Making the Most of Math

Rhiana Zips  
rlz123@psu.edu  
Third Grade Intern

Cheryl McCarty  
cam17@scasd.org  
Third Grade Teacher

Gray’s Woods Elementary
# Table of Contents

Abstract .................................................. Page 3  
Classroom Context/Background ..................... Page 4  
Rationale ................................................... Page 5  
Literature/Experts ....................................... Page 8  
Wonderings ................................................ Page 9  
Why is this inquiry and not an improvement project? Page 10  
Inquiry Plan and Description ....................... Page 11  
Data Collection .......................................... Page 14  
Data Analysis ............................................ Page 16  
Claims & Evidence to Support Claims ............. Page 21  
Conclusions .............................................. Page 26  
New Wonderings ......................................... Page 26  
Bibliography ............................................. Page 29  
Appendix .................................................. Page 30  
  Appendix A ............................................. Page 31  
  Appendix B ............................................. Page 33  
  Appendix C ............................................. Page 35  
  Appendix D ............................................. Page 37  
  Appendix E ............................................. Page 38  
  Appendix F ............................................. Page 39  
  Appendix G ............................................. Page 40  
  Appendix H ............................................. Page 41  
  Appendix I ............................................. Page 48  
  Appendix J ............................................. Page 50  
  Appendix K ............................................. Page 51
Abstract

The purpose of our inquiry project is to determine the effects of pre-assessment in mathematics. We focused on flexible grouping and its affect on students learning and teacher’s planning. We pre-assessed our students with material from the Investigations Curriculum, specifically the Combining and Comparing Module, and at the onset of this unit, used this assessment to create flexible learning groups. Throughout the teaching, students were grouped according to their formal and informal ongoing combining and comparing strategies, readiness to learn new concepts, and need for re-teaching. The goal of our project was to determine how and if pre-assessment was beneficial to the students, as well as the role of pre-assessments role in future teaching.
Classroom Context/Background

We are currently teaching in a self-contained third grade classroom, consisting of twenty-three students. The backgrounds of many of the students are fairly similar. There is little socioeconomic diversity within our classroom. Many of our students are part of a one-income family in which the male/father figure works during the day while the female/mother figure is a homemaker. We have a little less than half of our students who are members of a two-job household, in which both parental figures work during the day. We have only one student that qualifies for free and reduced meals. As for racial diversity, it is not extraordinarily present. We have a few students with a mixed heritage, but we would classify our classroom as 98% Caucasian.

We do have a variety of academic diversity and learning styles within our classroom. Four of our students attend Title I Math, and three students attend Title I Reading. We have one student with a Learning Support IEP for a replacement program in reading. Additionally, two of our students receive speech services and five students attended a “Jumpstart Reading Program” in which students work in small groups at stations to improve reading and writing skills.

In terms of mathematics, we have six students, or roughly one-fourth of our class, whom have consistently scored advanced on their end-of-module assessments and district-wide mathematic checkpoints, as well as have demonstrated insightful problem solving strategies during our daily math block. These students receive Learning Enrichment services in math for 50 minutes per week. The majority of our students have scored proficient in the aforementioned assessments and have demonstrated varying mathematic progress throughout the teaching of our different math modules. As
mentioned before, four of our students receive supplemental math instruction for a period of 20 minutes per day through Title I services.

The specific context of our inquiry project was the Investigations Curriculum, in which major math concepts are presented through modules of study that involve students in exploration of major math concepts (Russell p. 1-1). The philosophy of Investigations allows for student exploration, inventive strategies, and varying approaches to solving problems, as well as, working in a variety of grouping situations. An emphasis is placed on expressing mathematical thinking and strategies with words, pictures, and numbers. Our first Investigations Module was Mathematical Thinking in Third Grade, in which students were introduced to some of the content, processes, and materials and problems they would encounter as they explored the areas of the Investigations curriculum (Russell p. 1-10). Throughout this module, students were instructed as a whole group, with the students focusing on problem solving strategies and recording and representing their work. This module serves as a data-gathering unit for teachers as they observe their students mathematical readiness. The following three modules, “Things That Come in Groups,” “Flips Turns and Area”, and “Landmarks in the Hundreds,” differed in the respect that these were taught using whole group activities, individual teaching, pairs, and small groups.

