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Rebuilding Our Math Community

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By

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Abstract

This study investigates the attitudes of second grade students in mathematics. It looks into what research states about student attitudes and anxieties in school age children and different methods of keeping them positive.

Over a two-month period, a teacher conducted a study in her classroom in New York City to assess change in student mathematical attitudes over time. A survey was given to her second grade students and changes were made in the classroom environment during math times, as well as within the *TERC Investigations* curriculum that the school follows. During and following the two-month study, two additional surveys were given to students.

The results found that there was some positive change in whether or not students found math to be boring. Otherwise, results tended to be the tended to show no change. On reflection, the teacher believes that changing attitudes requires much more time than the time allotted in this study.

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Introduction

It was the second to last day of school and I had just finished a year teaching third grade. Two fourth graders came to visit our third grade class to share and answer questions about what fourth grade is like. Among a series of questions, there were a large number of questions about math in fourth grade.

"How often do you do math?"
"Do you do math everyday?"
"Do you have to learn fractions?"
"Is math 40 minutes or a whole hour in fourth grade?"

All I could think about is, "What happened?" Why did my class have negative connotations towards math? Why were my students so afraid of math that they needed to be assured that it wasn't going to be awful or much harder in fourth grade?

The story above is only one of many different stories that revolve around the negative attitudes that children hold regarding mathematics. Thinking about this incident and knowing that there are many more stories out there, it concerns me as an educator. What is it about math that gives people such negative feelings? Why does it seem more acceptable to be afraid of math or have a negative attitude towards it in society than other subjects? What is missing in our classrooms that can make our students more positive about math?

When I think about my third graders who seemed nervous about what to expect in math the following year, I wonder about where their feelings were coming from. I worked hard with my co-teacher to find ways to make math fun, engaging, and the learning worthwhile. Not just students that were struggling, but also students that demonstrated deep reasoning in math and were meeting all or most of the benchmarks were worried about what was to come in the following year and it

confused me. Why were they demonstrating anxiety about fourth grade math? Why did they seem to have a negative attitude towards learning it?

A recent article in the San Francisco Chronicle describes a fear of math as a phobia that is similar to any other phobia (such as a fear of heights, needles, or spiders) and that those who fear math are often avoiding it in their daily lives (Allday, 2012). Jessica Bishop (2012) explains results of a study where she found that by high school, more students would decide not to enroll in any mathematics courses if they had that opportunity (p. 35).

A lot of children hold a negative attitude towards mathematics throughout classrooms today and a negative attitude towards math can even begin before a child enters kindergarten (Geist, 2010). Trisha Mitchell (1999) defines a negative attitude in math as "those beliefs which indicate a lack of motivation, interest and enjoyment in mathematics". Mitchell, along with many others, continue to discuss the idea that when students don't recognize mathematics content as something that is relevant in their lives, their learning and understanding will be negatively impacted. It was found that when students are more empowered and recognize a purpose for math learning, their engagement deepens and their overall attitude becomes more positive (Mitchell, 1999).

In an effort to decrease student anxieties and create more positive attitudes around mathematics, there is a great need for rethinking the mathematics education happening in schools today. Geist (2010) explains the need to make a change in how math is taught and in how student's view mathematics. He explains that the negative attitudes people have around mathematics will continue if classrooms

don't change the way math is taught. Additionally, he writes, "Creating a country of "mathophobes" does not bode well for us in the uncertain global economy of the future" (p. 29). Mathematics surrounds us as people throughout our daily experiences, whether it is paying for something at a store, calculating the tip at a restaurant, paying monthly bills, or within the work we do in our profession.

If the answer to changing attitudes in mathematics is to rethink the way educators approach the teaching of mathematics in the classroom, then educators need to be thinking, planning, and reflecting on ways to enable students to become empowered mathematicians who value learning mathematics.

So much of the literature talks about the negative attitudes that school aged children have towards mathematics. I continued to think about why that is and where those negative attitudes come from. Most importantly, I wanted to think about myself as an educator and how I could find ways to combat the negative attitudes that children have towards math. How can I instill more positive attitudes towards math in my students?

Literature Review

Throughout my review of different literature on attitudes and beliefs about mathematics, there was a lot that stuck out to me in relation to negative student attitudes around math and how math is taught in classrooms. In particular, there was a common finding that I read about within the literature in regards to ways student attitudes in math can be shifted. Ways of shifting student math attitudes to become more positive happens from empowering students as mathematicians. It can be engaging for students to invest in problem solving. It's also important to help students recognize the relevance of mathematics in their daily and future lives.

It's been found that students often begin school with a positive attitude towards mathematics and that as time goes on and children grow older, their positive attitude towards learning mathematics decreases and by high school, their attitude is often negative (Nicolaidou & Philippou, 2003). In addition, it's been found that negative attitudes towards math, as well as those with high anxieties around math is a big determiner of whether or not students will continue their math education in the future (Anderson, 2007).

Educators tend to believe that children learn more effectively when they enjoy learning and demonstrate an interest in math. Children who enjoy learning math have greater motivation to learn and it can come in a natural way (Nicolaidou & Philippou, 2003). Children have a natural curiosity that needs to be sparked in specific ways that enables them to use that curiosity to explore the world and make sense of it.

The literatures suggest that negative attitudes in students emerge from the kind of learning that is happening in the classroom. Geist explains that when textbooks, timed tests, and "teacher imposed methods" of achieving a correct answer are the basis of a math classroom, it could lead to students developing a negative attitude towards mathematics. These methods produce anxiety in students and negative attitudes because children associate math as being boring, there is more memorization, and a lack of concept based learning (and deep understanding of the math at hand) (Geist, 2010).

Robert Underhill (1986) explains, "Far too few feel mathematically empowered; far too few feel in charge of their own learning, feel in charge of the growth and development of their own mathematical knowledge" (p. 66). He relates this idea back to student beliefs around math and the beliefs teachers' hold in regards to teaching and learning. Underhill explains that when math is something to be taught and where information is given to the learner, the learner memorizes facts and procedures without creating meaning. If math is taught in a way where teachers are more of facilitators, students end up creating their own meaning and strategies for learning (Underhill, 1986, pp. 58-61).

The type of learning and teaching that Underhill (1986) describes is constructivism. Constructivism is an approach to learning where the learner learns by constructing their own understandings as they make sense of their experiences by using their prior knowledge to help guide their new understanding (Simon and Schifter, 1993, p. 331). Underhill explains that when learners partake in this constructivist approach, they "are motivated by the act of construction itself" (p.

59). Curiosity is a major component of motivation and if students are given an opportunity to create their own mathematics reasoning, they tend to find greater satisfaction and approach learning in a more positive way (Underhill, 1986, pp. 58-61).

This constructivist method of teaching is focused on the developmental needs of the children. When teachers plan with a constructivist approach, it is recommended that they think about Vygotsky's *zone of proximal development (ZPD)*, which is 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 (Berk & Winsler, 1995 p. 26). This theory is important because it argues "against standard intelligence and achievement testing" and values a learning process where children are building upon their knowledge based on what they already know. Within this theory, children should be working on tasks within their ZPD and this can enable children to be actively engaged with their learning both through interacting with other students socially or independently. When teachers give children tasks that can be accomplished, but also build upon their prior knowledge, they are bringing the learning and engagement to life for children (Leikin & Zaslavsky, 1997). This is important because it has been found in various literature that attitudes tend to be more positive when student engagement is greater.

Leikin and Zaslavsky explained that oftentimes, math lessons don't foster students' active role in their learning. In a study, they strived to incorporate more

active learning through small group work and found that when students were given opportunities to work in small groups during math, students were more positive about their learning. It is noteworthy that when students interacted with each other when learning mathematics and there was an emphasis on communication, it had a positive effect on their learning and the quality of their learning (1997).

As stated above when describing what constitutes a negative attitude towards math, when students are not motivated to learn, it can impact their attitude (Mitchell, 1999). Therefore, motivation needs to be developed in students. To develop motivation, Bishop (2012) writes that it's important to think about each student's mathematical identities because a mathematical identity can play a role in either enhancing student attitudes (or vice versa). Students need to believe that they can understand mathematics and that mathematics can be learned and used. Teachers should have a goal that their students be flexible explorers in regards to mathematical ideas and willingness to engage in finding a method of solving a difficult problem on their own. Furthermore, as the literature asserts, when students are willing to engage in mathematics and recognize the value in it, they develop into students with more positive math identities (p. 35).

Teachers have the ability to encourage their students to take on a desired identity (one that might be more positive) and that they can do this in subtle ways. One way is to enable more time for students to speak and share ideas (Bishop, 2012, p. 44). Another is to refer to students as *mathematicians*, which sends a message to students that they are not working towards becoming mathematicians, but that they already are (Bishop, 2012, p. 44).

Jan Mokros, Susan Jo Russell, and Karen Economopoulos (1995) explain that one of the main goals a math teacher should have is that students "enjoy and appreciate mathematics" (p. 55). This goal is achieved when children go beyond the mathematics that is happening in the classroom and develop a curiosity for it in their daily lives. They add that it is important to think about how students feel about themselves as math learners and that students will be more successful mathematicians throughout their lives if they feel confident and supported in the classroom (pp. 55-56).

Mokros, et al. explain that to further achieve this goal that students are confident mathematicians who can continue to appreciate and learn mathematics throughout not only their schooling, but life as well, that school environments must foster an atmosphere where a variety of strategies are encouraged, valued, and respected. This allows students to become more willing to take risks and brings them to higher levels of understanding (p. 55).

Simon and Schifter (1993) describe a project in which teachers were provided with support to engage their students and set up their learning spaces with a more constructivist view of mathematics and learning. They describe student change throughout the study in three areas: cognitive, affective, and social. An *affective change* that was described only occurred in elementary school classrooms. Elementary school teachers reported that their students expressed more interest and enjoyment in math (p. 336).

A difference was also found in terms of student social behavior. When the social organization of the classroom is set up in a way where students were

responsible for their own thinking and the thinking of other students, and by valuing all different ideas, students become enabled to take risks and share their ideas with each other (Simon & Schifter, 1993).

How to Foster the Methods Described Above to Enable Positive Attitudes in Math

Based on the ideas described that students need to feel empowered in math, take ownership in constructing their own understandings, and learn from working and sharing ideas with each other, it's important to think about how teacher's can create a classroom that fosters these ideas.

Teachers are recommended to spend time thinking about the best way to create that environment from the moment students arrive on the first day of school to keeping the atmosphere a positive space until the end of the year. The creation of a strong classroom community is an important step in providing this optimal learning environment for students.

Ruth Charney (2002) quotes Jane Nelsen, who says, "What good is academic learning if young people don't learn to become contributing members of society?" (p. 22). This quote says a lot about what classroom life should be like. Using this quote, Charney explains that people throughout the world recognize themselves as members of a group and that it is important for children to recognize that one group they are a part of is their particular classroom community. Within that community, children can contribute and receive care towards one another, as well as learn from each other. Charney says, "Creating community means giving children the power to care" (p. 22).

