FOSTERING MATHEMATICAL LEARNING

THROUGH GROUPWORTHY TASKS IN AN ELEMENTARY CLASSROOM

by

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ABSTRACT

This action research project focuses on mathematical learning through groupworthy tasks in mathematics. Through giving students groupworthy tasks, I examined mathematical learning, student strategies, status, and how students work together in a third grade classroom. The research primarily focuses on student understanding of mathematical concepts through personal and group exploration. The question explored is “How can groupworthy tasks, coupled with classroom norms, support deeper mathematical understanding for students during group work?” I collected the majority of the data over a three-week period at the beginning of the school year. Through data analysis I found that groupworthy tasks can strengthening mathematical concepts through student-to-student discourse.

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CHAPTER 1: PROBLEM STATEMENT AND LITERATURE REVIEW

Problem Statement

Through my experiences in classrooms, I have noticed that mathematics is taught primarily with direct instruction. I was first introduced to equitable group work in mathematics after my undergraduate studies. In my experience, group work helped me understand mathematics better than traditional methods of learning. The group work I experienced was more than a collection of peers working on math. It had a specific structure that supported equitable learning and participation among all members within the group. The structure included three important elements to create equitable group work, which included the norms and jobs created, attending to status in the groups, and the tasks given. The tasks were complex and required multiple people collaborating to successfully complete the task. The tasks could also be called "groupworthy". These tasks were effective for my learning in mathematics and I became interested in understanding if groupworthy tasks might also help elementary students in understanding mathematics. I was also curious as to how these types of task, and the structure of equitable group work, could influence student perceptions of themselves in mathematics.

How can groupworthy tasks coupled with classroom norms support deeper mathematical understanding for students during group work? I continued to ask myself this question when I worked with third grade students at Crescent Lake Elementary[1]. This was my student teaching placement at the time of this

[1] All names are pseudonyms to protect the identity of the participants.

action research project. This school is located in a suburban, middle class community with a high percentage of military families. During my six-month practicum placement at Crescent Lake, I found that students at this school viewed mathematics as a series of formulas and rules to memorize in order to pass classroom tests and state standardized tests. I noticed that, for some students, math was not enjoyable, because they did not understand mathematical concepts. They found it boring, were disengaged, or they had low self-efficacy in mathematics. I wondered how group work could support these students through more active student engagement in mathematics.

I noticed that students who are experiencing disengagement in mathematics or are not able to connect with the material tend to lose interest and willingness to work with challenging mathematics problems. This leads to students who feel as if they are unable to do math, perceive themselves to be "bad" at math, or are unable to keep up with other students in mathematics.

Students who have low self-efficacy or perceive themselves as not as capable as other students (low academic status student), may not participate as much as other students who have higher perceived abilities and status. Research has shown that it is difficult for students who perceive themselves to be less competent in mathematics to have equal access and participation in group work (Cohen, 1999). However, research has also shown that when group work is implemented in ways that attend to sociomathematical norms, expectations, and roles, more students may be able to access the content. This action research project aims to investigate how group work structures such as norms, roles, and

the type of tasks given to groups can positively influences students' perceptions of their competence in mathematics.

The Community

Crescent Lake Elementary is a kindergarten through third grade school located in in a medium sized town near a military base in the Pacific Northwest. This area was developed primarily for military families who wanted to live off the military base; however non-military families attend this school as well. Over 50% of the students at Crescent Lake have parents or family in the military. Crescent Lake Elementary was built about 12 years ago.

Crescent Lake Elementary students performed well on standardized tests, including math. Students were taught how to take these tests and the instruction in the classroom centered on the type of math they needed to know in order to receive passing scores. Although most students were successful at passing the tests, I wondered if the students really understood the mathematics behind the standard procedures and formulas. During my time in this classroom, I saw many instances in which students used formulas to solve math problems. However, when I asked students why the formula worked, or what the numbers represented, they were often unable to explain or justify their answers. As a future teacher, I want my students to be computationally fluent with procedures (Russell, 2000). I also want my students to have a deep and connected understanding of the mathematics they are learning and to be able to explain and justify their answers.

Benefits of Group Work

Studies have shown that learning mathematics in cooperative groups can promote student learning and strengthen mathematical understanding (Battistich, Solomon, & Delucchi, 1993; Boaler, 2008; Kesselring & Wheelan, 2005). Research has also found that when students are able to explore the mathematics before the formulas provided to them, student learning and performance will increase (Kesselring & Wheelan, 2005). These studies, as well as many others, have prompted me to become curious about the relationship between certain aspects of group work, namely group norms and groupworthy tasks, and deep student learning in mathematics beyond memorization of the formulas and procedures.

In the review of the literature related to group work as method for increasing participation I found three themes that contributed to how I understood the ways in which group work could be implemented in my classroom. These themes were the use of norms, attending to status and group size, and groupworthy tasks.

Groupworthy tasks are larger, more complex problems that small groups of students solve collaboratively. Lotan (2003) describes groupworthy tasks as being as “close as possible to genuine dilemmas and authentic problems” (pg.72). These tasks require students to use their understanding of mathematics to solve complex mathematical problems and justify their understanding of mathematics (Lotan, 2003). The goal of this type of cooperative learning is to

increase student understanding, engagement, and responsibility for their own learning (Stevens & Slavin, 1995; Artut & Tarim, 2007).

Typically the students at Crescent Elementary have been taught the U.S. standard algorithms and it was difficult to know if the students had conceptual understanding of why the algorithms worked. With the inclusion of groupworthy tasks, I hoped to support students in learning both conceptual understanding and procedural fluency with algorithms. Research suggests that groupworthy tasks play a beneficial role in helping students learn to work collaboratively with peers, deepening student understanding, and allowing students to experience learning in a more engaging way (Boaler 1998; Lotan, 2003; Stevens & Slavin, 1995). Burns (2013) states that "mathematics educators at all levels should seek to develop in their students…the ways we want student to engage with the mathematics they're learning" (pg. 43). In other words, students should be engaged and actively involved in learning mathematics. Students who are able to have a more participatory experience will be more engaged in their mathematics and learning. My intention was to provide my students this opportunity through a group work structure.

Teaching students to work collaboratively is not easy. There are many questions and concerns that arise when asking students to work in small groups. Some of these questions and concerns include students not talking to each other, grouping students who are at different academic levels, the sophistication and productivity of the conversation students have, students who take over while others do not patriciate, and when students get the wrong answer.

These concerns are valid and can often become the reasons teachers give up on group work. However, research has shown that when students are explicitly taught how to work collaboratively, these issues can be mostly avoided (Cohen, Lotan, Abram, Scarloss, & Schultz, 2002). In my study I taught students the importance of working collaboratively on groupworthy tasks in mathematics. This means that students worked in small groups on one complex math problem. I also purposefully implemented norms and roles to support more equitable participation. It is important for students to know how to work with other students with the help of group norms, expectations, and roles.