**Rationale**

In taking into account the diversity of our students’ mathematic thinking and progress, and the variety of learning styles within our classroom, we constantly questioned “the best way” to meet our students needs in math.
According to Susan Jo Russell:

“Approaching the mathematics content through Investigations helps students develop flexibility and confidence in approaching problems, fluency in using mathematical skills and tools to solve problems, and proficiency in evaluating their solutions. Students also build a repertoire of ways to communicate about their mathematical thinking while their enjoyment and appreciation of mathematics grows” (1-1).

However, considering the composition of our math class, we felt that while a small percentage, roughly one-fourth of our students, demonstrated confidence and flexibility in their math skills, that same percentage, clearly did not feel confident in their repertoire of skills and as a result, rarely shared their mathematical thinking with their peers. Both these groups of students’ enjoyment and appreciation of mathematics was beginning to falter. The NCTM’s Curriculum and Evaluation Standards for School Mathematics (1989), states “student’s mathematical dispositions are shown in the way they approach task. Do they attack a problem with confidence, show a willingness to explore alternatives, and maintain interest as they work? Do they reflect on their own thinking?” (Sammons 11-2).

We chose the Combining and Comparing Module because specific concerns arose with the concepts of addition and subtraction. These were skills that we had visited and revisited throughout Calendar Math activities and numerous times throughout the year. Some students commented on “already knowing” the material and appeared frustrated when given a task or problem that was “too easy.” Others were tackling this same open-ended problem with frustration and strategies that were often below basic third grade methods. As you can see in Appendix D, Appendix E, and Appendix F, we were aware that our students were demonstrating very different strategies for these concepts. It seemed our teaching of the Investigations Curriculum was sometimes in conflict with the
philosophy of the program itself. We wanted all students to be confident, fluent, and enjoy math. We wanted to offer students meaningful mathematical problems while emphasizing depth in mathematical thinking (Russell 1-1).

About this time, our methods courses and a district wide in-service focused on the role of the three types of assessment in the classroom; pre-assessment, formative assessment, and summative assessment. We became interested in pre-assessment in mathematics because, in terms of addition and subtraction, we knew that we had students who fell into different comfort levels and understanding. Pre-assessing our students for our upcoming Combining and Comparing Module could give us concrete data and teaching strategies to reach all of our students in the most efficient and beneficial way.

Thus, the purpose of our inquiry project was to determine the affects of pre-assessment in the Combining and Comparing module and the role of flexible grouping within the Investigations philosophy as well as teaching all math concepts. We hope that if we determine the conceptual knowledge and strategies of each student, this data to could be used to match our students’ readiness for specific addition and subtraction instruction. The intent of this project is to determine what happens when students are given necessary scaffolding so that each student is able to be successful and enriched in mathematics. We were led to a main inquiry question:

*What are the effects on both teachers and students when using pre-assessment strategies in mathematics in order to determine the next steps in teaching our curriculum (Investigations).*
Literature/Experts

Jana Lunt, a mathematics professor for the Professional Development School at Penn State University was asked:

_How have you used pre-assessment in your teaching?

She responded:

“It is natural for me before I start teaching a topic to figure out what my students know about a topic. You can’t teach somebody effectively without knowing where they already are. I know that for students to learn the most you have to build off of what they already know, you can’t start teaching them without already knowing what they are thinking about.”

Being that one of us is an intern and that Lunt is a mathematics methods course instructor who believed in using pre-assessment, pre-assessment was used during the methods course and brought to the attention of the intern as being extremely important. This belief has carried to our third grade classroom.

Based on the fact that pre-assessment is supposed to be modeled after the summative assessment that the students receive at the end of a unit, Lunt was asked:

_What effects do you think that pre-assessment has on formative and summative assessment?