Teaching children to care has many different facets. First, it is important to teach children to care for one another on a social level. As that is achieved and worked on throughout an on-going basis, children learn about care for each other's learning, their own learning, their classroom and materials, and more. Teachers and classmates can build community and the idea of teaching children to care through cooperation, sharing ideas, including everyone, and recognizing each member of the community through showing kids that you care for them and modeling for them what is right (Charney, p. 22-31). It's important to note that Charney focuses on teaching children to care in general and is not focused on math. Her words apply to the creation of a classroom community of learners and even though she does not concentrate on math, her words apply well to the other literature on math attitudes and beliefs.

Keeping this sense of community in mind, James Hiebert (1997) explains, "Doing mathematics as part of a group means seeing yourself as a participant of a community" (p. 43). Hiebert talks about a need for students to see themselves as a part of the community created in the classroom. In order to work as a group and learn from each other mathematically, it takes "a great deal of communication" (Hiebert, p.44).

Hiebert discusses the belief that non-constructivist, or traditional ways of teaching where the focus is on the individual and not on helping one another "has had a destructive effect on the climate and culture of mathematics classrooms" (p. 44). When mathematics communities do not value cooperation and communication of ideas, the atmosphere diminishes and students' ideas are not necessarily valued.

There are a variety of ways to encourage mathematical learning and risk taking. To promote a stronger, optimal environment for math learning there needs to be a combination of many things happening within the environment. The community is an important place to consider when striving to promote mathematical learning. The Continuum of Sociomathematical Norms, (Carroll & Mumme, 2007), explains ways in which aspects of life within a mathematics classroom is more or less likely to promote mathematical learning (Carroll & Mumme, Figure 1). The continuum lists different components on the left hand column and writes how those components need to be addressed to best promote learning. In order to promote learning, all the components need to be woven into the classroom in positive ways as described by the right-hand column on the continuum (Carroll & Mumme, Figure 1).

This continuum teaches teachers of mathematics how to stress each component. For example, the final component is in regards to community. Within this component, the continuum explains that to best promote a learning environment, mathematical argument around different topics serves as the basis of learning and students are helping each other be responsible for their learning. That alone, however, doesn't guarantee the environment is completely conducive to mathematical learning. All other components must be achieved as well.

There also needs to be an emphasis on sharing ideas and questioning them. It is not only important to share multiple strategies as a class when discussing problems together. The relationship between different strategies needs to be discussed as well. In addition, when classrooms embrace confusion and mistakes

that students make in math, that allows the community to work together and support one another in finding new ways to solve a problem (Carroll & Mumme, 2007).

At the same time that teachers foster an environment where students need to look at the relationship of different strategies, teachers and learners need to be in an environment where asking questions that extend student thinking and reasoning is important as well in promoting mathematical thinking (Carroll & Mumme, 2007).

Mathematical thinking and reasoning "should be the center of the mathematics curriculum" (Mokros, et al. p. 28). In mathematical classroom communities, kids should be thinking about their strategies for solving problems on their own. They should be keeping track of their strategies and expanding on them as they become more comfortable with them, and they need to find ways to communicate them to other people so that others understand their strategies as well. During math discussions, students talk about each other's strategies and determine why or why not an answer makes sense (p. 28).

It's important to make sure that students don't think of a math problem in only one way or only have one strategy to problem-solve in math. By collaborating in the classroom, students can compare their strategy with someone else's and benefit greatly from seeing a problem solved in a new way. By creating an environment that fosters collaboration and cooperation, students have more opportunities to talk about why strategies work in math and how they are related to one another (Hiebert, 1997, pp. 44-45).

The idea of collaboration within the classroom community has been mentioned and is extremely important in promoting children's learning of math. Since community relationships take time and students are all learners, there's a truth in that students "Do not always share the same goals" and that students aren't always "Mindful of the feelings and needs of others" (Hiebert, 1997, p. 45).

Students need practice in working together and teachers need to remember that kids are still learning to do things like listen to each other, ask each other questions, and share ideas. To develop an environment where children can work together as collaborators and learn from each other, expectations and routines need to be created and gone over so that kids can develop an understanding of norms and so that they can be independent and continue to learn (Charney, 2002, pp. 37-65).

Setting up an environment where children know and take part in creation of the rules for that environment is an important step in creating a successful learning community (Charney, 2002, p. 69). This establishment of appropriate classroom expectations and norms helps keep the environment suitable for optimal learning. When this happens, discussions about strategies, methods, and student's ideas can be focused on in greater depth (Hiebert, 1997, p. 45).

In an effort to keep the environment suitable for optimal learning for every learner in the classroom, every idea and strategy that is shared by any classmate deserves respect. This is an important step in making sure that all learners have access to feeling empowered to take a risk in math and share their thinking. Additionally, this optimal learning environment is achieved when students know that they can be "Free to take risks, to experiment, [and] to try things out without

being ridiculed" (Hiebert, 1997, pp. 47-49). It's important for students to learn from mistakes and recognize that making mistakes is part of the learning process and this can make students greater thinkers and more willing to take a risk (Hiebert, 1997, p. 49).

In creating an environment in the classroom for students to be willing to take risks, share ideas, and make mistakes, teachers should highlight the process of math as opposed to concentrating on the answer. Some strategies teachers use to promote this process include asking kids how they solved a particular problem and once an idea is presented, asking if anyone solved the problem another way (Melnick, 2009, Handout 2).

Charney (2002) also explains the need for modeling in the classroom of how kids and adults listen to one another. Students need to make sure that they are listening to one another so that they can understand other people's thinking and take advantage of trying out different strategies that might move their thinking forward. In order to do this, they need to listen to each other (Hiebert, 1997, p. 47).

When students listen to each other and start taking risks to share strategies, it's important that teachers recognize every child's thinking. Sharing an appreciation for a student who takes the risk and shares an idea in front of the rest of the class is a way to help generate student conversation and further sharing of ideas (Melnick, 2009, Handout 2).

When teachers "celebrate each child's thinking", students begin to realize that "all responses are valued equally" and that "responses are not judged" when children share their ideas. Continuing to foster and support each child and their

engagement in math, it's important for teachers to also value explanations that students give without judgment. When teachers foster classroom conversations without placing judgment on a right or wrong answer, it allows children to work through to problem at hand and catch their own mistakes or the mistakes of other classmates (Melnick, 2012 Handout 1).

Description of the Study

Given the large amount of negative attitudes of mathematics in children and my experiences as a teacher thus far, I conducted a study in my current Second Grade classroom to see how my students felt about math and if I could create a more positive experience for them as learners and maintain a sense of inquiry in the classroom as well.

My plan was to give my students a survey about their attitudes, beliefs, and feelings of math before beginning a new unit of study. Based on their feedback on the surveys, my plan was to have conversations with my students, both individually and as a class in regards to what they shared in the surveys. Additionally, my plan was to think about how I could extend students thinking on a differentiated level and set goals for students. At the end of the unit, I planned to give a follow up survey that asked similar questions as the first to see if their attitudes shifted. This study took place between the middle of January in 2012 and the middle of March in 2012.

Setting Description

For the purposes of this Integrative Master's Project, I worked with students in my current second grade classroom. In my classroom, there are twenty-three second graders. I am a full time associate teacher in the classroom and in addition to myself, there is a head teacher, as well as an additional associate teacher who shares her time between two classrooms.

The classroom is in a private elementary school in New York City that is known for it's experiential teaching philosophies and child-centered classrooms.

The student population comes mostly from the West Village, but there are many students that come from Brooklyn, and other areas of Manhattan as well. The school prides itself in being diverse and encourages children to learn about their classmate's families and backgrounds, as well as similarities and differences through daily occurrences.

Description of Actual Study

Part One

To begin my study, I gave a survey to my students in regards to their attitudes, feelings, and views about themselves as mathematical learners. What I found in the results told me a lot about my students. The majority of my students agree that math is important to learn and that they feel that they are 'good at math'. Whether math is boring or not is approximately split in half: nine students agree it is boring, nine disagree, and four said it is boring sometimes. See the remainder of the results in the Artifact Chapter of this study (Artifact 1B).

Another statement where the results were alarming to me was, 'It helps me understand math when I see other kids strategies on the board', in which thirteen students disagreed and two chose sometimes. More than 50% of the class didn't think they could gain a better understanding when they see other student strategies? This made me wonder what students were gaining from math conversations as a class community. Were students taking advantage of learning from each other?

In addition to this, a majority of the students suggested that they would rather work alone in math than with other people. This made me wonder about the

climate of the classroom. Working with other people or in a group takes so much communication (Hiebert, 1997). Maybe students were feeling that they didn't know how to communicate and needed guidance in overcoming the challenges in this area so that social interaction was promoted.

In terms of my students written responses, common responses for the question, "What helps you learn math?" included: math tools (cubes, brain, fingers, etc), working in quiet, and in some cases, alone. Student responses to "What makes it hard for you to learn math?" included too loud of a noise level, sitting on the carpet for a long time, and when other people distract them (friends talking to them). As someone who has strived to teach in ways where children value the learning process, it struck me when I saw student responses to "I feel proud in math when...". Many students responded by talking about finishing all their problems, doing a lot of math, or finishing before other people (Artifact 1B). Thinking about these results and thinking about what Charney (2002) writes about teaching children explicitly made me reexamine my values as a teacher and how I portray them to my students. It made me realize that as a teacher, I can't assume that my students will just pick up the same values that I have. They need to be taught them as well.

I set off to teach the fifth unit of study in the curriculum our school follows, *TERC Investigations*, which was a unit on patterns and ratios. During the first few days of teaching, I made sure to have extensions available for students to extend their thinking about the patterns they were finding in their problems about the number of rooms in relation to the number of floors in different buildings. These

extensions pushed their thinking on patterns and whether or not the patterns students were noticing in different tables would work with other numbers as well. The goal of this was to allow students to deepen their understanding of the relationship represented in the tables and for them to recognize why the patterns were occurring. Just as it is stated in my *Literature Review*, a way of empowering students and raise their motivation is through developing a natural curiosity that helps them develop stronger reasoning (Underhill, 1986).

A game was also invented as an extension and option once other math work was completed. The game was called, "How Many Rooms? How Many Floors?" and it related directly to the concepts being spoken about during math (Artifact 2). Aside from the concepts in the game relating to math, the recording sheet for the game was made purposefully in a way in which students were required to interact with their partner. This is because I noticed (along with the other classroom teachers) that students were not interacting when working together so we wanted to make an effort to allow for more interaction.

Part Two

At the same time while I was beginning the new unit, problems had been occurring in our classroom during math time since students returned from winter break (two weeks prior to my unit beginning). There was a huge lack of participation during class conversations, the behavior management of the group was challenging with disruptive behavior and interruptions happening throughout community conversations and math time in general, a large number of students were having side conversations during math, and a large number of students were

not following classroom directions. Needless to say, despite the efforts I had put forth in creating extensions for students in our study of patterns and ratios, it felt nearly useless because it was so difficult to foster and deepen the ideas within the extensions.