Benefits of Equitable Groupwork

In reviewing the research related to structured and more equitable forms of groupwork, I found two major benefits for students. First, groupwork can support students' mathematical understanding. Second, groupwork can support student motivation.

Supporting Student Understanding

Research states that collaborative group work can support and promote student learning (Boaler, 1998; Webb, 2008). Group work and collaborative learning can build on students' understanding of mathematics and number relationships by deemphasizing standard formulas and allowing students to explore mathematics problems with their peers and without direct instruction from the teacher. Wheeland and Kesselring (2005) state that successful group tasks have "too many different skills (that are) required for any individual to successfully accomplish such complex tasks alone" (p. 323). Therefore, students

need their peers as resources for learning. Some researchers refer to this as delegating mathematical authority (Cohen, 1994; Hufferd-Ackles, Sherin,2004).

Learning formulas equates to the limitation of only knowing the formula; this does not allow students to understand the mathematical concepts behind the formula. Students need to understand mathematical relationships in order to not only remember math, but to truly understand the connections and to apply it in other situations beyond school academics. Boaler's (1998) study of students' experiences with what she calls "open" and "closed" mathematics revealed that,

> One important conclusion that I feel able to draw from this analysis is that a traditional textbook approach that emphasizes computation, rules, and procedures, at the expense of depth of understanding, is disadvantageous to students, primarily because it encourages learning that is inflexible, school- bound, and of limited use. (p.60).

Therefore, it is imperative that students learn mathematical concepts in order to achieve mathematical understanding beyond memorizing traditional procedures.

Allowing students to engage in mathematical sense making can allow students to use math when they leave school because they can better understand how math can be used in real life situations. When students learn math through procedures and formulas, they likely will not make connections to the real world around them. When these students grow up and leave school, they may not understand how to use math in their everyday lives and will most likely forget the formulas they learned in school. Boaler (1998) states that,

> if students are unable to make use or sense of their school mathematics in such tasks within school, it seems unlikely that they will make use of this mathematics when similar tasks are encountered in the real world with an even greater complexity of mathematical and nonmathematical variables" (p.53).

Students may not be able to make connections to the real world and math when they learn formulas without understanding why the formulas work. Boaler (1998) claims that students will likely have a better understanding of math if they are able to work on complex mathematical ideas with their peers before learning the formulas.

Students who learn to work collaboratively in groups listen to and learn from their peers. Students learn to see that there is more than one way to solve a problem and they can formulate their own strategies that work best for them. This helps students build mathematical understanding (Boaler, 1998; Huffard-Ackles, Fuson, & Sherin, 2005). Students who are able to work together can build on connect to each other's ideas. They can work together to build a deeper understanding of mathematics and learn from each other. It is important for students to extend their understanding and knowledge and learn to build their own algorithms. For this project, I wanted to allow students to figure out how to solve math problems with their peers by providing a groupworthy task without giving out the standard formula. Through this practice, I wanted to see how students might learn conceptual mathematical ideas by building on or learning from the ideas of their peers.

Student Motivation

Allowing students the opportunity to explore math on their own can equate to personal understanding of mathematics. Meyer, Schweinle, and Turner (2006) state that "the more learning is rewarding and enjoyable and the less it is boring or anxiety producing, the more students will seek it for its own sake. Therefore, students' experiences in classrooms - motivationally and emotionally - are crucial to their attitudes, behaviors, and achievement" (p. 271). Students who are allowed to explore, for their own reward and enjoyment, have more interest in their learning. Therefore learning will be more enjoyable.

Paulo Freire (2000) discusses passive learning and teacher-centered instruction and the link to motivation in learning as the "Banking Concept". The Banking Concept is the idea that students sit in class while listening to the teacher talk. It is assumed that students enter the classroom as blank slates and that learning happen by the teacher depositing knowledge into the students' heads. Being able to explore math beyond simply listening to the teacher allows students to use multiple parts of the brain. Students need to be able to use multiple parts of the brain in order to make sense of what they are learning and to feel empowered by their learning.

The act of learning is more than listening to a teacher talk, it is about experiencing new knowledge. Students learn better when learning is a pleasurable experience that activates multiple parts of the brain. Zull (2002) explains learning is less pleasurable when it "involves recall of association." He describes the importance of students using all parts of the brain to connect with

learning and remembering what they are learning. As a result, students are more actively involved in their learning. Freire (2000) states that, “The outstanding characteristic of this narrative education, then, is sonority of words, not their transforming power” (p. 1). Memorizing facts does not activate actual learning. Freire (1998) continues, “to teach is not to transfer knowledge but to create the possibilities for the production or construction of knowledge” (p. 30). In order to help students learn, they need to be engaged and learning the subject in multiple ways. Students who do not feel motivated in their learning are less likely be engaged which can limit success.

In mathematics, students can feel frustrated and disempowered when procedures and formulas do not make sense. When this happens they are more likely to dislike math, see themselves as “bad” at math, and find little motivation in learning it (Boaler, 1998; Boaler, 2002; Cohen, 1998; Huffard-Ackles, Fuson, & Sherin, 2005). In classrooms where students are able to apply math concepts and work problems out for themselves, students are more likely to understand the math and therefore, find mathematics more enjoyable. These students feel empowered and more motivated in their learning (Boalar, 1998; Meyer, Schweinle, & Turner, 2006; Slavin & Stevens, 1995).

When students are given opportunities to talk about their mathematical thinking, they may feel more actively involved and motivated. Chan, Franke, Freund, Melkonian, and Web (2009) found that there is a direct link between communication and student success. Mercer and Sams (2006) found that student discourse also helps children develop knowledge and understanding. If a

student is developing their own understanding, they will be more willing to work and learn. Berger and Hanze (2007) state that when working in cooperative groups “students can be guided toward greater feelings of competence, which increases motivation, and can lead to a better academic performance” (pg. 39).

Other researchers have found links between motivation and its effects on learning. Meyer, Shweinle, and Turner (2006) state that “achievement, motivation, and affect are contextualized and made meaningful by their experiences in the classroom” (pg. 271). The authors explored the perceptions that fifth and sixth grade students have about mathematics. This study investigated the relationship between student motivation and its effects on learning math by investigating a variety of classrooms and identifying patterns of motivation and affect. The authors found that there was a close relationship between affect and motivation. Students with high efficacy, where they perceived themselves with the necessary skills to perform mathematical tasks, were also strong in their social and personal affects in the classroom. Students with high efficacy who had a high affect in their social behavior demonstrated more motivation in mathematics and felt more capable to tackle mathematical problems.

The Meyer et al. study established credibility by collecting and analyzing data from multiple sources. The transferability of the study was strong because the authors provided rich, thick description of the environment and the range of students they were studying. The confirmability appeared weak, as the authors did not describe their analysis process in detail. I am left wondering if the authors

confirmed their results with their participants or if their findings were reviewed by an “outsider” peer.

Before successful collaborative group work can happen in mathematics there are things that teachers need to consider and prepare for to ensure successful group work. Teachers need to understand and consider how they will assign roles for students, the size of the groups, the student levels in math, and their perceived abilities. Teachers also have to prepare for the types of problems they give students and how they want to structure classroom behavior with rules and norms.