Lunt responded:

“I see it as a continuum. The pre-assessment tells you where to start. At some point you quit doing pre-assessment and start doing formative. It’s not always clear-cut. Without the pre-assessment, I don’t see how the formative can begin; because how are you judging what you’re students have to learn if you don’t know what they knew before. After you’ve done more teaching you go into summative. Which is traditionally more formal looking, but it can be more informal too. In your head you feel that they should know this by now, and let’s see if they do. In that way, the summative then becomes the pre-assessment again. You can say, they don’t get that the way that I want them to, what do I do now? It’s all a big circle. There are landmarks, and you have to start with the pre-assessment. And there are tests that really deepen, summative. But it is all informing one another until you are satisfied to move onto another topic.”
We turned to Rick Wormeli, author of *Fair Isn’t Always Equal*, in order to research how to form the pre-assessment, what pre-assessment is, and how to implement it. Wormeli states, “It may be a bit radical, but go ahead and give the students the end-of-the unit test on the first day of teaching the unit” (21). We formed our pre-assessment so that it would look extremely similar to the summative assessment in order to follow along with the expert’s advice.

In order to research the three types of assessment (pre-assessment, formative assessment, and summative assessment) we read “Linking Instruction and Assessment in the Mathematics Classroom” by Kay Sammons and colleagues. Sammons states, “The purpose of assessment is to improve instruction and, therefore, learning” (12). Finally, since we were using flexible grouping throughout the inquiry process, we researched differentiated instruction strategies. Tomlinson states, “Kids of the same age aren’t all alike when it comes to learning, any more than they are alike in terms of size, hobbies, personality, or likes and dislikes” (1).

**Wonderings**

After we focused on a main inquiry question, we came across several wonderings in regards to the use of pre-assessment in mathematics. Would the students have more of a chance to succeed in math if pre-assessment has occurred? We wondered if placing students into skill-ready groups would affect their attitude towards math, or their overall self-esteem in mathematics. How would pre-assessment strategies change the beginning points to mathematical lessons, specifically, skill-ready groups and ultimately the Combining and Comparing Curriculum?
Equally, our wonderings lead to the role of teachers. How would pre-assessment affect teachers and the act of teaching? We wondered how pre-assessment helps the teacher determine how to split students into skill-ready groups or learning stations. How much time and planning is involved? Finally, what makes a pre-assessment and effective pre-assessment?

We hope that our wonderings will determine the best way to introduce mathematical concepts and material to our students so that we are reaching every student and helping each student learn mathematics in the most successful way.

**Why is this question part of inquiry and not an improvement project?**

“The teacher inquiry movement focuses on the concerns of teachers (not outside researchers) and engages teachers in the design, data collection, and interpretation of data around their question” (Dana 4). At this point in the year, how to make math most meaningful for all students was a major concern of ours. The answer to this question had continually evaded us to the point that we knew there was no one right answer. Thus, leading us to our main inquiry question “What are the effects on both teachers and students of using pre-assessment strategies in mathematics in order to determine the next steps in teaching our curriculum.” Hubbard describes inquiry as “an ongoing process of discovery – a process that continually requires us to rethink not only our understanding of our discipline, but also our sense of the questions we should be asking and of the best procedures to analyze our own and our students work. Consequently there is a sense that our research is never finished” (XV).

We believe these statements to speak to the heart of our project. We were prepared for the journey of asking questions about assessment and the grouping of our
students. In searching for these answers, we believe that we could help ourselves grow and become better, more enlightened teachers. Dana says, “whether you are a prospective teacher at the dawn of your teaching career or a veteran teacher with years of experience facing new educational challenges everyday, teacher inquiry becomes a powerful vehicle for learning and reform” (5). Finally Dana believes that the “traditional” way that teachers would learn things about their class, in which was not inquiry based, “does not often result in real and meaningful change in the classroom” (6).