As the math point-person / teacher at the time, I was alarmed that majority of my students weren't growing and meeting the goals of each day's lesson. I felt it hard to combat difficult behaviors and maintain an academic conversation at the same time. If I felt that way, I imagined children felt it hard to learn with the numerous interruptions and distractions that were happening in the classroom.

Due to these problems and in collaboration with our school math coordinator and the other teachers in our classroom, we decided to put the curriculum on hold. We needed to get our students back on track. Similarly to how Charney (2002) explains a need to give children the power to care, as a teacher, I needed to take a step back with my students and regain their focus and re-teach or teach them to care.

To teach my students to care meant to think about how we as teachers set up a community at the beginning of a school year. In collaboration with the school's math coordinator, we wanted to teach the class what it means to be a part of a community of math learners. In doing this, we held a series of conversations about what it means to be a learner, a part of a community, what makes it hard to learn math, etc.

Our first step in rebuilding our math community was to develop a new expectation during a math meeting. The expectation was that everyone had to sit in

a circle next to his or her math partner. Since there is a focus in math that stresses problem solving, we asked for students to brainstorm different ways that they could change their seat to follow this expectation in an organized way before the main conversation for the day would begin.

Some student ideas to solve this problem were: "Teachers call one kid at a time around the room", "Everyone gets up, finds their math partner, and sits down", and "We all sit in our circle spots and then half the group finds their partner and sits with them and then the other half does that. The class agreed on the second strategy and quickly found new seats so that students were all next to their math partner.

The reason for students sitting next to their math partner is so that they have an easy time knowing who to talk to during a "turn and talk" time and so that the partnership could make a decision together as they transition from the conversation on the rug to their partner or individual math work. This can save time since students won't have to look for each other before making a decision. As I said, it also creates an easy "turn and talk". This is a way of promoting mathematical learning so that students can have opportunities to discuss ideas together (Carroll & Mumme, 2007).

After that, we began a two and one half week journey of recreating our math community. That first day, our class concentrated on the survey results from the question, "What makes it hard for you to learn math?" Teachers displayed every child's responses in a list format anonymously and asked the class what they had

noticed. This led students to begin reflecting on what has been happening during our math time and think about how and/or why it should change.

That day, there was a large concentration on the noise level in the classroom. Students noticed that a lot of kids said it's hard to learn math when it's loud or noisy. In guiding a discussion, teachers sought out strategies and solutions from the students that could help change the climate in the classroom.

Over the two and a half week time period, we continued discussions about our math community and what it means to be a learner, as well as introduced the students to some new games so that students had time to both engage in mathematics, but also practice being a part of our newly revived community. We developed guidelines for our math community together as a class (Artifact 3):

1. *Our math community agrees to support each other so <u>everyone</u> has a fair chance to learn and feels safe doing so.*
2. *During math time, we will keep our conversations about math.*
3. *During math time, we will work on being respectful of the learners around us*
    a. *Be aware of distractions that you cause and ask others to focus on learning if you are being distracted.*
4. *Take care of our class materials.*

These guidelines were created with the students and over the course of time. We needed to set up an environment and establish appropriate expectations as a class in similar ways to how Charney (2002) explains it: making guidelines that are clear and that involve students so that the learning community can be most

successful. Hiebert (1997) went on to explain the necessity so classroom conversations can happen in greater depth. Once students are taught to be a part of the community and respect each other and the guidelines, we would be able to move on and hopefully instill a happier math time.

In addition to these guidelines, teachers and students established expectations for classroom meetings. Those expectations included students keeping their bodies in one spot near their partner and that students should get a drink or go to the bathroom before or after the meeting. This was established because during a class conversation on "What makes learning math hard", one student brought up that "A lot of kids move around and it's distracting". These expectations were an additional way that helped our class abide by the guidelines we had created.

Just as I stated above, games were taught to the class as a way for students to practice being a member of our math community and for a continued engagement with mathematical ideas. Since there is a large concentration on the number system and the base ten number system in the *TERC Investigations* curriculum for second grade, and since we were going to move into a new unit that focused on place value of tens and ones, the games that were introduced allowed students to explore similar concepts.

An additional reason these games were introduced was to create a repertoire of games in the classroom that students could choose to play during a math choice time or when students finished other work in class. Mitchell (1999) who had done research on student attitudes in math found that students enjoyed playing games

and that games were a way of making math more fun and engaging. Additionally, mathematical language was practiced and demonstrated during these games.

As time continued during our two and one half week pause in the actual curriculum, there seemed to be some regaining of focus and calmness in the classroom as observed by teachers. Our conversations changed from being about how our math community should look to some short conversations on, "How did math go today?" to allow students to reflect on their experiences at hand. By the end of the two and one half weeks, our conversations fully shifted into thinking about mathematical ideas and strategies that could be used while playing the games we had introduced.

Throughout the two and one half weeks, we also created and encouraged goals for both individual children and the group as a whole. For individual children or partnerships, goals tended to be about how they used math tools effectively. For example, some students needed some redirection in how to use the 100 Chart in a way that could help them achieve our most common class wide goal: not to count by ones when you are adding.

During our final few conversations about strategies used to play these games, I connected the math to the context of 'Sticker Station'. The context of 'Sticker Station' is part of the *Investigations* curriculum and allows a more concrete context for students to understand and represent numbers in tens and ones. It had been talked about earlier in the school year and was about to be brought up once again during the sixth unit that was about to start.

Part Three

Throughout my time teaching math to my students and throughout constant reflection over conversations and observations I've had in the classroom, I found it challenging to provide students with a 'hook' that would keep them engaged as inquiring mathematicians. In reflecting with the other teachers I work with, we noticed a more positive atmosphere in the classroom and that there seemed to be a greater sense of community. There seemed to be fewer interruptions happening, smoother transitions occurring from math meeting to work times, and a general engagement amongst the students during math. While I felt a change in the environment/atmosphere during math time since we had stopped the curriculum, I knew that the work was not over and there was still a lot of learning to be done.

As I thought about what lay ahead, it seemed natural to continue our curriculum, *TERC Investigations*, into the sixth unit of study: How Many 10s? How Many 1s? As I jumped into the unit, I constantly questioned, "How can I use this curriculum and the mathematical ideas/concepts it aims to teach to best engage my students and allow them to grow as mathematicians?"

Approximately one week into this unit of study, a second survey was given to students in regards to their attitudes, feelings, and beliefs about math. It was very similar to the first survey and meant to compare results from before changes in the classroom happened to after those changes occurred (Artifact 1C).

Changes/Edits Made in the Unit (During Part Three)

Throughout the unit of study, my students engaged in a mix of lessons and games that were part of the *Investigations* curriculum as well as self-created games and also adjustments to the curriculum.

Thinking about the goals and objectives of the unit being about the relationship of the tens and ones, I used the provided context of "Sticker Station" to engage the class. This context helped students better understand some abstract ideas and allowed for them to explore further into the patterns and observations one can learn and make about the Base Ten Number System.

Since many students have stated that they dislike story problems and don't find them engaging, one major change that was made was to not use the math workbook in some cases. I deepened the context of "Sticker Station" and instead of students responding to addition questions about stickers in their workbook, all students received a sticker book (Artifact 4). Originally, TERC Investigations has students working on a similar concept using the context of a sticker book (Artifact 4A). I was inspired by their concept and reorganized their version of sticker books in a way to hopefully benefit my students.

The sticker book creation was both meant to draw students' attention as well as provide a way for students to record their ideas in multiple ways. A goal was for students to move away from counting by ones when adding to breaking numbers apart. On each sticker book page, students were provided with a blank 100 chart and were told they had a specific number of stickers. They were asked to find a missing amount of stickers purchased and show their strategy. The combination of the blank 100 Chart and a space provided to show student ideas forced students (in a way) to share how they used the 100 Chart to help them solve the problem in a mathematical way.

As students continued to explore the patterns within the 100 Chart and number system in general, students were taught a variety of games that were provided within the curriculum. When students were playing the game, "Roll a Square" and "Unroll a Square", teachers noticed similar patterns occurring to earlier in this study in terms of the ways partners were interacting with one another. The game entails using cubes to construct a 100 Chart and students responding to questions that had them adding or subtracting different amounts of numbers.

Teachers were noticing a lack of partner interaction while playing the game. Many students seemed to be going through the motion of playing their turn and when their turn was over, many students began playing with cubes and creating spinning toys out of them. Two things were happening. First, students were not engaged with the mathematical ideas and second, they were also exhibiting a lack of interaction with each other. As stated in my review of literature, Hiebert explained that in order to work as a group and learn from each other mathematically, it takes "a great deal of communication" (p.44). The lack of interaction among partnerships suggested to me that there was not a lot of communication happening of the mathematical ideas. How could students learn from each other and be challenged to grow further if they weren't conversing or even attending to each other?

In addition, I wondered about the nature of the tasks within the game. In reviewing literature, Vygotsky was a proponent of students working on tasks within their zone of proximal development so that they are able to work and learn together and become more engaged (Berk & Winsler, 1995 p. 26). Was the issue with my

students the nature of the task or was it an issue of students not knowing how to share ideas together?

In a response to what was happening in our classroom, I had a discussion with the class community, opening with the question, "What was the goal of math today?" Students responded by saying, "To play a game", "To use the 100 Chart", and "To play an adding game with a partner". This conversation led to the realization that both students and teachers needed to make a larger effort in both conveying the goal of a particular math session and working towards that goal, whether it be related to math or social interaction among classmates. There was a specific goal that students were to be working on adding in groups instead of by ones and also to be thinking about how the number *ten* could help you to solve larger numbers or find a missing part.

As math continued throughout the study, students and teachers talked together about setting goals for students to work on and made them clear. An example of some of the goals (academic and social) that were being worked towards included listening to a partner, sharing a new strategy, and helping a partner not count by ones. Shellard (2004) offers advice to teachers in promoting positive attitudes in mathematics and explains one way as including students in the process of creating goals. This way, students may become more aware of what they are working on.

In an effort to have students engage in similar ideas, teachers created a timed game called, "How many stars can I draw in one minute?" and "How many cubes can I connect in one minute" (Artifact 5)? I explicitly stated the goal for math and wrote

it on the board: "Today we are working on adding numbers in groups of ten". This game allowed students to spend more time interacting and while it didn't have students using the 100 Chart, it still reinforced counting in groups of ten and ones.

As a class, we had been discussing the reasons the 100 Chart is helpful and the different patterns found throughout the 100 Chart. Throughout the unit of *Investigations,* students were constantly interacting with the 100 Chart through games, using it as a tool to add, and recognizing patterns. In a continued effort for the 100 Chart to be brought more to life for my students so that it continues to serve as a tool that can move students away from counting by ones, I introduced the class to the idea of an 'open 100 Chart'. Following an activity adding a string of numbers together (based on the context of, "How many pockets is our class wearing today?), students had to visualize where the number 55 would be found on the 'Open 100 Chart'.