Practices that Support Equitable Group Work

Not all group work equates to equitable learning and deeper understanding of mathematical concepts. Research states that structures need to be in place for equitable learning to occur. Specific structures and practices that equate to equitable learning in group work include the classroom norms and roles, attending to status and size of the groups, and the type of task that is given to the students. Students often may not be able to equitably participate in group work without the teacher setting up the classroom environment where this type of learning can occur.

Classroom Norms

If students do not understand how to work in group work situations, students may not be motivated or willing to persevere and participate in group work. It is important for students to know the expectations when working collaboratively with other members of their group. There is more to group work

than simply grouping students together and expecting those students to work collaboratively and gain a deeper understanding of math as a result. Before students can work on group tasks, they need to learn how to work with their peers effectively. Students may not come into a classroom knowing what it means to work collaboratively. To achieve cooperative group work, the teacher must establish norms and students need to learn how to follow them (Cohen, 1998).

As a teacher, I wish for all of my students to talk during mathematics discussions but their talk needs to be of a certain nature. Their talk should be directed toward the conceptual understanding of the mathematics they are learning. This is harder than it sounds and is why it is important for classrooms to be grounded through a set of established rules. Particular norms can help students to be respectful and listen to each other's opinions. Kronenberger and Souvignier (2007) state that when helping young children work in cooperative groups, they need explicit (preparing experts as teachers, questioning and explanation training) as well as implicit (fostering interdependence by adequate learning materials) support (pg. 769). Part of this support should be the rules and norms that are set up within the classroom for group participation. Some of these norms can include, but are not limited to:

1. Listen to what others say.
2. Hear what others say.
3. Participate by speaking out at some point.

Beyond these rules, one of the most important norms that can be established with students is that mistakes are not only acceptable, mistakes are welcome. Rather than seen simply as errors, teachers can help their students see mistakes as learning opportunities. This will extend their learning, help them investigate misconceptions, and understand that mistakes should be celebrated as important learning opportunities for all students.

Research has shown that when teachers attend to and support students in developing these types of classroom norms, productive mathematical learning is more likely to happen. Cobb and Yackel (1993) describe the importance of sociomathematical norms, which are different from general classroom norms. Sociomathematical norms provide students with specific, mathematical rules and expected behaviors. For example, students need to understand what constitutes a mathematical justification or a clear explanation based on the mathematics they are learning. Sociomathematical norms are set in place to help with social interactions among students that support mathematical understanding. In this study, the researchers collaborated with second and third grade teachers by assisting them in rethinking how they teach in classrooms with a focus on problems posed by the teacher, which the students then solve through collaborative group work, also known as problem-based learning. Another part of this research helped teachers develop the appropriate classroom atmosphere, so that students could develop their personal understanding and meaning to solutions in math.

Cobb and Yackel offer the following explanation for why this type of mathematical instruction can be effective: “opportunities arise when children attempt to make sense of explanations given by others, to compare others’ solutions to their own, and to make judgments about similarities and differences” (pg. 466). The opportunity for students to be able to talk gives students a deeper understanding of the learning. This dependability of this study was strong in that the research context and procedures were clearly described which allow their study to be replicated easily in other mathematics classes.

Norms, and more specifically, sociomathematical norms, can influence the learning for both the students and the teachers. In classrooms where students’ norms were in place that supported students in more equitable and mathematically rich interactions, students understood the mathematics better and were able to clarify their thinking more accurately.

Attending to Group Size and Status

Learning how to group students is an important skill for teachers to learn. Teachers who understand these skills may be able to create more effective groups, in which all students learn with and from each other. As norms are being established, teachers can also attend to the size of the group. It could be challenging to enforce norms and rules without understanding how the size of a group affects student participation. When a teacher is deciding the optimal group size, there are factors they must consider. If the group has only two or three it may be the case that that there may not be enough input for complex problems. As a result, the problems small groups can solve must not be too complex.

Furthermore small groups can suffer from the fact that there are not enough people for a deep discussion with multiple perspectives. This may prevent a variety of ideas to emerge. On the other end of the spectrum, are groups that are too large. Research suggests that groups over five people can result in students being left out (Cohen, 1998; Stevens & Slavin, 1995; Boaler, 1998). Gillies (2003) states the importance of having no more than four group members, because these conditions allow for “children in structured groups [to] give more detailed and explanatory help to each other, ask deeper and more comprehensive questions, and achieve higher learning outcomes” (pg. 47).

Another concern with group work is that students often come into the classroom with different background experiences and preparation. There are a few different ways teacher can address this issue including how students with different experiences will be able to work together effectively. One common way to address this issue is placing students with the same level of understanding together, also known as homogeneous grouping or ability grouping. However, this approach is not optimal because it does not allow students to use each other as resources or learn diverse perspectives (Cohen, 1994).

An alternative approach is to create mixed ability groups, or heterogeneous groupings. Teachers need to be aware that this type of grouping can also be problematic if not structured properly. Status issues can occur without norms and attending to status issues. This method can provide students the opportunity to reinforce their knowledge by developing diverse strategies and ways of solving math problems. Students who are fluent with procedures can

support students who struggle in that area. Likewise, students who struggle with procedural fluency but are skilled at representing their thinking with diagrams or justifying their ideas verbally can add to the knowledge of the students in their group. Students can ask each other challenging questions about why the math works which can engage students to really think about their strategies, leading to deep conceptual understanding. Even within this model of grouping students, teachers need to continue to look for and attend to status issues within small groups.

Students' perceived abilities in mathematics are often linked to the students' status within the classroom. Cohen (1998) states that "In small groups, low status members talk less than others; when they do speak up, no one takes their ideas seriously and other members may not even listen to what they have to say" (p.18). High status students tend to talk more than the other members of the group. "The failure to participate does not come from the personality of the low-status child. It is situational. Changing the social situation will change this behavior" (p.19). Attending to status is one of the most important reasons why classroom norms and expectations should be in place before groupworthy tasks happen. Students need to learn how to work within groups in order for group work dialogue to be successful (Artut & Tarim, 2007; Cohen, 1998; Elbers & Hann, 2005; Kronenberger & Souvigier, 2007; Mercer, 2006). Teachers can also attend to status by establishing the classroom norm that learning math in cooperative groups should be about applying effort, not ability. Bennett and Flores (1998) state that "because children appear to evaluate their peers' basis

of perceived effort it would seem necessary for the teacher to structure the motivational climate in the classroom to promote effort as opposed to a less controllable attribute like ability." Classroom norms can help students understand that learning math is mostly about effort and motivation.