**Inquiry Plan and Description**

The inquiry began on February 19, 2007 and lasted until April 6, 2007. On February 19, we gave the students an attitude survey (Appendix A) so that we could determine how they felt about learning math in our classroom. “Emotions and feelings play a large role in the way a student learns information. When a person has had a bad experience in the past and is learning or doing something that triggers that memory, there is a barrier formed that inhibits the new learning” (Gregory 40). We felt that it was important to know which math concepts the students found challenging or difficult, as well as which areas the students felt the most confident, their strengths. Knowing this we could reflect on our past teaching methods for these concepts. Also, when did our students feel most comfortable learning math? Were their any patterns in students’ preference to grouping, in particular; whole class learning experiences, as opposed to small groups or individual experiences? We questioned how the students felt when math block began each day because prior to this, some students were very vocal when grouped in small groups, as opposed to given the same whole group task and extensions.
“One of the first things that needs to be done is pre-assessment to find out what students already know or can do” (Gregory 37). During the week of February 19, a pre-assessment was given for the Combining and Comparing unit (Appendix B). Wormeli states with regard to summative assessment, “Design this one first, and make sure everything in the unit’s objectives or understandings is accounted for in the summative assessment, and that it doesn’t assess anything beyond the unit’s goals” (27). Therefore, our pre-assessment was modeled after the summative assessment from the Combining and Comparing module and was almost identical to the assessment that the students would be receiving after completing this module. After the students were pre-assessed, we then grouped the students into three skill-readiness groups. The names of the students in each group were written in an anecdotal record book in order to keep track of their progress each day.

One skill-readiness group received 60 minutes of teacher instruction each day for five weeks. This was because this group received the lowest scores on the pre-assessment. The students were taught various ways to add and subtract, round, estimate, tell time, and count money. Both the Combining and Comparing module was used, as well as supplementary re-teaching materials.

The next skill-readiness group received 30 minutes of teacher instruction each day for five weeks, with the remaining time used as independent practice or formative assessment. They also worked on addition and subtraction strategies, multiple methods for solving a single problem, standard notation, compatible numbers, and estimation. Again, both the Combining and Comparing module was used, along with supplementary material.
Another skill-readiness group also received 30 minutes of teacher instruction, along with independent practice and open-ended problems each day for five weeks. This group worked on the same material/topics as the middle level group, but at an accelerated rate. We thought of the work that this group did as an extension of the middle level’s work.

Formative assessments are “en route checkpoints, done frequently. They provide ongoing and helpful feedback, in forming instruction and reflecting subsets of the essential and enduring knowledge” (Wormeli 27). Due to the nature of our inquiry, the formative assessment data was constantly assessed. Student work was evaluated, and student progress was noted during collaboration meetings so that we were best able to match the students for the next day’s math lesson. The mathematical concepts taught were planned in the evening, after that day’s math lesson, due to the fact that we consistently analyzed the student’s understanding of the concepts in order to determine if they needed additional practice and instruction, or if they were able to join a new group as understanding was developed. Steps for re-teaching were also developed at this time.

On April 6 the students were given the summative assessment, Appendix C, for Combining and Comparing. This assessment looked much like the pre-assessment (Appendix B.) We wanted to discover if our work with students in smaller groups was successful. Did our students learn the objectives of the unit?

At the completion of our unit, the students were given another attitude survey (Appendix I). Did flexible grouping affect the students’ attitude towards mathematics at school? How did they feel about themselves as math learners?
**Data Collection**

**A. Pre-Assessment**

As previously mentioned, the students were given a pre-assessment for the Combining and Comparing unit prior to teaching of this module. The students were reassured that the document would not be graded and that we would be using the assessment to help us better plan the teaching of the unit. They were informed that the pre-assessment would look much like the summative assessment for the unit so they were not expected to already know the material and also that they would be given a “sneak preview” into not only the concepts that we would be learning, but also the end-of-the unit test.

**B. Observations and Anecdotal Notes**

“As we begin to look at assessment in broader terms, the importance of the classroom teachers being a trained observer becomes evident” (Sammons 12). Furthermore, “We must rely on the teacher to observe students in a learning situation and depend on the ability of the teacher to describe the students’ grasp of a particular concept. The teacher must then process this information to make instructional decisions based on the needs of the students” (Sammons 12). We were constant observers of our class. We kept anecdotal records to note the strategies our students were using while combining and comparing numbers. Our ultimate goal was for our students to meet the end-of-unit Investigations “checklist” of learning outcomes, see Appendix J. Our notes, Appendix H, became pieces of evidence for student progress, or the need for additional practice and re-teaching. Each day, the investigation concept and session were recorded, along with the names of each student participating in each group. These records also became a
springboard for our discussions of the next day’s grouping and readiness to learn new concepts.