The purpose of using the 'Open 100 Chart' was to encourage visualization and continued talk of the patterns found. "Where did it make sense to show 55? What about the number, 27?" These questions and looking at an open chart that had no individual boxes allowed students to think deeply and engage in a mathematical debate about where they would place certain numbers and why.

At one point in the study, a homework assignment was sent home with students so that they could interview a grown up about how they use math outside the classroom. During a morning meeting time, students made a list of different ways math is used that included cooking, tipping at a restaurant, shopping, sports, paying bills, figuring out the time difference from one time zone to another, and

more. The goal of this activity was to help students find a purpose of math and how it is used in people's everyday lives as an additional way to foster a more positive attitude (Mitchell, 1999).

In addition to the above additions to this unit of study, additional changes in the routines of our classroom included a more constant change in the partnerships among students. Originally in our classroom, student would work with the same math partner for a long period of time. Instead of creating partnerships that would last for an entire month or unit, I changed them on a weekly basis or when needed. This was so children had more time to interact with a variety of people and learn from their strategies and different situations.

Throughout this entire unit and study, students were reminded of the expectations and guidelines that were set as a community. Teachers pointed out when students were following them and when they weren't. It was important to set up a model for the class that incorporated a daily reflection that recognized how math went on each particular day. In addition, conversations continued on the purpose of math meetings and sharing our ideas as a community.

At the end of the study, students were given a final survey (Survey 3) that simply asked, "How is math going for you?" and "I felt proud in math when..." (Artifact 1D).

Conclusions

The biggest conclusion I think I was able to make from doing this study was that it is very hard to change a person's attitude in a short amount of time. When comparing survey results, there wasn't that large a difference in how students responded. Below is a comparison of part of the results from Survey One and Survey Two. In addition, reflections on a third survey (Survey Three) are included. The nature of Survey Three was different than the first two, so it is excluded from some of the conclusions.

Math is Boring

There was a difference in how students responded to whether they agreed or disagreed that math was boring. In Survey One, approximately 41% of students who responded agreed that math was boring. On Survey Two, it went down to approximately 30% of students agreeing that math was boring. Since some students responded 'sometimes/so-so' on their own in both surveys, it's also important to look at the percentages of those that disagreed with the statement, "Math is boring". On Survey One, the same approximate 41% of students disagreed with the statement, while on Survey Two, approximately 61% of students disagreed that math was boring (Artifact 1E).

Based on the two surveys, this is a big change in my classroom's overall view of whether or not students are considering math to be boring. That is approximately a 26% increase over the course of about one month's time. These results were attributed from the same set of questions that were asked at two different times. The positive increase could have been due to a number of factors

including a change in the unit of math study, the focus in the classroom on community, or other potential aspects.

Math is Fun

While there was a positive difference in student outlook on whether math was boring or not over time, there was almost an opposite difference in whether students agreed or disagreed that math was fun over time. This is based on a child's perspective and their own interpretation of what 'fun' is.

During Survey One, approximately 45% of students who responded agreed that math was fun, while on Survey Two, it dropped to approximately 39% of students who agreed math was fun. In addition to that, on Survey One, 36% disagreed with the statement, "Math is fun" and on Survey Two, 48% disagreed with that statement (Artifact 1E).

Partnerships

There were small differences in the number of students who enjoyed working with a partner. Originally on Survey One, 18% of students who responded circled that they work best with a partner during math and based on the Survey Two's results, 57% of students students agreed with the statement, "I like working with a partner". While that is a big difference, the questions were phrased in different ways and that could lead to different results, which makes it hard to compare. On Survey One students were asked how they worked best and on Survey Two they were asked if they like working with a partner in a more general sense.

Looking back at an older survey ('Myself as a Math Learner' which was filled out a few days prior to Survey One) where students highlighted boxes that were

true about themselves as math learners, 57% highlighted that they liked working with a partner during math. That is the same percent over time that was found in Survey Two. There was a difference in students who disagreed with the statement, "I like working with a partner". During the older survey, (Myself as a Math Learner), 43% didn't state they like working with a partner, while on Survey Two, 35% disagree with the statement. In that instance, there is a slight decrease in the number of students who disagreed with the statement (Artifact 1E).

Feeling 'Good' at Math

In looking at results of when students feel that they are "good at math", there was also a slight positive change. During Survey One, 73% of students agreed with the statement, "I am good at math", while 9% disagreed with the statement. The results for Survey Two show that approximately 83% of students agree and only 4% disagree with the same statement (Artifact 1E).

Short Answer Responses

Throughout the short answer questions on each survey, there were not big changes in how students responded. In interpreting these results, I think the short answer results are most helpful for me to see each student's individual reflection at a given time. These results helped to foster conversations as a class.

It's hard to compare a difference in the results of when students feel/felt proud in math because of the short answer questions. Throughout my unit of teaching, I had thought a lot about the results of when students feel/felt proud in math. When looking at the results of Survey One's question, "I feel proud in math when...", I interpreted many of the student's responses as many students holding a

belief that math is about the answer or the product. Based on the results of Survey One, it seemed that many weren't seeing mathematics as a process, but as something they wanted to be finished with.

When I saw the results from Survey Two and Three, it seemed that there were a few more students who responded that they felt proud when they tried other student's strategies or helped other students by offering a strategy. There were also student responses that stated that they were proud because they got to share with the class and found more efficient ways of adding numbers together. Some of the short answer comments that students wrote during Survey Two and Survey Three demonstrated that there were students still concentrating on the idea that they were proud when they were finished with math, finished with a lot of math, and/or if they worked on a lot of math quickly.

Looking at the differences in responses students wrote for a variety of short answer questions, there are commonalities and overlap between the results of both Survey One and Two, as well as each question. There were students on both surveys who responded that they disliked math or found it hard when they had to solve story problems, sit on the rug a long time, when it is noisy in the classroom and hard to concentrate, and when math is hard for them. I might conclude from this that students are aware of some of their needs as learners. There are students that can tell you the environment that works best for them or when they might need a tool to use. During conversations as a math community, the most common topics regarding our math community was around the topic of noise in the classroom and amount of time spent on the rug in a meeting/conversation.

My Observations

Though there were admittedly some surprising, less than positive responses indicated in the surveys, my observations indicate one surprising and appealing finding. I observed a change in the atmosphere in my classroom throughout the two-month study. From my observations, it seemed that there was an increase in positive behavior in the classroom. Students seemed to be more aware of expectations and there were fewer interruptions during class community meetings. Students also seemed more independent in working with partners, completing their work with partners or individually, and were independent in knowing what to do when they were finished with their work before others.

As a result of both positive behavioral changes among students in my classroom and their growth as a community, our class was able to make a progressive shift in the focus of our conversations. Instead of mainly concentrating on the needs of the community, we were able to begin focusing more on mathematics and the different strategies that the students use to approach mathematical problems. Over time, it also seemed that there was less confusion within different topics covered in math. When I first began this study, many students were not participating during math meetings and work times. I felt that there were constant distractions and behavioral interruptions. These resulted in students demonstrating more difficulty with solving mathematical problems accurately. As students learned how to communicate with each other, both during community meetings and in partnerships, I got a sense that there was significantly more understanding occurring.

Researcher's Ponderings

It is important to consider a variety of factors. In thinking about my own observations, it is important to note that while I feel the way I do based on my observations, I recognize that there could be students feeling differently from me. For example, even though I sensed more student understanding, that doesn't necessarily mean all students understood every piece of information we spoke about in class. I did not compare results of mathematical assessments from one unit to the next. It simply was an observation that students were more independent as time went on and had fewer individual questions.

I also wonder about second graders' abilities to recognize the full affect of change and verbalize it in their reflections. I know my students are aware of certain aspects and changes in the classroom and in general, they are very observant people. That being said, there are aspects that students concentrated on in the surveys that could be based on the conversations that the class had in general and not their specific feelings. These conversations varied from what is helpful or hard for students as learners in math to when students feel proud in math. Developmentally, I wonder if students get stuck on certain ideas or things that come up in the moment which become the interpretated response. The question for me seems to be, "Can students think about a larger period of time at once or do they concentrate in the moment?" When students filled out Survey Two, were they able to think back to what math was like when they filled out Survey One a while back? These questions concern me at the time of writing this study.

In addition to all of the thoughts stated above, it also needs to be recognized that this study was only in one classroom with a group of twenty-three children. There might be very different results if this study is done in more classrooms with more students.

Second Thoughts

It's also important to think about the actual surveys that were given to my students. What would have happened if the surveys were exactly the same or if every child filled out each survey? Since a few children missed certain surveys, that could have impacted the results. Additionally, the types of questions asked could have impacted the results. Especially some questions I used as a comparison that asked students different things (such as if they like working with a partner or how they like working best). If I were to re-create this study, I would edit the surveys so that they were all the same. I also realize I never explicitly ask students if they like math or not and why. That would be an interesting question to compare over time.

Reflection

My original goals for this project were different than what the outcome was. When I began this project, I had hoped to make an effort to incorporate a larger sense of inquiry in my students during math. I had hoped the students might feel a desire to investigate mathematical ideas further and in a sense, 'play' with numbers, as different concepts were introduced to the class. I wanted my students to become mathematically empowered, like Underhill (1986), explained through constructivist methods of teaching. I wanted students to make sense of the math they were learning and I wanted to extend their thinking. This constructivist approach to teaching and learning appealed to me and I had hoped to see it played out in this classroom and in my study.

That didn't happen. While my students have constantly been growing throughout the year in their readiness to learn, what they needed was practice in how to be a part of a community. The changes I made in this study and the reasoning for concentrating on the community was because it seemed that students needed reminders on how to be a part of a community of learners. As my students continued to grow throughout the year, they hit a 'bump in the road'. At the beginning of my study, the group of students I was working with was barely gaining any math in general because they needed to learn something else as a group so they could be ready to learn mathematical concepts. Other things were more pressing than the math content and processes of learning. My students needed to learn how to work together. There were so many different components to that though. I couldn't just have conversations about working with partners and give them an

extension to work on. Students really needed to be taught how to work in a community of mathematicians.

As a teacher, this was a very big take away for me. As I continue to go on and teach in other classrooms and gain experience, I feel I have a better sense of where to start in terms of mathematics in the classroom. Charney (2002) says it so well: "Of course, before we can expect children to do right, we must teach them what we mean by right" (p. 31).

It can't just be expected that children will know how to interact with each other in positive ways, how to work with partners, and how to engage in conversations during a classroom meeting. In order to teach children and go in depth within different mathematical concepts during class, I need to teach children how to work in a community of mathematicians from the moment they step into my classroom. Teaching children to work together in a community is something that I think never ends. That's life. It's especially life when working with children. There is always a conversation or teachable moment that can happen. As I continue to teach students how to work in a community of mathematicians, I believe I can continue to go into greater depth with them in developing their sense of inquiry and a more positive attitude of math.