Groupworthy Tasks

There is a balance in giving students tasks during group work. Lotan (2003) states that there are five design features in creating a groupworthy task. They are open-ended and require complex problem solving, provide students with multiple entry points to the task and multiple opportunities to show intellectual competence, deal with discipline-based, intellectually important content, require positive interdependence and individual accountability, and include clear criteria for the evaluation of the groups product (pg. 72). These tasks have to be complex enough so that multiple people are required to complete the task at hand. However, the task also cannot be overly difficult so that students cannot complete the task without significant help from the teacher. These tasks involve students developing and using their own strategies to solve a problem with multiple access point. This allows for but also requires multiple perspectives and ways of thinking to successfully completing the task. The tasks should be given to the students without first teaching formulas or procedures. This provides students the opportunity to understand mathematical concepts before memorizing mathematical formulas.

When all the important elements are in place in cooperative groupworthy tasks, there is a high level of learning of mathematics that goes beyond learning

the formulas. Johnson and Johnson (1979) state that students who are provided tasks that “create conceptual conflict, feelings of uncertainty, and epistemic curiosity; increase students’ accuracy of cognitive perspective-taking; promote students transitions from one stage of cognitive and moral reasoning to another: increase the quality of students’ problem-solving; and, increase students’ creativeness” (pg. 62). Groupworthy tasks coupled with classroom norms can help support students in learning mathematics, push them to think about math critically, and motivate students in mathematics.

Group work must be implemented strategically with norms, attending to status, and the type of task given to students. Without these important elements in the group work, equitable learning will not occur. In my research, I explored groupworthy tasks in mathematics to see how students perceive themselves in math with equitable learning. I aimed to investigate the following questions: How does providing a structure for group work, including implementing norms and groupworthy tasks, influence student participation, motivation, and mathematical understanding.

CHAPTER 2: METHODS AND DATA COLLECTION

Participants and Setting

The setting in which my action research was conducted was at an elementary school located in a small town near a military base in the Pacific Northwest. Crescent Lake Elementary is a kindergarten through third grade school. Because the school's close proximity to the military base, about 50% of the students come from military families and homes.

Demographic Data

The racial makeup and ethnicities of students at Crescent Lake Elementary varies with Caucasian students being the majority. Below is a list of the ethnic groups at Crescent Lake Elementary.

Ethnicity		Student Subgroups	
Hispanic	9%	Students living below the poverty line	10.64%
White/ Caucasian, non-Hispanic	66%	Students eligible for free lunch	5%
Black, non-Hispanic	5%	Students eligible for reduced lunch	3%
Multiracial	5%	Transitional bilingual students	7%
Native Hawaiian or Other Pacific Islander	3%	Special Education	8%
Asian/ Pacific Islander	15%	Gender Ratio	
Native American or Native Alaskan	0.5%	51.8% Female	48.2% Male

[1] All names are pseudonyms

Table 1

The classroom where I conducted my action research study was in a third grade classroom with 23 students. The students at this school participated in

‘Walk to Math’ which groups students by perceived ability. Walk to Math did not fall on the same days of the week. The teachers had choices as to which days they want their students to participate in Walk to Math. I observed that students participate in Walk to Math approximately two of the five school days. In the third grade, Walk to Math involves three teachers. During this time all three classrooms split their students into high-, medium-, and low-achieving students in mathematics based on both state standardized test scores and general classroom achievement in mathematics. The students from the three classrooms who were considered high achieving students go to one teacher, as well as the medium and low achieving students. Although my action research focused on mathematics, I only conducted my research on days when Walk to Math did not occur. This was important because I wanted to have the same students throughout the study to make sure that my data were derived from the students that were in my classroom. I also felt it was important to have a range of student abilities in my research, because I was interested in examining how groupworthy tasks might support the mathematical learning of all students, regardless of their prior mathematical preparation and experiences.

Groups and Roles

Math started after lunch at 11:45 and spanned 90 minutes. On some days, the Walk to Math took about 45 minutes of that math time. However, during my research study, all 90 minutes were devoted to the same classroom with the same students every day research was conducted.

During the first two weeks of my research, I spilt the students into heterogeneous groups at random. By doing this, students were not grouped by ability. All students had the possibility to work with any other member of the classroom. I assigned four students to each group and each member of the group had a different role. This was to help students equitably participate within the group. By assigning each student a role, each student had particular expectations and needed to contribute to the group. The roles I assigned and the responsibilities of the roles are as follows.

Question Monster:

- Answer group questions before asking the teacher.
- Ask the group to explain their thinking.
- Only the question monster could ask the teacher a question.
- If the question monster has a question, they ask the other people in their group before asking the teacher.

Fair Monster:

- To make sure all people in their group are treated with respect.
- Make sure everyone takes turns.
- Help solve problems in the group when they arise.
- Make sure everyone understands what is going on.

Time Monster:

- Keeps everyone on task.
- Know when the activity is finished.
- Ensure that everyone in the group finishes the activity on time.

Tool Monster:

- Pass out the tools.
- Make sure everyone respects the tools.
- Returns tools to the correct place.

I organized the 90 minutes, allowed for math, in a precise way. During the first 10 minutes of math time, I asked students to sit together on the floor facing the white board. I conducted a Number Talk, or a short series of math problems that were linked to the groupworthy task, where students discussed their strategies for solving the problems. At the end of the Number Talk, I assigned groups and excused students to begin their groupwork time. Students worked on the groupworthy task for approximately 30-40 minutes. Each task I designed had several parts to the problem, to help ensure that all groups would have something to work on. This also minimized groups finishing well before the allotted time. The last 20 minutes of math time were designated for students to come back as a whole group and share their thinking and how they got their answer. If I felt that there were misconceptions, the next day the math lesson would be designed with that particular misconception in mind. The days that were not devoted specifically to groupworthy tasks were designed around student understanding of the concepts we were working on and often utilized more direct instruction for the whole class and individual work. The days that were not used for groupworthy tasks were structured to talk about the concepts behind the task. I used direct instruction and math talks for the first 20 minuets and the rest of the time would be devoted individual work in the student math books. These days

tended to be more teacher centered; however, I allowed students to talk about the ideas and ways of thinking during this time. I also tried to help students better understand different ways of thinking about the answers that their classmates had come up with and the strategies students used when finding answers.

The last week of my research changed due to the nature of the school and the classroom in which I was teaching. The cooperating teacher decided that it would be best to group students by ability because he needed to take over the class the following week. Per the request of the cooperating teacher, I created ability groups based on their test score on the Easy CBM for mathematics. The Easy CBM is an online test that all students in the school take in the beginning and end of the school year. Per the request of the cooperating teacher, the students were separated into the Red Group (those who were perceived to be of low mathematical ability), the Yellow Group (those who were perceived to be of medium ability), and the Green Group (those who were perceived to be of high mathematical ability). The groups were labeled by color and the students knew which group color they had been assigned. During this time, students continued to follow the norms – which will be discussed in the next section - and roles we established previously. However, the dynamics of the classroom changed dramatically for the groupworthy tasks, which provided interesting results, which will be discussed in Chapter 3.