C. Student Survey’s

As mentioned in our Inquiry Plan, our students were given two surveys. The first survey was given before the pre-assessment and skill-ready groups were implemented. The second survey was given after our summative assessment. This survey asked similar questions to the pre-inquiry survey, but also included a question regarding how they felt about the Combining and Comparing unit. See Appendices A and I.

E. Collaboration

“Talking with another professional may help you call into question assumptions or givens about teaching practice, a process that is critical to making your teaching problematic through the process of inquiry. Teacher talk enables teachers to examine and critique these givens in education. In talking with others you are able to generate possible alternatives to practice as well as consider different interpretations that help every teachers gain perspective as his or her inquiry unfolds” (Dana 51). Mentor/Intern collaboration was essential throughout the entirety of our inquiry process. After school each day, we met in order to discuss the progress of our students and, in turn, plan our lessons for the next day.

F. A Checklist

We used the Combining and Comparing unit checklist as another means to document our students’ progress throughout the module. (Appendix J.) This checklist became a tool for planning supplemental lessons to compliment the Investigations curriculum when additional practice or re-teaching was needed.
Data Analysis

The first piece of data analyzed was the pre-flexible grouping attitude surveys. Out of the 23 students in our class, only 21 students filled out this survey due to the fact that two students were absent the day that the surveys were handed out. The first page of the survey consisted of four multiple-choice questions in which the students circled a Garfield that depicted their attitude about the question. The second page consisted of written response questions. See Appendix A. The question “When do you think you learned your best in math?” was added at the end. Students responded by writing their answer on the bottom of their survey papers. This question was included because we wanted to know specific thoughts and feelings about our students’ mathematics learning and successes.

To analyze these initial surveys we tallied the number of responses for each question. Our “master” attitude survey (Appendix A) documents our results. Noticeable patterns emerged. Many of our students felt they were making progress in third grade as can be seen by their response to question 1; “How do you rate yourself as a math student (how good are you at math)?” Seven students rated themselves as excellent and fourteen students rated themselves as good. Therefore, twenty-one out of twenty-one students believe that they are becoming better mathematic students in third grade.

Another theme that was evident was in our students’ enjoyment of mathematics as a subject in third grade. Eight of twenty-three students replied that they very much enjoyed learning math in our classroom and ten students responded that they enjoyed math. Combined, seventy-eight percent of students were enjoying learning math in school.
Additionally, “In third grade, how well do you feel you understand the things being taught in math?” was question number four. Eleven students responded that they understand math extremely well in third grade, nine students said that they understand math pretty well, one student said that s/he partially understands, and no students responded that they did not have an understanding of third grade mathematics. The percentages were quite close to fifty percent of total students deeming that they have a good understanding of third grade concepts.

Another pertinent theme recognized from our initial student survey was that 11 out of twenty-three students believed that they learned best in small group learning environments. When asked to reflect on the question “When do you think you learn best in third grade math in third grade?” forty-seven percents responded that small groups are beneficial to their learning of math concepts.

When analyzing the students’ pre-assessments and summative assessments, we used a Combining and Comparing Assessment Master, Appendix G. The Assessment Master categorizes student understanding as Advanced, Proficient, Basic, and Below Basic. In our class, 20 students took both the pre-assessment and the summative assessment. When looking at the pre-assessments, the Assessment Master categorized eight students as having a Basic understanding, eleven students as having a Proficient understanding, and one student as having an Advanced understanding of Combining and Comparing. After instruction and formative assessment, the summative assessment was given. The Assessment Master, Appendix G, categorized two students as Basic, eleven students as Proficient, and seven students as Advanced in their understanding of Combining and Comparing. This data shows that the number of students with only a
Basic understanding decreased by 60%. The number of students with an Advanced understanding increased from only one student to seven. Essentially, this means that fifteen students improved in their understanding of Combining and Comparing concepts.

