I was not good than I got better

Students felt better because they were beginning to see that they could “do” math because they were doing it in ways that were important and meaningful to them. They began to see math as something that was being used all the time in the world around them and not simply during the 45 minute math block each day in class. The daily encouragements that they received as they shared their varying strategies for solving problems also encouraged students to take changes and to not be afraid of being “wrong,” a term that soon found its way OUT of our math discussions.

What is your favorite thing that we do in our math class?

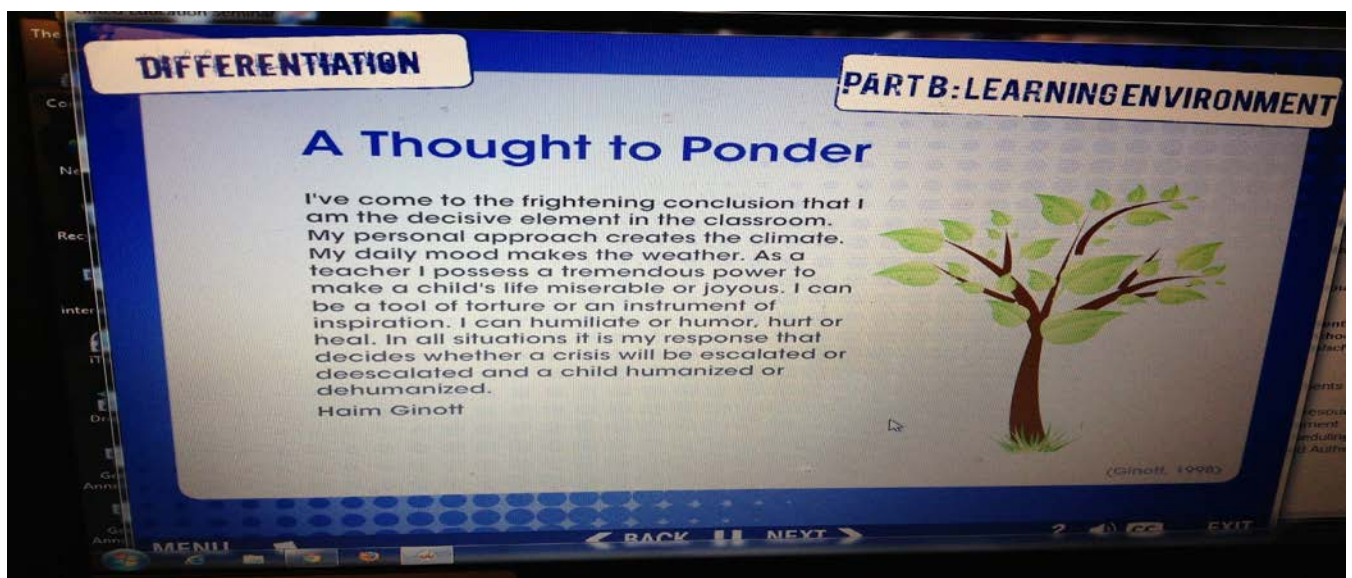
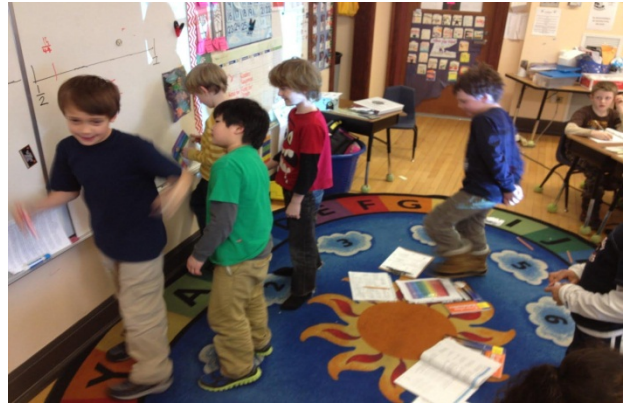


This data shows that students most enjoyed the bigger real world problem solving projects. Again, these projects were student generated and led which is, I believe, why students were so motivated to do them. Students could see how their efforts in math were being put to actual use. Instead of simply doing worksheets or activities for a grade, their projects gave them lots of personal satisfaction and enjoyment.

A few things that I learned:

You have to relax. You must be flexible. You have to let this be student led. You have to trust that you have taught students the tools and strategies needed to collaborate, teach each other, and motivate themselves. A final example of this ideology is pictured to the right: **Franks "Think Circle"**.

As I observed, my initial reaction was to go over and say, "Frank, you need to get back to work. Stop playing around." As I watched him, he would walk over to the board...share his two-cents, listen for a second, and then start walking in this circle. I asked him what he was doing and he looked back at me with an expression of "duh..." as he explained, "I am walking in my think circle. I just needed to think for a second." He did this a few times over. Always pulling himself back into the discussions. I close with a "Thought to Ponder" that I always came back to as I worked through my action research; a simple reminder that we, as teachers, have the ability to "make it or break it" with a child. My hope is that I am always their biggest cheerleader throughout the school day and beyond.



Policy Implications and Recommendations

Based upon my research I am making the following recommendations:

School Level

- By the end of August 2014, I will upload to Google Drive all of the resources and materials that I created, modified, or found useful for other teachers in my school to access.
- By the end of September 2014, I will offer small group professional development on the practices that I implemented in my classroom because of my research.
- Dedicate 5 minutes at the beginning of each weekly teacher team meeting to discuss and receive feedback on successes and areas of need with guided math, as well as using real world problem solving in the classroom.
- Create a database of materials and activities organized by math strand and RIT band for teachers to access and use when differentiating.

Classroom Level

- Provide time to teach, re-teach, and expand on collaborative group work norms throughout the year.
- Allow time daily (8-12 minutes) for students to talk about, evaluate, and reflect on math problems in both small and whole groups.
- Create 1-2 bigger real world math problems for students to participate in each quarter.

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