Classroom Setup and Development of Norms

Classroom norms and expectations were used from the beginning (day 1) of the school year. These norms and expectations were constructed with the

students regarding what they believed would make a healthy, safe, and enriching classroom environment. The list was posted on the white board in front of the classroom at all times and I referred to it frequently as a reminder of expectations. I also worked with the students to create sociomathematical norms. These sociomathematical norms were used specifically to what the expectations are during group work. These sociomathematical norms were as follows.

- All students need to be able to explain their way of thinking.
- Students need to work together to solve problems.
- Students can solve problems in a variety of approaches.
- Mistakes are ok. They are a natural part of learning.
- Students will work towards finding their own strategy and learning other student strategies.

For my action research, I made sure that four students were in a group. The tables provided in the classroom were made for two students to share. Therefore, I put two of these tables together to make space for a group of four students. There were 23 students in this classroom. One student in the classroom had Down Syndrome, and his IEP plan designated him to have separate math lessons created by the Special Education teacher. This student was not part of my action research, therefore I conducted my research with 22 students.

This classroom was equipped with a Smartboard and a document camera. I used both of these items to teach mathematics during my action research study. I used these items during my instruction and during classroom math talks.

Students often used the document camera with the Smartboard to show the classroom their work and understanding of mathematical concepts. This classroom also had two medium-sized white boards that were approximately four feet by four feet. The Smartboard was located in the middle of two white boards. The white boards were also used during instruction by both the students and me. The majority of the time, the students were working at their grouped desks with their own paper or large poster paper.

Groupworthy Task Design and Implementation

When designing a groupworthy task, I had to think about what I wanted my students to learn and structure the task to meet that learning objective. I did not want to teach my students how to find the answers in mathematical problems using only the formula or by telling students how to solve problems. I had to think about all the different ways students might think about an assigned problem including possible misconceptions and how I would address any potential misconceptions. One of my objectives was to help students learn to solve mathematical problems on their own, without direct instruction from me, their teacher. I spent time creating mathematical problems that were challenging enough that multiple students were needed in order to successfully solve the problem. I also made sure that the problems I created had multiple steps and multiple possible solution strategies. The tasks that I designed were structured as word problems with multiple steps. When giving the students the task, I did not give them formulas or strategies to solve the problem.

Before students started the groupworthy task, I made sure to address our norms so that students were reminded of the classroom expectations during group work. The first half of my action research project I randomly assigned students into groups. I did this by drawing names. I then handed students their job cards. I took record of what job cards the students have had, and assigned them new jobs when I could. I assigned job card this way because I wanted all students to have the opportunity to try out each job.

While students were working on the task, I made sure to walk around the classroom listening to the conversations the students were having. I carried a journal with me and took notes about what I observed, heard, and questions I had which I wanted to investigate later. I also took this time to talk with groups and their understanding and where they were in completing the task. I asked pressing questions such as “Can you explain your strategy to me?”, “Can you explain your groups strategy?” and “Why does this strategy work?” These types of questions pressed students to explain their thinking. These questions also allowed me to see if students were on the right track and were understanding the task.

Students were asked to work on a large poster sized piece of paper and all sign their name at the top. I assigned each student within the group a different color marker to see which students were participating in making the poster. If I noticed students not participating in making the poster, I made sure to talk to those students and ask them to explain their poster to see if they were following along and understanding their groups strategy.

After the groupworthy task was over, I had groups share their posters. This allowed for students to explain their thinking and to see how other people solved the problems. We would talk about different strategies and why they worked in order to find the correct answer.

Data Collection

This was a qualitative action research study, where I was the teacher and researcher. I collected data primarily over three weeks. However, because of the nature of my study, I started the classroom norms and expectations from the first week of school before I conduct my study. This was important because students needed to be accustomed to the norms and expectations before they participated in group worthy tasks. The students in my study had little to no experience working in groups on complex tasks. Because of the inexperience of the students and the complexity of working on group worthy tasks, I eased my students into working in collaborative groups before the research commenced.

Journal and Field Notes

I took careful journal and field notes during the entire duration of the study. The journal contained notes and thoughts connected to how students are learning math through group worthy tasks. Journal entries were made daily during math time. I also made journal entries after math time ended as I reflected on my observations and how the day went overall. These entries are my first-hand experience and documentation of my perceptions and observations.

Video Documentation

Film documentation was a critical form of data collection. Although journals and field notes provided me with first hand observations, they did not catch everything that is going on in the classroom. Also, because my journal and field notes are about my perceptions and observations, there may be some biases to my notes and internal perceptions from what I believe happened in the classroom. The film documentation helps eliminate some of those biases and perceptions that I may not have considered or seen and provide me with a more objective perspective than my first-hand experience. Film documentation provided me with the most accurate form of information of classroom environments to draw on my research data. Video recordings were taken during the time when students are working within their group worthy tasks to capture students working without the distraction of a teacher watching them and taking notes. Parts of the video have been summarized or synthesized, while other parts that are critical to my research analysis were transcribed verbatim. These transcribed data strengthens the credibility and conformability to my research study. This will strengthen confirmability and credibility because I will be able to see exactly what students are saying without inserting any biases or perceptions I have of what students said only using journal notes.

The camera was positioned in various areas of the room. I positioned the camera in different areas to capture the different students working and to gather more information about how students are participating in group work. I also used video recordings during math talks and lessons to see how students were

responding and thinking about mathematics. Video recordings helped me see if there were changes in the way students talk about mathematics and to help document direct student quotes.

Student Interviews

A small group of 6 students was selected to participate in student interviews. These 6 students were chosen, because they represented different abilities in mathematics. I selected students with differences in achievement and status to examine the ways in which group worthy tasks support these types of students.

Interviews were conducted twice during the study. The first interview was before the students had experienced groupworthy tasks, and the last interview will be after the three weeks of group worthy tasks are over. I gave students open- ended and focusing questions in the interview and push students to critically think about their understanding of math, how they are working in a group, their perceptions of their abilities in math, and their experience in math. The interviews were recorded and transcribed for a more accurate representation of the student experience in mathematics. The recordings and transcriptions help minimize my internal biases and perceptions from my first-hand experience, although notes and journal entries will also be taken during and after student interviews.

Student Surveys and Exit Tickets

All students were given surveys and exit tickets as a part of my data collection. This was important because interviewing only 6 students limits the

amount of experiences that other students will have during math and group worthy tasks. It was important for me to understand the perceptions and understanding of all the students in the study to see how students are making sense of the math and how they feel about the tasks.

Surveys were taken three times during the duration of the study. The first survey was given before students had participated in a group worthy task. The second survey was given in the middle of the three-week research study. The last survey was given at the end of the research study. Surveys were compared and contrasted to demonstrate any change in student development in group worthy tasks.

Exit tickets were given every other day. These tickets focused on what students learned that day and if they are understanding the material. Students will self-reflect and analyze their own learning and perceptions of the learning target for that day and if they feel like they need extra help to understand the material.

The surveys and the exit tickets show and capture student changes more accurately than just my own interpretations of their learning and understanding. It is best to have the students tell me about their learning rather than me making assumptions. These surveys and exit tickets were given to provide students with time to reflect about where they are in their own growth. Student surveys and exit tickets were taken individually so students were not distracted or influenced by other students and peers.