Things I Learned from This Study

Based on the results of my study, as well as what research has found within the literature that I reviewed, I feel empowered to make certain recommendations for teachers so that teachers can do their best to create a learning environment that fosters a positive attitude in their students towards mathematics.

Math Community

If there is one large takeaway from this study, it is the importance of teaching children how to act as a community of mathematicians. It's important as a teacher to help foster a community by engaging in conversation with the class on the ways students believe a community should act together based on their experiences. Basing the conversations in the community around their prior experiences, it allows children to encounter problems and find ways to solve them on their own with a teacher's help (Charney, 2002, p. 71).

Hiebert (1997) discusses a need to establish a community where communication and reflection is constantly happening (p. 39). There is so much communication that needs to occur when students are asked to share their ideas and strategies with each other. In order to foster that communication, establishing classroom expectations and norms helps students become mindful of the other learners in the group.

It is a teacher's job to not only create guidelines and expectations with the class for how the community will act, but also to find teachable moments within daily classroom occurrences that can be incorporated to the community guidelines/expectations. For example, if students and/or the teacher is noticing

that materials are being left out or mixed with other materials, it's important to bring that up in conversation as a community. Our class, for example, created a guideline that stated, "Take care of our class materials" (Artifact 3).

When a class creates a guideline such as, "Take care of our class materials", it's important to ask the students what that means. Having student's model ways to respect the materials and clean up can empower them to respect and abide by this guideline.

As a community, it's important to have ongoing conversations that allow students to reflect on themselves as mathematicians and learners. Students need to be taught reflection and what it means to be a part of a group of learners. They need to understand that they need to take ownership of their own learning and also find ways to allow the people around them to learn as well.

As a teacher, you can do this by observing your students and asking them questions to reflect on. Topics of possible conversations could range from, "How did math go today?" to "What does it mean to work with a partner?" or "How can I make sure I am responsible for my own learning?"

Another important feature in a community is that students learn from one another. A way of encouraging students to see a connection between different ideas or strategies mathematically, or even simply one persons idea verses their own, is through 'Accountable Talk'. One way of ensuring students are accountable for what is being said in the math conversation is to teach students phrases that should be used when responding to, adding on, or sharing a new idea. Phrases that can be taught are "Adding onto ___, I think ____", "I agree/disagree with ____ because ____",

"I think_____", and also, "I see it another way. _____". Another way is for the teacher to pose a question and say, "Who can repeat that idea or put it in their own words?" or "Do you agree with that idea?" (Melnick, 2011, Handout 3). These are questions worthwhile to ask and they tell the learners that it is important to listen and take in the information being presented.

Math Partnerships

Just as we spoke about the community being a place for students to learn together and learn from each other, encouraging collaborative work with different people and providing new opportunities to engage with different partners allow students to learn from everyone. Changing partnerships frequently is important so that students become aware of different or similar ideas, as well as have a continued opportunity to see different strategies in place. As teachers, it's important to think about what partnerships would work both on a social level and academic level so that all students are in an optimal learning situation.

Conversations with Individuals

It's important that students feel valued as mathematicians, no matter what their level of learning is. Calling students *mathematicians* is one way of empowering them. Students are always working out problems and need to find ways to communicate the strategies they use for other people to understand. When a student is recognized for their hard work or make a big leap during a particular math session, they should be recognized as a mathematician. It might sit with them and allow them to explore further and develop a sense of pride.

If a student has a question in math, it's a good idea to help answer that student by posing a new question, providing scaffolding or questioning students for prior information, or asking students if there is a tool that can help them figure it out. Rather than giving a child a particular tool or strategy or giving a full answer to a question, by using the ideas listed, it may allow a student to gain a better grasp of the math in the end. The math ends up coming more from them and they almost invent their own ideas as they engage in deeper thinking.

Additionally, it is important to keep the learner thinking. If a child comes up with an answer, without specifying if it is correct or not, ask them, "How do you know?" Questioning children to think more deeply or explain their reason to you or another student keeps the learner engaged and thinking about the mathematics involved.

It is also important to work with students on creating individual goals for them as learners. That way, students know what they are working towards and have a goal in mind. Goals would depend on the individual. A child who is always drawing pictures might have a goal to also show their thinking in numbers. Another child might be working on better organizing their written work so other mathematicians can read and understand it. Another child could be working on finding more efficient strategies than counting by ones. This can help children make sense of math and feel like the work they are engaging in is manageable, and also feel empowered to learn and explore more.

Games

Introducing games into the classroom that allow students to further explore specific mathematical concepts provides a fun way for students to engage with other students, continue practicing certain concepts, and extend students into deeper thinking. Games could help students gain mathematical fluency. It can be a way for students to practice math ideas on a daily basis and students enjoy playing them!

As a teacher, research a game or create your own game in relation to a concept your students are working on. Teach it to your class and allow students to practice the game. When students have a repertoire of games, allow students to play them after they finish the assigned math work each day.

Games are a great way to not only allow students to practice ideas and gain fluency (depending on the game), but they can be differentiated to meet student needs. Sometimes, minor adjustments like simply changing the dice from having dots to having numbers is a way to differentiate student needs. Also, some students might use two or three dice while others use one die. Dice can also have larger numbers as well.

In addition to the games, it's important to have mathematical conversation around them. It may be asking for the best strategy or students can be asked questions that make them think more deeply about the goal of the game.

Math Tools

Providing a variety of different math tools can help students understand abstract ideas in a more concrete way. It's important to teach students how to use tools effectively so that they can be used for optimal learning. For example, if a

student is always using the 100 Chart and is counting by ones, engaging in either an individual, small group, or whole group conversation about patterns in the 100 Chart and how those patterns can help students move away from counting by ones can provide students with a more effective way of using different tools. Also, modeling different tools can provide students with options of tools to use in different situations.

Allowing for Student Reflection

Allowing students to reflect on themselves as math learners and how math is going for them as mathematicians is a way that can inform your teaching, tell teachers about student feelings, and also foster a sense of importance of reflection for students. By offering students an opportunity to reflect through the use of a questionnaire or survey, teachers can learn so much from their students. These reflections from students can give a teacher insight as to what kinds of conversations they should have with their class. It can inform a teacher how their students are feeling about themselves as learners and this in turn can inform a teacher's teaching. .

Final Thoughts

As a teacher, I feel that this study has helped me grow professionally. It has allowed me to be more reflective on my students and their needs as learners. In the future, when teaching math, there are specific steps I would like to take in order to maintain a classroom environment that is optimal for math learning.

As I reflect on the entirety of this study, I wanted to capture specific aspects that can be both useful to myself as a teacher and other teachers as well. Some of those aspects include what kinds of conversations to have with your community of learners, valuing collaboration, allowing time for student reflection, and finding ways to empower students learning math. I thought about those specific aspects and created a brochure that could be useful to me and my colleagues in the future that has ideas on how to keep students engaged and feeling good about learning math (Artifact 6).

Artifacts

1. Survey Given and Results
    a. Myself as a Math Learner
    b. Survey One
    c. Survey Two
    d. Survey Three
    e. Comparison of Some Results
2. Game: How Many Rooms? How Many Floors?
3. Math Guidelines Picture
4. Sticker Book
    a. Example of Sticker Problems from Curriculum Used
5. Game: "How many stars can I draw in one minute? How many cubes can I connect in three minutes?"
6. Brochure

Artifact 1A

Myself as a Math Learner

Highlight the boxes that are true about you.

I draw pictures to show my math thinking.	I like playing games in math.	I like it when a teacher calls me a mathematician.	I know a lot of math.
I like when the teacher gives us choices in math.	I know combinations that make 10.	I like to explain my thinking.	I like math.
I can explain my ideas in math.	I can use a number line to show my thinking.	I like working with a partner in math.	I like a challenging math problem.
I like when math is easy.	Tools like connecting cubes or the 100 chart help me understand math.	I know doubles combinations.	I like using numbers.
I like working with a teacher in math.	Math is my favorite time of the day.	I can write a math equation to show my thinking.	I like working alone in math.

Artifact 1B

Math Survey One

Circle which **best** describes you as a learner in math.

1. How do you work best in math?
   alone with a partner in a small group in a large group

Circle **Agree** or **Disagree**.

2. Math is important to learn.
   Agree Disagree

3. Math is boring.
   Agree Disagree

4. I am good at math.
   Agree Disagree

5. Math is fun.
   Agree Disagree

6. Doing math makes me nervous.
   Agree Disagree

7. It helps me to understand math when I see other kids strategies shared on the board.
   Agree Disagree

Answer these questions:

1. What helps you learn math? _____

_____

_____

2. What makes it hard for you to learn math? _____

_____

_____

3. Are there times you feel you don't like math? If so, when? _____

_____

_____

4. I feel proud in math when _____

_____

_____

Artifact 1B

Survey One Results

*Survey #1 was taken by 22 out of 23 Students

Agree / Disagree Statements

Math is important to learn:
Agree: 20
Disagree: 1
Sometimes/So-so: 1

Math is boring:
Agree: 9
Disagree: 9
Sometimes: 4

I am good at math:
Agree: 16
Disagree: 2
Sometimes/So-so: 4

Doing math makes me nervous:
Agree: 7
Disagree: 14
Sometimes/So-so: 0

Math is fun:
Agree: 10
Disagree: 8
Sometimes/So-so: 4

It helps me understand math when I see other kids strategies on the board:
Agree: 7
Disagree: 13
Sometimes/So-so: 2

Circle which best describes you as a learner in math:

Alone: 11
With a Partner: 4
In a Small Group: 3
In a Large Group: 2
***Didn't respond**: 2

Short Answer Responses:

What helps you learn math?

- Seeing every strategy
- Cubes
- Playing math games
- Seeing other people's strategies
- When a teacher helps me
- I work with a friend I have known for a long time
- When I use snap cubes
- Using my brain and not getting distracted
- My fingers
- My brain
- Using math tools like cubes
- When we are not on the rug for too long
- Working by myself because it is quiet and peaceful
- Breaking numbers apart
- By doing it in school
- It helps me learn math when I'm not with a partner
- Math tools
- When it is quiet and when I'm alone
- A quiet room
- Using tools
- Math tools and my fingers. My brain is important for math
- Noise

What makes it hard for you to learn math?

- Almost everything
- Loud
- Sitting in group discussions
- Nothing!
- When a kid says "that's so easy" or something like that
- When the room is loud
- It makes it hard for me to learn math when there is a lot of noise
- When my friends are talking to me and talking about lunch
- When people talk to me when I'm doing math
- Nothing
- Guessing the math problem??
- When we are on the carpet for too long
- Nothing
- When people are making noise
- When people talk to me when I'm working
- When I'm with a partner
- When a teacher comes to me and screams at me
- When a friend is talking
- A really noisy room

- Being alone
- A lot of noise
- Quiet

Are there times you feel you don't like math? If so, when?