We chose three examples of student work to analyze in further detail. Appendix D is the first piece of student work. On this student’s pre-assessment, the answer was incorrect. S/He used a skip counting or counting up method in order to solve the problem. This student received a Basic on the pre-assessment according to the assessment rubric for Combining and Comparing. Appendix G, because s/he solved the problem incorrectly; however, there was basic addition strategy, counting by twos, utilized to count on from an even number to another even number, 14 to 28. In this specific situation, a mistake was made while counting on, however the student recognized counting on as an acceptable strategy for solving a subtraction problem. Conceptually, this student understands that addition and subtraction are related, and this particular student demonstrated basic computational fluency with regards to this concept.

On the summative assessment, this same student scored an Advanced as S/He used a method of grouping the numbers together within an addition sentence, or standard notation, in order to obtain the correct answer. The student also used an additional method of “traditional math” or a familiar algorithm approach to double-check his/her work.

The second student’s work, Appendix E, received a Basic. This student obtained the correct answer on the pre-assessment through grouping numbers and counting by ones; however, this strategy is categorized as a basic understanding strategy on the Assessment Master, Appendix G, due to the fact that this strategy does not specific
combine or compare numbers in order to obtain an answer. On the summative assessment, this same student used a traditional math approach in which s/he used a subtraction sentence, or standard notation, to solve the problem correctly, thus showing recognition of a combining and comparing problem. Through this approach, the Combining and Comparing rubric would place this student in the Proficient category.

The third piece of work that we are analyzing is Appendix F. While in the pre-assessment this student obtained the correct answer, his or her method of solving was grouping numbers through pictures. The student then counted the lines that s/he did not cross off while counting up in order to determine the answer to the math problem. The assessment rubric indicates this student as Basic. This same student used a more advanced method on the summative assessment. S/He used noted her strategy in a traditional standard additional notation in order to solve the nearly identical problem. This student then used another method, which was drawing on a number line and counting up using landmark numbers, in order to double-check his/her work.

After completing the Combining and Comparing module’s summative assessment, we gave the students the post-flexible grouping attitude survey. This time, 22 students completed the survey. The survey consisted of seven questions, and similarly, all of which could be answered through circling the Garfield that matched the way the students felt about the question. The first question, “Do you think that you are a better math student now then you were at the beginning of third grade?” was a question that we found to be extremely important. Eighteen students claimed that they feel very strongly about their progression in mathematics since the beginning of the year, two students think
that they made good progress, one student said that s/he made little progress, and one student said that s/he made no progress in mathematics since the beginning of the year.

This data, of which before our inquiry only seven students felt that they were excellent math students and after our inquiry 18 students rated themselves as great math students, was particularly important to us because we wanted to determine if our students were going to make progress in mathematics though our pre-assessment inquiry. According to the students’ attitudes about their own progress, they believe that they are learning and progressing in their understanding of mathematics.

In analyzing our post-attitude surveys, themes regarding small group and whole group instruction emerged. When asked, “How much do you enjoy learning math in small groups?” seventeen of twenty-three students highly enjoyed a small group learning experience, and four students reported liking small group math instruction, whereas only one student responded that they did not enjoy learning math in small groups. When further questioned about his/her answer to this specific question, the student relayed that s/he preferred learning and completing math tasks alone, rather than in any group situation. Accordingly, two students responded that they did not enjoy “learning math in a whole group situation, while eleven students replied that they enjoyed learning in this environment. Therefore, it would seem, the majority of our class, twenty out of twenty-three students favor small group-learning situations, while roughly half prefer whole group math instruction.

Prior to our inquiry project we were concerned that our confident math students participated frequently during math discourse, leaving a handful of students perhaps confused or unsure about the strategies being shared, or apprehensive to share their own
math thinking with the large group. Interestingly, our post-attitude survey data reveals that this opinion is not entirely true. When asked to respond to two questions on the subject of participation during small and whole group math discussions, the data was telling. Seventeen students responded that they participated often in whole group situations, when asked “Do you feel like you ask questions when you are in small groups?” and three responded that they participated when asked questions. When asked this same question regarding whole group situations, eleven responded that they participate frequently and nine felt they participated. The data reflects that, for each grouping, twenty students participated and participated often, with the results slightly higher for those that ultimately felt more comfortable during small group learning.

**Claims**

Claim 1: Our flexible groups were not nearly as flexible as we had envisioned them to be.