Data Analysis

All video recordings and interviews were transcribed. The data were analyzed and coded through patterns seen in the data. The first set of data I coded was the student interviews. As I coded the transcripts of all student interviews, I looked for patterns that emerged and wrote notes about those patterns (Mertens, 2010). There were four themes that emerged from the student interviews. Students commented on pacing, self-efficacy and status, mathematical understanding, and the importance of roles and norms. I read the interviews a second time using different colored highlighters. I highlighted the patterns and themes and each theme received a different color. Every interview was coded the same way so I could see clearly how students were thinking about these themes in mathematics. With each theme, I then grouped them further by perceived ability of the student (Green, Yellow, or Read ability grouping). I wanted to see if there was a relationship between these themes and perceived ability. By categorizing my data in this manor, I was able to see major differences and similarities between students from different ability groups. This method of coding proved to be an effective way for me to understand the student interview data. I chose to use this same method to analyze the video recordings. I transcribed all videos and looked for patterns seen in this data. I color coded the same patterns to help strengthen my findings.

I used the surveys to see if similar patters emerged. I color coded student responses with the same themes that emerged in the interview data. I read all

the questions from all students paying attention to how the themes were included in the various survey responses. I then looked to see which student responded in relation to that theme and which ability group that student had been assigned to. the interviews and surveys.

Limitations

This study wa conducted over a three-week period. Three weeks is enough time to see if students can learn from groupworthy tasks. However, because of the time constraints, it was impossible to see how students are effected and change by groupworthy tasks over the course of the year and the potential impact on standardized testing. In addition, I was not able compare students standardized test scores to see if this way of doing math will improve standardized testing. With the time limitations as stated, this could affect the study's dependability.

I will also not address the effect of group worthy tasks on race, gender, or economic status. Because of the time constraints, I will only look at students' understanding in math and their experiences in group worthy tasks. By not looking at race, gender, or economic status of each student, this weakens the reliability of this project.

In order to address the transferability of this study, I attempted to provide details about my action as well as in-depth descriptions of the context. This study describes one specific classroom with a group of third graders in mathematics. Therefore this study might not be transferable to other grade levels, subject

matters, or settings. I attempted to provide enough detail to allow the reader to determined the transferability of the findings to their own setting and context.

CHAPTER 3: ACTION RESERCH FINDINGS AND IMPLICATIONS

Research Findings

This research project examined how students developed mathematical understanding through my implementation of groupworthy tasks and norms. In order to analyze how students were understanding and building mathematical understanding, I collected various types of data to support my findings. I collected student surveys, student interviews, and exit tickets. I also gave students several opportunities to work on groupworthy tasks and test out their own ideas and strategies to solve problems. While students worked on the tasks, I kept a journal to take notes on how students were working together and made video recordings of student group work. At the end of each activity, I collected all student work as evidence of students' mathematical understanding.

As I analyzed the data, four findings emerged. The first finding was that the students made judgments about their peers' abilities in mathematics and also about their own perceived abilities. A relationship developed between the ability group in which the students were placed and their perceptions of competence of themselves and their peers. A second finding involved pacing. There was a relationship between the pace at which a student wanted to work and the ability group they were placed in. Students that were seen as more capable in mathematics and placed in the *above grade level* ability group wanted to work faster, while other students preferred to take their time and explore numbers. A third finding was that through working on groupworthy tasks, students learned how to create their own strategies and understanding. Students had to rely on each other and mathematical relationships to learn strategies. The final theme

was related to increased mathematical understanding. There was a direct link between students building their own strategies in groupworthy tasks and increased mathematical understanding. Students learned mathematical relationships between numbers as well as student-generated formulas.

Ability Grouping and Status

In the first half of my action research study, students worked in heterogeneous groups during groupworthy tasks. Students were randomly assigned to groups of four, thus creating mixed ability groupings. During the second half of my research, the students were grouped by ability per the request of the cooperating teacher. The justification behind this decision was so that students who were struggling would get more help and the students who were more advanced could go at their own pace. The students were color coded by ability. Students who were perceived as struggling were called the Red group. Students who were perceived as being gifted in math were called the Green group. The students who were in the middle were named the Yellow group. Through the entire project, students had the opportunity to work in both mixed ability groups and the colored groupings.

A significant finding that arose after the students were assigned to the ability groups was related to perceived competence, or status. Students began to perceive each other as smart or not smart based on their color grouping. My analysis showed that students in the Green group started to see the Red group as incapable of doing the same work as they could. In addition, these students did not think the Red group's ideas were as valuable as their own. I gave out two

surveys during my research. One was completed at the beginning of the research, after the students had four opportunities to work in heterogeneous groups. The other survey was given after the research project was over. One question that was given on the second survey was, “What helps you learn math? (small groups, working with the teacher one on one, working by yourself).” Seven out of eight students in the Green group indicated that they would rather work by themselves. One of the students wrote “I like working by myself because there are no distractions. Red group is slow and distracting.” Another student answered “Working by myself because I get the right answers. Other groups usually get wrong answers.”

I found that students felt that being smart at math meant doing well on tests, or being told by the teacher that they were good in math. Take for example, Daniel, a student who had been placed into the Green group:

Mrs. Poff: Do you think you are good at math?

Daniel: Yes.

Mrs. Poff: Why?

Daniel: Because it is my favorite subject. I am highly capable, and my teacher says I am good at it.

Daniel’s perception about being good at math was about being in the highly capable group and being told by adults that he is good at math. Students enter the Highly Capable Program by taking a test and scoring a particular mark. When students score high enough on the exam, others perceive these students as being good in math.

In my journal notes and observations, I noticed that students who were in the Green group often ignored students who were in other groups. Students who were in the Red group might come up with a mathematical justification that was correct. However, when trying to explain their answer and understanding to the group, their ideas were often not considered. An example of this happened during a whole class discussion after a groupworthy task. A student who was in the Red group explained the strategy she used to solve the problem. She was talking about how she figured that13X12 was not a hard problem to solve. She explained to the class that she could make the problem easier on herself. She told the class that she could first do 10x12 to get 120. Then she realized that there were 3 more groups of 12, so she added 12+12+12= 36. Then she could simply add 120+36 to get 156 as the answer. I noticed that one of the students in the Green group was not paying attention. I asked him if he understood the strategy on the board. He said “I did not pay attention because I have a better way to do it that is faster.” This demonstrated that the girl who was presenting her strategy was not valued for her mathematical thinking, regardless of how precise and efficient it was.

Students who were in the Red group also struggled with how they perceived their own mathematical abilities. When the groups were mixed ability, the students in the Red group found group work to be enjoyable and felt it helped them learn math. All seven students in the Red group indicated that they liked group work. In every survey or interview I gave, students in the Red group overwhelmingly were in favor of group work. For example, I interviewed Sammy

before the ability groupings began. Sammy told me how working in mixed ability groups helped her feel smart:

Mrs. Poff: Do you enjoy group work?