- When people question me
- Nope
- Math in the classroom. I like math when it has to do with something real. I like math games but not recording or story problems
- It never happens to me
- Yes, when it is hard for me
- When I have a bad day and I feel frustrated
- When we sit in a group and do math
- When math gets easy
- Yes.
- No because it is always fun
- Yes
- I really don't like when we do story problems
- When math gets tiring
- I always like math even if math problems are easy
- No
- I don't like math when I just have one thing to do
- When the problems are hard and too easy
- All the time
- Times when math is hard
- When it is problems about math
- When it is too easy and when it is too hard
- All the time

I feel proud in math when...

- My mom doesn't help me
- When I get a question right
- Always
- I complete a story problem
- I solve a problem before others
- I have a good day and I feel confident
- I get all the answers right
- I do a lot and finish it all
- I work hard and do story problems
- I get it right
- When I figure out a story problem
- I am able to share my thinking on the elmo
- Complete a problem
- I fill up the math pages
- I finish an end of unit assessment because I learned so much in that unit

- I finish all my work
- I complete my sheet
- Finish quickly but do it well
- Kind of easy, kind of hard
- I get to do all I want
- When I understand and do well
- When I fill the whole page

Artifact 1C

Math Survey Two

Circle **Agree** or **Disagree**.

8. I like working with a partner.
   Agree Disagree

9. I feel comfortable asking my partner a question about math.
   Agree Disagree

10. I am good at math.
    Agree Disagree

11. Math is fun.
    Agree Disagree

12. I need help during math.
    Agree Disagree

13. Math is boring.
    Agree Disagree

14. I can help a friend understand something in math.
    Agree Disagree

15. Games help me learn math.
    Agree Disagree

16. It's important to ask questions in math.
    Agree Disagree

17. It helps me to understand math when I see other kids strategies shared on the board.
    Agree Disagree

18. Math has been better since we started using more games.
    Agree Disagree

    Explain why you think so: _____

    _____

    _____

How is math going for you as a learner? Answer these questions.

1. How do you feel about our recent math meetings? _____

2. What has been helping you learn math recently? _____

3. What is still making it hard for you to learn math? _____

4. Are there times you feel you don't like math? If so, when? _____

5. This week, I felt proud in math when _____

Artifact 1C

Survey Two Results

*Survey Two was taken by 23 out of 23 Students

<u>Some Agree / Disagree Statements</u>

I like working with a partner.
Agree: 13
Disagree: 8
So-so/Sometimes: 2
Comments:
- "Only when they are not distracting"
- "Only when they are serious"

Math is boring.
Agree: 7
Comments: "Math is so boring"
Disagree: 14
Comments: "Lately"
Sometimes: 2
Comments: "When we play games it is fun"

Math is fun:
Agree: 9
Comments: "Lately"
Disagree: 11
Sometimes: 3
Comments:
- *"Only when we have a game after that"*
- *"Because of story problems" [it is not fun]*

I feel comfortable asking my partner a question about math.
Agree: 14
Disagree: 8
Sometimes: 1

It helps me when I see kids strategies shared on the board.
Agree: 7
Disagree: 16
Sometimes: 0

Math has been better since we started games.
Agree: 19
Disagree: 4

***Agree Explanations*:**
- Because earlier in the year we just did 50 different story problems and no game. Now we do our 50 story problems fast so we can do games
- Because games are more fun than work
- Because it is more fun
- Because math games makes math fun!
- Because now that there are more games, people don't walk around
- Because we play more games
- It's easier and funner
- Because I can add, subtract, and learn all at the same time
- Because the games are fun
- Because it was less loud and so it was easier to work
- Because a lot of people think the math games help them learn math
- I think games helped because you get to use different kinds of strategies
- Because I solve it by myself
- Because you have more things to choose from
- Because it's forming learning into games which are fun
- Because we get to choose what games to play
- It just has gotten funner
- Because math becomes fun sometimes when we play games
- Math is funner with more games because it becomes fun and it gives me time to think.

Disagree Explanations
- I think no because the meetings are so long
- Because games are boring
- We have only playing games
- Because math games don't help anything

How do you feel about our recent math meetings?
1. I like them because they help me. But if they are too long I usually get restless.
2. I sometimes start day dreaming and get confused
3. Tiring
4. I don't think they were very good because they were so so long
5. Good
6. They have been sort of boring when we are on the rug for a long time
7. They are sometimes too long and sometimes too short
8. Good because we get to play more games
9. Good because we talk longer. That helps me. People are being quieter at meetings.

10. They're good because I learn when I'm on the rug.
11. I sometimes feel bored being on the rug because when I stay on the rug too long I get a little bit bored.
12. It is boring
13. I feel like we have been on the rug for a long time every time.
14. The meetings are too long
15. Good because it helps me. It gives me clues for the answers
16. Good because we get to know what we are going to do
17. They are boring because they don't help me
18. Good because you get to share your work. We talk about how it's going, not just the math.
19. Ok, it's not my favorite thing to do but it is ok.
20. The meetings distract me from caring
21. They get boring when they are long.
22. I don't like it because I get impatient
23. The same as before. They weren't fun and they are boring.

What has been helping you learn math recently?

1. It helps me when I work alone unless I have someone who is steady.
2. When a teacher helps me
3. Drop a dollar
4. Strips and singles
5. Noise
6. The games
7. Cubes, stickers, and strips of ten and ones
8. Playing games like oh no 99 or racing trio.
9. Breaking numbers apart.
10. Breaking numbers apart.
11. Playing with a partner because your math partner can help you.
12. All of the materials
13. Doing the math problems
14. Nothing because we are only playing games
15. My brain and fingers
16. Math tools like cubes and stickers
17. Games have been helping me
18. Reading the equation over
19. Games
20. The games
21. Math Homework
22. When the room is quiet so I can concentrate
23. ?

What is still making it hard for you to learn math?

1. It is hard to learn math when there is a lot of noise and when I have an unsteady partner.
2. When I work with a partner.

3. The loud
4. Nothing
5. Quiet
6. When we are on the rug for a long time
7. The noise level
8. When we have a lot of work to do. When it's on the board and you have to do all of it.
9. Nothing because it is all games sometimes
10. Nothing
11. When the story problems are a little bit too hard for me.
12. When it is too loud
13. It is still too loud
14. Nothing makes it hard to learn math but having a math partner
15. A lot of noise in the class
16. Not using math tools and guessing what the answer is going to be
17. The noise level is 1-10 at 7
18. Nothing
19. Some story problems.
20. Nothing
21. Everybody screaming
22. ?
23. Nothing

Are there times you feel you don't like math? If so, when?

1. I don't like math when we have so many story problems and no games!
2. When it is hard like subtracting a big number from a big number
3. Nope
4. Yes, when the problems are hard
5. All the time
6. When we're on the rug for a long time
7. Sometimes when I have a place to go. (When I'm distracted or excited about something else)
8. When there's a lot of story problems
9. When there's a really large number like 1000
10. No, because math is always fun with story problems and games
11. When math isn't so fun
12. When we have to do math problems
13. When my math partner is not concentrating on our game
14. I don't like math when we are only playing games
15. I love math all the time
16. I don't like math when it's very hard and I don't understand
17. Normally if there isn't a story problem, game, or survey
18. Never
19. During story problems
20. All the time because math is boring.
21. When we do math problems

22. When the room is really loud it makes it tricky to work
23. Always. It's not fun.

This week, I felt proud in math when...

1. I got to share my thinking with the group and when I got my math done quick enough to play a game
2. Someone said I was growing in math.
3. I won Oh No 99!
4. I completed all the story problems
5. I got all the problems done
6. I got to share on the board
7. I was helping Cloe out.
8. I found an easier way to add numbers together
9. I solved a hard math problem.
10. I was absent for a day and when I came back to school, I finished a lot of story problems.
11. When I did the story problems
12. I finished 4 story problems.
13. I told Wyatt my strategy of a math problem and it helped him.
14. When I won my first math game. [Also] that I did 3 math problems quickly
15. I did the right answer
16. I really figured it out and figured out my work.
17. In Oh No 99, I never hesitated a number. (I didn't have to count by ones, I just knew combinations that helped me add numbers)
18. I feel really proud because I'm really good at math! (equations and other stuff)
19. I was playing Oh No 99 and I got one jack, two kings, and two queens
20. I never did
21. I got a lot of time.
22. I accomplished a page and at the end of math I do everything correct
23. I helped Jack with an equation for a game. I helped count.

Artifact 1D

Math Survey 3

How is math going for you? _____

_____

_____

_____

I felt proud in math when _____

_____

_____

_____

Artifact 1D

Survey Three Results

*Survey Three was taken by 21 out of 23 students

How is math going for you?

1. Good sometimes. The times I like are when there are games following the work.
2. With a math partner it is so so. By myself it is great.
3. Good sometimes because it's good when we have games because it turns learning into fun.
4. Math is going great for me!
5. Good in a way. It isn't good because it gets really loud in the room.
6. Bad
7. Good/Bad because sometimes people distract me.
8. Awesome because you get to play lots of fun games!
9. Math is not so fun. Math is fun when we play games.
10. Bad
11. It is kind of harder than usual. I like working alone more than a partner
12. Math is going great for me because the games got better and better.
13. It is going good except for I think were on the carpet too long
14. Good because I am really getting it.
15. Math is going well when we do math games and we do story problems
16. It is going good for me and I love math games.
17. It is a little hard for me in story problems
18. It's very fun with all the games
19. Good because theres more games
20. For me math is so boring!
21. Awesome!

I felt proud in math when...

1. I got to finish my work and got to the game.
2. I used different strategies
3. I got [drew] 36 stars in a minute. [In a game]
4. I let my partners choose the game.
5. I accomplished a really hard math problem
6. Got in trouble
7. I got the most of something.
8. I did five math work pages in 5 minutes
9. I came up with a new way to solve a problem
10. I helped someone.
11. I learned that I was improving
12. I win a math game and when someone wins.
13. I get a check on my math homework.

14. I figured out a story problem and when I first figured out what we were doing in math.
15. I shared my strategy in front of the whole class.
16. [No Response]
17. I got to share to the class
18. I won get to 99!
19. I learned 4 new things in one day.
20. I threw the dice in the air.
21. I felt proud when I beat my partner.