Throughout the inquiry process, we wanted to use flexible grouping in order to implement small group instruction during our allotted math block. We felt that by having the students in smaller groups we would be able to provide them with the instruction that they needed in order to establish a deep understanding of the Combining and Comparing module. Prior to our inquiry, we read the article, “Math and Reading Ability Grouping the Elementary School,” which summarizes the conclusions of Robert E. Slavin's 1986 comprehensive review of research on the different types of ability grouping in elementary schools.

“Based on his examination of the features of successful and unsuccessful practices, Slavin recommends that the following elements be included in successful ability grouping plans:

*Students should identify primarily with a heterogeneous class. They
should be regrouped by ability only when reducing heterogeneity is particularly important for learning, as is the case with math or reading instruction.

*Grouping plans should reduce student heterogeneity in the specific skill being taught, not in IQ or overall achievement level.

*Grouping plans should allow for frequent reassessment of student placement and for easy reassignment based on student progress.

*Teachers must vary the level and pace of instruction according to student levels of readiness and learning rates in regrouped classes.

Only a small number of groups should be formed in within-class ability grouping. This will allow the teacher to provide adequate direct instruction for each group” (“Ability” 1).

We felt that each of these elements were considered and included during our regrouping for math instruction, however, our grouping was not as flexible as what we had hoped. We have several examples to illustrate our point.

Throughout our twenty-five day instructional period students remained in their initial post-pre-assessment groups for the majority of instructional time. In a combined four lessons out of twenty five lessons, two of our groups joined together to introduce and review additional and subtraction concepts. Similarly, during three additional lessons our groups were modified to review subtraction concepts and assess readiness for traditional algorithms for the purpose of rechecking work. Therefore, 84 percent of the time two of our groups remained with the very same students in which they began the module, leaving a remaining 16 percent learning in a combined learning situation. Consequently, no movement was made within our neediest addition and subtractions skill-readiness group.

Furthermore, only one student who was moved to another group and this movement took place as a result of a formative assessment. This student was then
observed speaking to his/her peers during group work. S/he was saying that this was not
his/her normal group, and that s/he was supposed to be in the “other” group. This told us
that, not only were out students very aware that they were being grouped in a certain and
constant way, but also that they had begun to associate or identify with a particular
learning style and or ability.

Our next example is with regards to our pre-assessment. After this assessment,
and also through multiple observations we recognized this student as ultimately using
very procedural computational methods, but s/he rarely demonstrated confidence in
recording or using conceptual mathematic strategies. We grouped this student with other
students that needed more instruction and practice with their conceptual skills. After a
few weeks of the grouping, this student’s father emailed us for more information about
how and why we were grouping the students during mathematics. This led us to believe
that, again, this student was expressing feelings about his/her grouping and that this was
brought to the attention of his/her parents.

Claim 2: For students to be most successful, all three forms of assessment (pre-
assessment, formative assessment, and summative assessment) are essential to teaching
mathematics.

Our pre-assessment aided us in determining the beginning points for Combining
and Comparing. It also enabled us to discover which areas to highlight so that we could
enhance our students learning and enrich their understanding. We were able to tailor the
Combining and Comparing module so that concepts that were already mastered were not
necessarily re-taught, but revisited. In “Fair Isn’t Always Equal” author Wormeli
indicates that many teachers make the mistake of forging ahead with curriculum without
regards to the pre-assessment data. We must take action as a result of what we have learned (29).

The formative assessment, perhaps, was the most valuable, and the most important, form of assessment for our students. In our classroom, we conducted formative assessment through “kid watching” and more formal measurements, such as unit checkpoints. We made daily observations about how our students were learning, and what they needed extended for them in order to accomplish a solid understanding. We also had the students complete performance tasks throughout the entire Combining and Comparing module. In looking at the performance task and through collaboration, we were able to determine the “next steps” for our upcoming lessons.

The summative assessment is what brought all of our assessment work together. Through pre-assessing and formatively assessing the students we were comfortable giving the students the summative assessment. As it was described in our data analysis, our students became more advanced in their understanding as well as their methods of solving problems.