Sammy: I love it because we can do our best and share ideas.

Mrs Poff: Do you like sharing your ideas?

Sammy: Yes. I have different ways of finding the answer. Everyone finds different ways and we can all share our ideas. We learn everyone's strategy.

Mrs. Poff: Why do you like sharing your ideas?

Sammy: Because I know that I am smart when I can think of ways to getting the right answer. I also think it is fun to see the different ways.

Sammy is in favor of sharing her ideas with other members of the class. Not only did Sammy enjoy hearing the ideas of other students, it made her feel smart to know that she had come up with her own way of thinking about the mathematics. On Sammy's survey, after she was placed into the Red group, I noticed one difference in how she thought about herself. A question on the survey that was given at the end of the study was 'Do you think you are good at math?' Sammy said "Well, yes and no. I am in the Red group. The other groups are smarter than me." This indicated that Sammy originally viewed herself as a resource to her peers during group work. After the ability grouping, she started to see herself as a student who struggled in math and she began to compare herself to other students within the classroom. Sammy, like many of the students in the Red group, started to see herself as being less capable than the students in the

Green or Yellow group. Although students in the Red group started to see themselves as not being as capable, I found that they still valued group work. The data showed that all students in the Red group liked group work and felt that they could contribute to the group and share their ideas.

Ability Groups and Pacing

Pacing influenced how students felt about participating in group work. My data indicated that many students placed importance on going at their own pace. Groupworthy tasks are not about finding the answers quickly, but taking time to deeply understand the math and being able to justify answers with reasoning. Not many students had experience in explaining their answers or coming up with their own strategies to solve problems. Students' prior mathematical experiences involved memorizing formulas quickly. Students initially came to my classroom believing that being good in math meant getting an answer quickly.

I found that students who were in the Green group thought the pacing of groupworthy tasks were slow. Many of these students have been told that they are gifted in math. Like many students, these students also thought that being good at math meant getting the correct answer as quickly as possible. In the following example, Don explained how working in mixed ability groups slowed him down:

> Mrs. Poff: What has been one of your favorite math lessons?
>
> Don: I like working in math books by myself. Sometimes they can be hard, but I mostly go through them fast. I can go at my own pace when I work in them.

Mrs Poff: So you like working by yourself the best? Can you explain to me more about why you like this?

Don: I like going at my own pace and not working with other students.

Mrs Poff: What about when you work with others in group work?

Don: I don't know, I do not like it too much. I don't want to work with slow students. Explaining can be hard.

Don clearly expressed his need to go quickly. He was perceived as being a highly gifted student in mathematics. However, from my observations during class, Don struggled with explaining his answers and giving mathematical justifications.

I also noticed students' preferences for and struggles with pacing during the groupworthy tasks from my video recordings. During a task when students were assigned to heterogeneous groups, I noticed one group of students who were struggling with pacing.

Camren: Ok, I found the answer.

Whitney: I don't know yet.

Camren: Well, I found the answer, so we are done.

Whitney: I don't know the answer.

Camren: Go faster then. I like going fast.

This video recording and conversation happened while I was attending to another group. Camren was a student enrolled in the highly capable program and often found answers to mathematical equations quickly. He expressed his need to move quickly through the task. Whitney was a student who did not struggle,

however she moved at a slower pace than Camren. When these students were working together, pace became an issue because Camren wanted to move on to the next problem before Whitney had a chance to find an answer.

Groupworthy tasks are purposefully designed so that students interact and talk about their strategies with their group members. These tasks demand that students slow down and think about the processes and strategies used to get the correct answer. Often, students are considered to be gifted in mathematics if they get the correct answer quickly, however that is only one way a student can be 'smart' in math. Explaining and justifying answers is also important for students to understand mathematics. However, Don was challenged by explaining and justifying his thinking and, for this reason, did not value groupwork.

Overall, most students liked the slower pace of groupworthy tasks. They were able to share their thinking and involve themselves in the learning process. After analyzing my data, I discovered only students in the Green group were frustrated by the slow process of groupworthy tasks and wanted to go at their own speed.

Strategies and Self-Efficacy

Group work allowed students the opportunity to build their own understanding of mathematics. As a result of students having the opportunity to try out their own strategies, without using a formula given to them, they were able to see that they had the ability to do math in their own way. Students found that they could use whatever strategy worked best for them to solve the problem at hand. This supported students' self-efficacy because students saw that they

could build their own understanding of mathematics. By building strategies, students were able to make sense of numbers and mathematical concepts. Students saw that they were capable of doing mathematics for themselves and in return could help the group solve and understand equations. In a student interview given on the last day of the project, I was able to hear firsthand some ideas relating to group work and self-efficacy.

Mrs. Poff: So should students try out their own ideas in math?

Anne: Yes. Because if students try out their own ideas then they know they can share it with the whole class on the white board or with the group. Students can use different strategies like equal grouping or a tape diagram. The whole class can learn my strategy and know that I was smart in math. Like I can show the class that I am now smart in math. Last year I was not smart, and now I am smart.

Mrs. Poff: Why do you think you are smart in math now and not last year?

Anne: Because I always can try different strategies like tape diagram, equal grouping, skip counting.

Mrs. Poff: Why was last year so hard?

Anne: Some kids didn't think I was very smart because I did bad on tests.

Anne was in the Red group and seen as a student who struggled significantly with mathematics. In the interview, Anne said that last year she did not feel smart in math because she did not do well on her tests and, as a result, other students viewed her not being smart. This made her feel that she was not smart in math. This year Anne had more opportunities to learn math by developing her own

strategies to fully understand mathematical concepts. Through multiple strategy use, she was able to make sense of the math and became able to share her strategies and answers with the class. This is self-empowerment, which is part of self-efficacy. Students who are confident in their abilities are more likely to feel that they have something to offer to the class and to feel smart in mathematics.

Students were empowered through the development of valuable mathematical ideas and strategies. Kyle, who was in the Red group, is an example of this. When asked the question on the first survey; “Do you think you are good at math? Why or why not?”, Kyle’s only responses was; “No, because I am bad at it.” Kyle did not think he understood math. Kyle did not always do well on his math tests, which is why he was placed in the Red group. However, after Kyle participated in groupworthy tasks in mixed ability groups, he developed a different idea of himself in math. On his second survey, Kyle wrote “I like working in groups, because I get help and I can help others.” Although Kyle still was hesitant about his abilities in mathematics, he started to see himself as capable of helping others and being a resource for other students. This was a big change in his thinking. Originally he thought he was incapable of doing anything in mathematics.

An overwhelming pattern that came out of the research was students started to talk about group work as a way to share ideas. Students started to see each other as resources. I noticed that I was talking and teaching less as the students started to increase their communication and help each other. This was particularly apparent with students who were in the Red and Yellow groups.

Students who were in the Green group, for the most part, still saw themselves or other students in the Green group as being the only resource. In an interview with Don, a Green-grouped student, he indicated that he perceived himself as a resource to the rest of the group.