Artifact 1E: Comparisons of Survey Results

1. Math is boring.

Survey One:
Agree: 9
Disagree: 9
Sometimes: 4
Total: 22

40.9% agree
40.9% disagree
18% Sometimes agree, sometimes disagree

Survey Two:
Agree: 7
Disagree: 14
Sometimes: 2
Total: 23

30.4% agree
60.8% disagree
8.6% Sometimes agree, sometimes disagree

2. Math is fun.

Survey One:
Agree: 10
Disagree: 8
Sometimes/soso: 4
Total: 22

45% Agree
36% Disagree
18% Sometimes agree, sometimes disagree

Survey Two:
Agree: 9
Disagree: 11
Sometimes/Soso: 3
Total: 23

39% Agree
48% Disagree
14% Sometimes agree, sometimes disagree

3. I am good at math.

Survey One:
Agree: 16
Disagree: 2
So-so/sometimes: 4
Total: 22

Agree: 73%
Disagree: 9%
So-so/sometimes: 18%

Survey Two:
Agree: 19
Disagree: 1
So-so: 3
Total: 23

Agree: 83%
Disagree: 4%
So-so: 13%

4. Working with Partners

- **Myself as a Learner Survey:**
  "I like working with a partner"

  Highlighted: 12
  (Of these 12, 4 like working alone, and 2 sometimes like working alone)
  Didn't Highlight: 9
  (Of these 9, 1 did not highlight "I like working alone"
  Total: 21

  Of Totals:
  Highlighted: 57%
  Didn't highlight: 43%

- **Survey One:**
  "How do you work best in math?"

  Alone: 11
  With a Partner: 4
  In a Small Group: 3
  In a Large Group: 2
  *Didn't respond: 2
  Total: 22

  Of Totals:
  50% work alone
  18% with a partner
  14% with small group
  9% large group
  9% didn't respond

- **Survey 2:**
  I like working with a partner:
  Agree: 13
  Disagree: 8
  So-so/Sometimes: 2

  Of Totals:
  57% agree
  35% disagree
  9% sometimes/So-so

Artifact 2

Game: How Many Rooms, How Many Floors

Materials Needed:

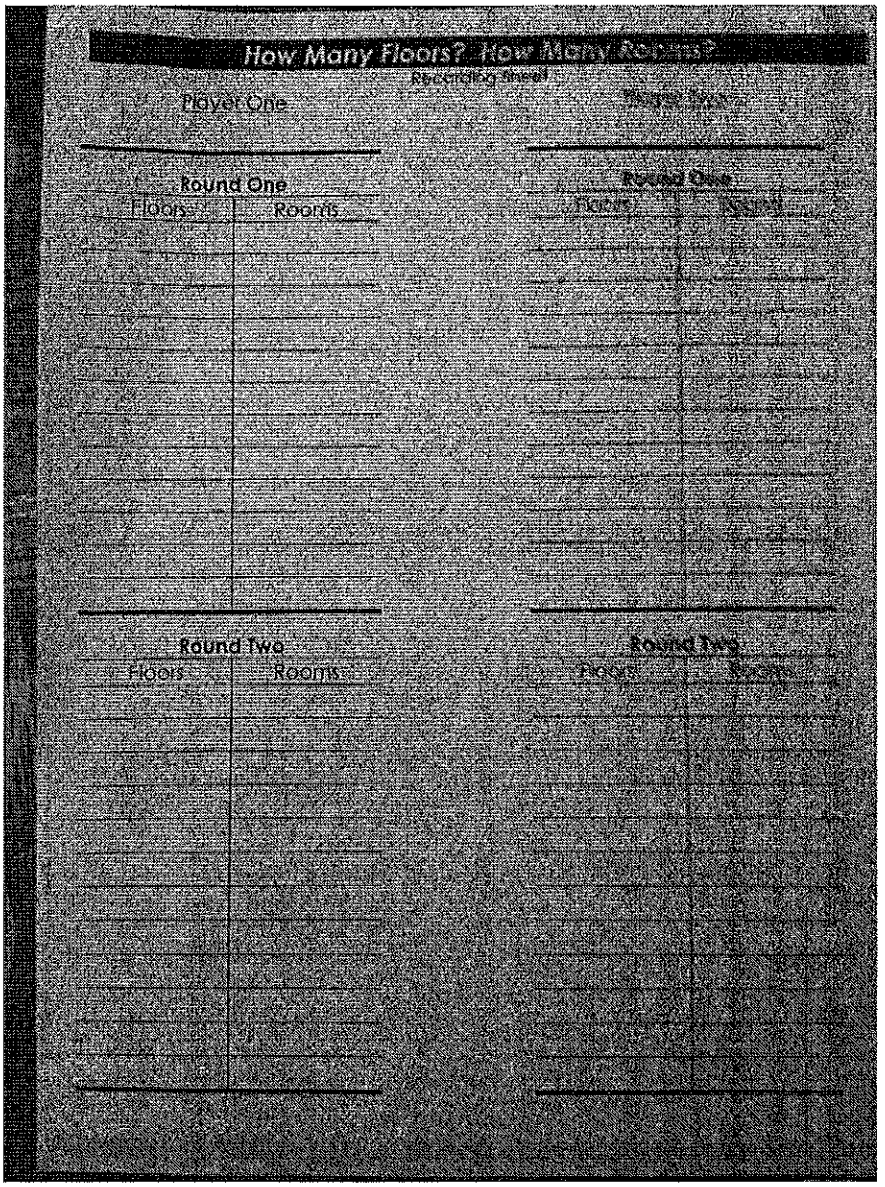
- Red Dice (numbered from 1 to 12)
- Green Dice (numbered or dotted from 1 to 6)
- Recording Sheet

Directions:

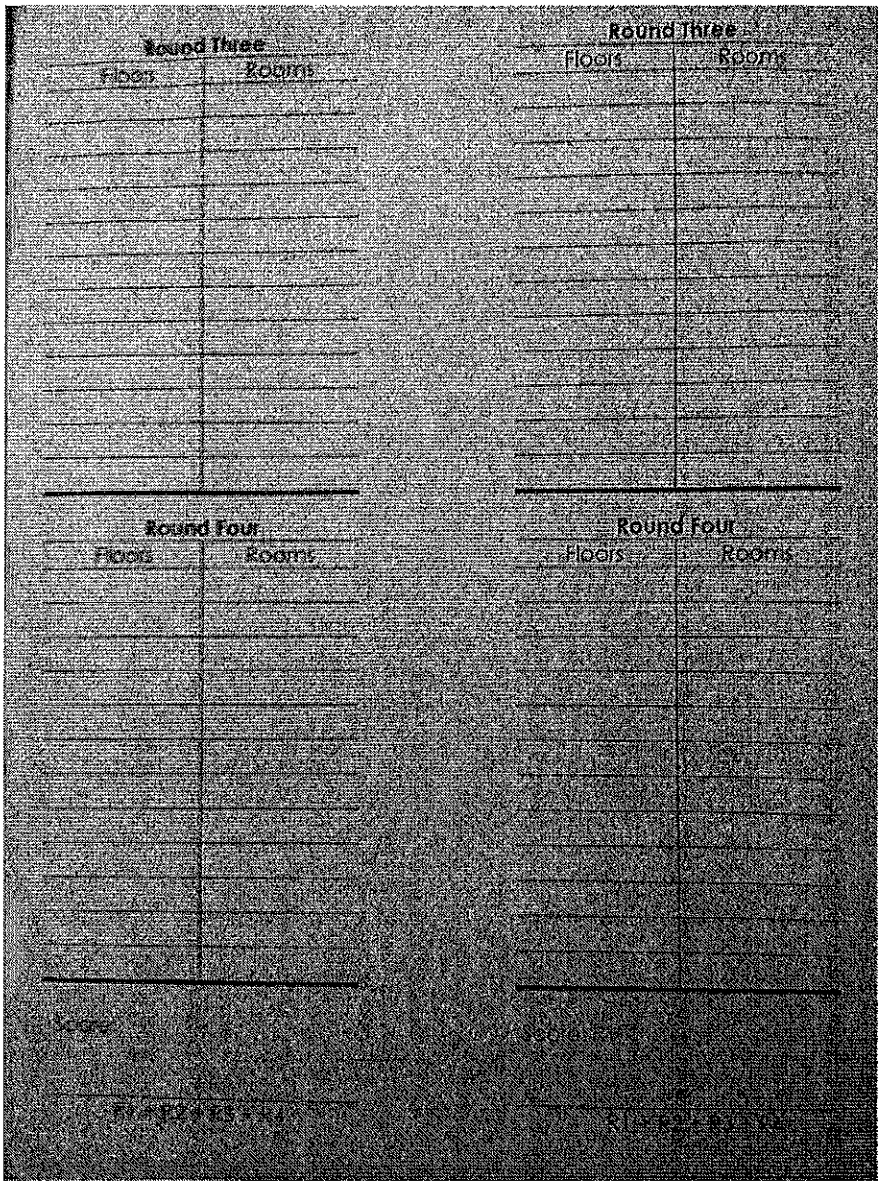
1. Player One rolls two dice.
2. Both players record the red die as the number of floors in the table for Round One. Both players record the green die as the number of rooms on the first floor.
3. Players figure out how many rooms will be in the building based on the number of floors (from the red die).
4. Repeat these directions for Player Two.
5. Repeat all directions for four rounds of the game.
6. Add up the number of rooms in each building from each round to see how many rooms each player rolled total.

Possible Extensions:
*Finding the number of rooms in more floors
*Finding the different between Player One and Player Two's number of rooms in each round or total
*Larger dic

Recording Sheet – Page One:

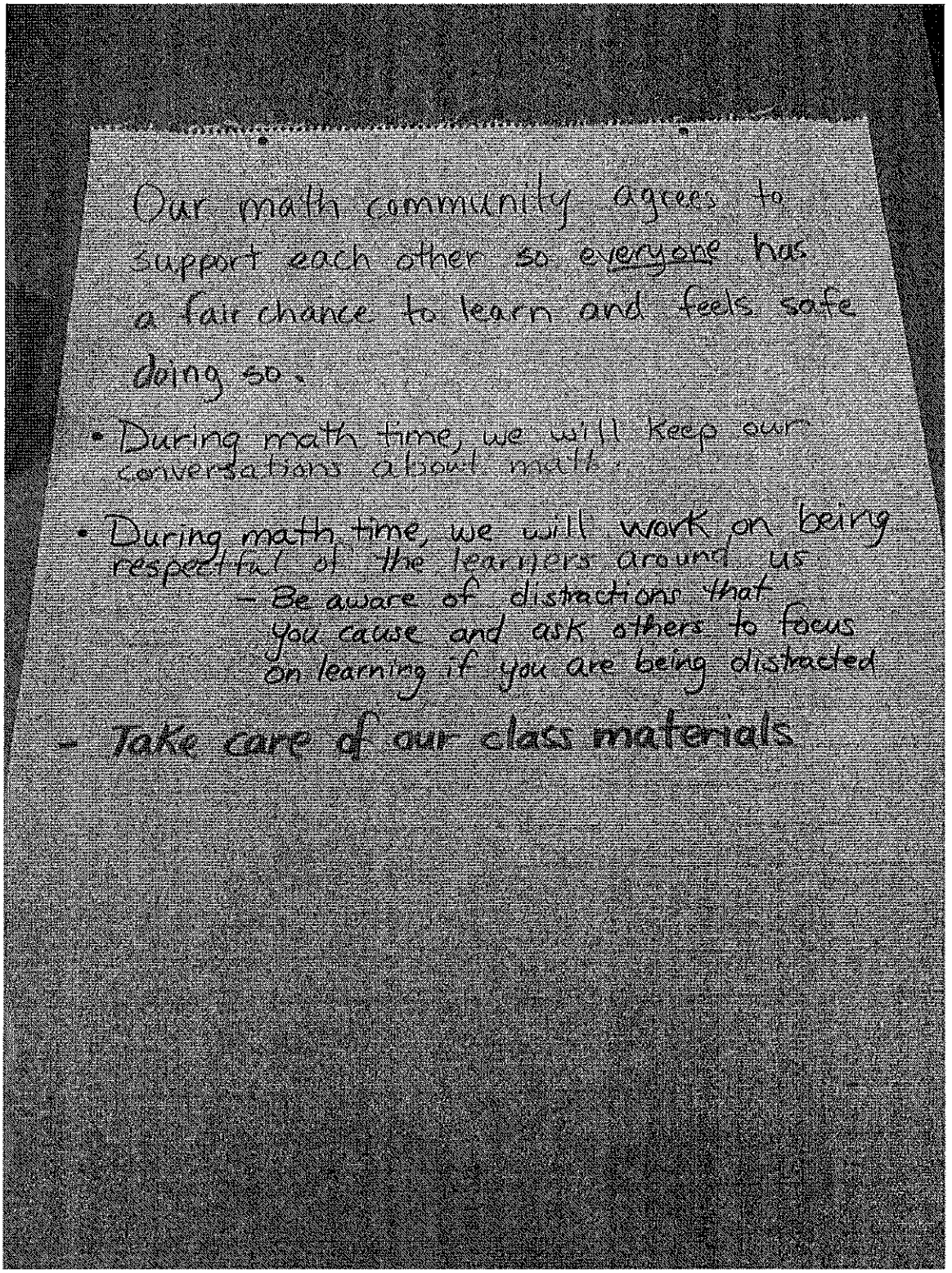


Recording Sheet – Page Two



Artifact 3

Math Community Guidelines



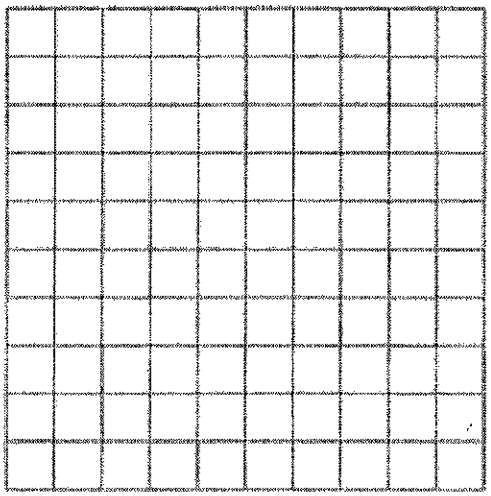
Artifact 4

Sticker Book

Example of One Page from Sticker Book

Student directions were to show the number of stickers on the sticker page (blank 100 Chart) and then solve a problem finding a missing part.

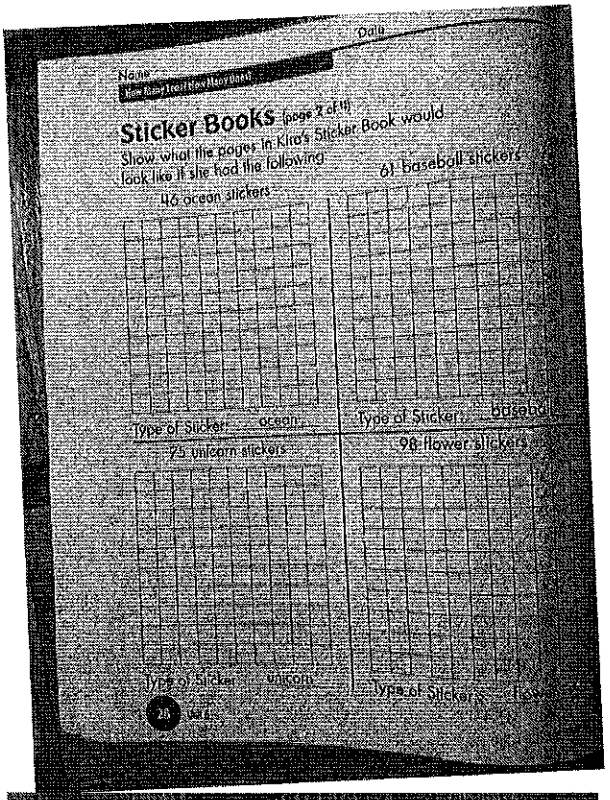
You have 36 hockey stickers.



How many more hockey stickers do you need to have 60 hockey stickers?

Show your work.

Artifact 4A: Example of Sticker Problems from Curriculum Used



Name Date

Sticker Books (page 2 of 4)

Show what the pages in Kira's Sticker Book would look like if she had the following:

46 ocean stickers

61 baseball stickers

Type of Sticker: ocean

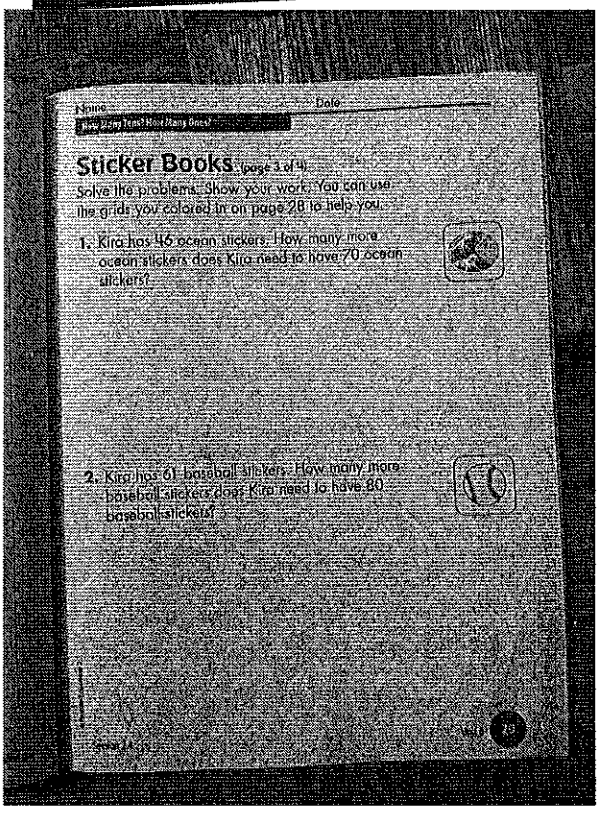
75 unicorn stickers

Type of Sticker: baseball

98 flower stickers

Type of Sticker: unicorn

Type of Sticker: flower



Name Date

Sticker Books (page 3 of 4)

Solve the problems. Show your work. You can use the grids you colored in on page 28 to help you.

1. Kira has 46 ocean stickers. How many more ocean stickers does Kira need to have 70 ocean stickers?

2. Kira has 61 baseball stickers. How many more baseball stickers does Kira need to have 80 baseball stickers?

Artifact 5

Games: How Many Stars Can I Draw in One Minute? How Many Cubes Can I Connect in Three Minutes?

Materials Needed:

- One and Three Minute Timers
- Paper
- Pencils
- Cubes

Directions for How Many Stars Can I Draw in One Minute?

1. Player One flips over a one minute sand timer and keeps track of time. While that is happening, Player Two draws as many stars on a paper as he/she can until the timer ends and Player One says STOP!
2. Players switch turns drawing and timing.
3. Each player figures out how many stars he/she drew by circling groups of 10. Then, each player writes an equation showing all the groups of 10 and ones.

As an extension, players can figure out how many more stars the player who drew the most had than the other player.

Directions for How Many Cubes Can I Connect in Three Minutes?

1. Player One flips over a three minute sand timer and keeps track of time. While that is happening, Player Two connects as many cubes as he/she can until the timer ends and Player One says STOP!
2. Players switch turns connecting cubes and timing.
3. Each player figures out how many cubes he/she connected by representing the cubes as pictures in groups of 10 on a paper. Then, each player writes an equation showing all the groups of 10 and ones to figure out how many cubes

As an extension, players can figure out how many more cubes the player who connected the most had than the other player.

Artifact 6: Brochure

Make Math Learning Purposeful

- Have students find ways math is used in their daily lives or interview a grown up about how they use math as well
- Set up a context for learning math
- Provide math tools to make math more understandable for learners

Keep the learner thinking.

Ask Questions

How did you get that answer?

How do you know?

Is there another way you can figure it out?

Does that strategy work for other numbers? Why does it work?

"Mommy, my teacher called me a mathematician today!"

Calling students **'mathematicians'** is an important way to empower your students. It tells them that you value their thinking, strategies, and abilities.

Empower children.

Encourage Different Strategies

- Gives students an opportunity to engage in deep thinking
- Allows students to have better understanding
- Students develop deep reasoning skills and become flexible problem solvers

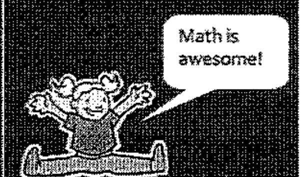
What helps you learn math?

"Seeing other people's strategies."
"Seeing every strategy"

-Student responses

How to Keep Student Attitudes Positive in Math

A Guide for Teachers



Created by Jessica Feiwus

A Part of the Integrative Masters Project

Bank Street College of Education

1.

Reasons to Keep Attitudes Positive:

- Math surrounds people in their everyday lives and people need to be able to use it
- Children who dislike math may enroll in fewer math courses in high school and beyond (Nicolaidou & Philippou, 2003)
- Student learning may be greater if they are motivated and interested in learning math
- Students may become more confident, willing to take risks, and hold a higher level of understanding (Mokros, et al., 1995).

How do your students feel about math?

"I like math when it has to do with something real."
-Second Grade Student

How to Create a Classroom Space that is Optimal for Learning

Have Community Conversations

- What was challenging about math today?
- What does it mean to be a learner in this community?
- What does it mean to work with a partner?
- Post sentence starters for students to refer to in conversations
  - I agree/disagree because...
  - I'd like to add on...
  - I see it another way...I think...
- Set goals for the class and individuals and make sure students are aware they are working towards them.

Value a Space for Collaboration

- Create math partnerships and change partnerships often
- Allow opportunities for students to share their ideas and strategies with the class
- Incorporate games into the curriculum

Allow Time for Reflection

- Teachers should want to know how their students feel as a math learner
- Student reflections can inform whole-class, small-group, or individual conversations to

"I felt proud in math when I came up with a new way to solve a problem."
-Second Grade Student

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