Mrs. Poff: Do you like group work?

Don: No not really. I always know how to get the answer.

Mrs. Poff: Can you explain more to me?

Don: I know that I am good at math and other people know that I am good in math, so I always have to help them.

Don saw himself as a resource, but did not acknowledge other students as being valuable resources that he too could learn from. He did not see that group work was a way to build strategies. Rather, he felt he knew how to get the answer first and always had to help other students.

Strategy building helps students understand what numbers and operations mean in mathematics. This was evident when students learned how to explain their strategies and mathematical understanding. After a groupworthy task was over, students participated in a whole-classroom discussion about the strategies being used. During this time, I saw how students came up with their own ideas and what they understood. This was also a time for students to be able to share their individual or group ideas. Students liked being able to share their ideas and strategies with the rest of the class. Students felt empowered in sharing their strategies, which led them to understand that they could be a resource to the rest of their peers. Students felt as though they could contribute to the mathematical

conversation which can lead to an increase in their self-efficacy. This was evident in an interview with Anne.

> Mrs. Poff: Do you like working by yourself, in a group, or with the whole class?
>
> Anne: Well, I like working in groups and I like working with the whole class.
>
> Mrs. Poff: Why?
>
> Anne: Well in groups we can talk to other people in our groups. In the whole class we can talk to everyone.
>
> Mrs. Poff: Can you explain that to me. What do you mean we talk to everyone?
>
> Anne: Like, if I have a strategy, I can come up to the board and show everyone that I am smart. I can show everyone that I can do math. Like I can multiply and show them how I did it. I know I am smart and I can do math now.

Through this conversation with Anne and other similar conversations with other students, there was a pattern that students liked to be able to show the class their mathematical contributions. Students such as Anne, felt that they were a resource of mathematical knowledge that they could share with the class and felt more competent in doing mathematics.

Mathematical Understanding

Groupworthy tasks are important because they help students learn mathematical concepts. They can encourage students to learn mathematical

concepts by exploring number relationships and developing their own strategies to solve the problem. This can lead to far deeper conceptual understanding than rote memorization. In an interview with Anne, who initially did not feel she smart in math because she received low test scores, I found that she valued the use of multiple strategies.

> Mrs. Poff: Do you like math?
>
> Anne: Yes.
>
> Mrs. Poff: Why?
>
> Anne: Because it helps you learn stuff. Like if there is a problem you can't figure out, then math is important. If there is a problem (in math) you can't understand then strategies can help you out. Like if I get stuck, I can use my strategies to help me out. I did not know how to do this last year. This year I know equal grouping, number bonds, arrays. I can use them on a test.
>
> Mrs. Poff: Do you like learning new strategies?
>
> Anne: Yes, because strategies help us to learn math and understand math. I know that if I get 5x4 and I do not know the answer then I can draw 5 circles and put 4 dots in each circle, then count the dots. Then I know the answer is 20.

Anne demonstrated that using her own strategies helped her make sense of a math problem, which helped her learn. Many times students would forget a math fact. Using 5x4 as an example, a student may not remember that 5x4 is 20. Anne knew that she could figure out the answer through her different strategies. Her

example of making 5 groups of 4 dots is a perfect example of understanding the meaning of numbers and operations. She knows that if she makes 5 circles and places 4 dots in each circle and adds up the dots, this will give her the correct answer in multiplication.

This finding was a pattern that I saw several times throughout my action research. For example, I collected exit tickets at the end of every groupworthy task as an assessment to determine what mathematical concepts individual students were learning. I also wanted to see what types of strategies the students were using. On one particular exit ticket, I asked the following question: “Melanie decides to bake blueberry muffins. Her recipe calls for 5 blueberries per muffin. She makes 10 muffins all together. Draw a picture and write a multiplication sentences to find the total number of blueberries she uses for 10 muffins.” One student named Jasmin struggled writing a multiplication number sentence to this problem. In order to solve the problem, she first drew ten circles to represent the total number of muffins. She then drew five dots in each of the circles. Underneath she wrote the addition number sentence 5+5+5+5+5+5+5+5+5+5=50. Next to this number sentences she wrote. “I know that adding 5 ten times will give me the same answer when I multiply. So I can just say 5x10=50. Jasmin demonsrated her understanding of multiplication by connecting her drawings to her use of repeated addition. I noticed this type of strategy was common with students, especially during groupworthy tasks that focused on multiple strategies for multiplication. Over time, I started to notice some of the students transition from using repeated addition to more efficient

strategies such as going straight to multiplication because they could recall their mathematical understandings and multiplication facts. Instead of asking students to memorize their multiplication facts, they learned to use mathematical relationships to solve problems during groupworthy tasks which strengthened their mathematical understanding.

Implications for My Teaching Practice

After my investigation and reflection on my own teaching practice, I thought about what I learned, what practices I want to continue to implement, and what practices I want to change or adapt for the future. First, I have found that groupworthy tasks are an important teaching strategy to help students learn to work together and share ideas. Groupworthy tasks also allow students to develop their own strategies. I noticed that groupworthy tasks helped students understand math and justify their answers with reasoning. They were most effective when I gave students the task with little to no explanation. After the task was over I often had students share out to the whole class how their group went about solving the problem and the strategies their group developed. This gave students more opportunities to learn new strategies and to hear multiple mathematical justifications.

In my future teaching practice, there are a few things that I would like to change in order to increase the success of groupworthy tasks. First of all, I would not group students by ability. This created many status issues among the students. Students in the Green group did not think the Red students had anything to offer them, when in fact the Red students came up with very

thoughtful and interesting ways to solve their problems. When the groups were heterogeneous, there were less status issues. Students who were placed in a color group also could not move into other groups. This was a form of tracking that communicates implicitly to students that they are good or not good at math. I want all students to feel that they are smart, capable of contributing to the group, and I want all of my students to be seen as a resource by their peers.

I believe that having the monster cards and using the sociomathematical norms was very successful in helping all students responsibility in the groupworthy task and working with other members of the group. The students were very focused on fairness. To them, fairness meant that everyone was participating and sharing ideas. Before we started our groupworthy tasks, students generated a list of rules and norms to follow to make sure that everyone was able to participate and was working hard. Through the project, established norms were the backbone of students feeling they could participate. Alongside the norms, each student had a job they were assigned within the group. The job cards and job descriptions are listed in Chapter 2. Students were very focused on what it means to be fair during group tasks. In classroom discussions, I asked students why they felt that being fair was a key component to make group work successful. Many students felt that the most important job card was the Fairness Monster. Through these norms and jobs, students felt that they were safe, responsible, and could work with other members of the group. In my future teaching practice, I will make sure to implement norms and jobs to make sure that students can have access to the learning. I also will make sure that I refer

back to the norms that were established often. I learned that students do need reminders on the expectations. In the future I will go over the norms and job cards before all groupworthy tasks especially in the first months of implementation.

I have found that groupworthy tasks can help all students learn mathematics if given proper time and support. I plan on using this strategy in my future teaching practice.

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