Gregory states that “Assessment as ongoing feedback is a necessary component of the learning process, not something that happens at the end of learning (37). We would also call to attention that assessment is, additionally, not something that takes place at the beginning. Our formative assessments were most significant in identifying opportunities to affect learning. Our evidence is that daily, our lessons were revised, rethought, and revisited and had a high impact on our students success and confidence as learners.
Claim 3: Students value and benefit (both in terms of confidence and performance) from small group instruction.

As shown through the data, before the implementation of small group instruction eight students were categorized as having a Basic understanding of the concepts and after the small group instruction only two students were categorized as having a Basic understanding of the concepts. The number of students with a Proficient understanding remained the same; however, the students in this category made progress. The students were showing an understanding of a combining and comparing problem through the use of number sentences, rather than using counting on strategies. The students were also able to double-check their answers in a different way than the strategy in which they used to solve the problem.

Before our small group instruction, only one student was categorized as having an Advanced understanding of Combining and Comparing, after the small group instruction seven students were categorized as Advanced in their understanding of Combining and Comparing. This data suggests that the students exhibited improvement in their understanding of addition and subtraction concepts, fluency and notation of their strategies.

Similarly, on the post-flexible grouping survey the students made it apparent that they enjoyed small group instruction, and that they felt comfortable asking questions during the small group instruction. The students also responded on this same survey to the question about having learned a substantial amount in mathematics with positive feelings. A majority of the students felt as if they had learned concepts and strategies beyond which they had at the on set of the Combining and Comparing Module.
Conclusions

After completing the inquiry process on pre-assessment in mathematics, we acknowledge that pre-assessment is crucial, and the creation of this assessment compels the teacher to consider the essential and enduring concepts of a unit. However, equally important are formative assessments, which validate student understandings on a daily basis. In addition, effort needs to be made so that grouping is flexible and concepts are not taught in isolation. “There are times in all classrooms when it is more effective or efficient to share information or use the same activity with the whole class. Such whole-group instruction establishes common understandings and a sense of community for students by sharing discussion and review” (Tomlinson 5). In “What Differentiated Instruction Is and Isn’t” Tomlison shares “The Flow of Instruction in a Differentiated Classroom.” Please refer to Appendix K. Ideally, a “differentiated classroom is marked by a repeated rhythm of whole-class preparation, review, and sharing, followed by opportunity for individual and small-group exploration, sense-making, extension, and production” (6).

Conclusively, and with regards to mathematic instruction, the majority of our students believed that they were making progress in third grade and were good math students. The students had and enjoyment for math learning and believed they learned best in small group learning situations.

New Wonderings

One common theme that emerged from our daily collaboration throughout this project was the amount of time spent planning for each upcoming math lessons. Additionally, little movement between our groups occurred, making our groups, for the
most part, inflexible. We wonder how to modify the Combing and Comparing unit so that learning is more student centered, where multiple approaches to learning take place. How could we create activities for students that promote fluid student movement and purposeful talking, so that all students will benefit?

Secondly, how do our students’ feel about themselves after being grouped for this particular unit? Grouping of students according to ability is one the most talked-about topics in education. In “Hot Topic: Does Ability Grouping Help or Hurt? A Talk with Anne Wheelock” Senior Editor of Scholastic Teachers, Meg Bozzone reports that:

“Tracking leads students to take on labels---both in their own minds as well as in the minds of their teachers---that are usually associated with the pace of learning (such as "slow" or "fast" learners). Because of this, we end up confusing students' pace of learning with their capacity to learn. We associate students' placement with the type of learners they are and therefore create different expectations for different groups of students. Once students are grouped, they generally stay at that level for their school careers, and the gap between achievement and levels becomes exaggerated over time. The notion that students' achievement levels at any given time will predict their achievement in the future becomes a self-fulfilling prophecy. (1).

Therefore, in understanding these oppositions to ability grouping, what affects did we impose upon our students’ perceptions of their math abilities and confidence as math learners? How damaging is grouping?

In the end, we are walking away with a better knowledge of three very different types and purposes of assessment, as well as the multiple roles of assessment in planning, teaching, and learning. We are also more cognizant of the affects of grouping students in stagnant groups without opportunities to return to the whole group for review, sharing and exploration. “Differentiation is NOT just another way to provide homogeneous
“grouping” (Tomlison 2). Likewise, homogenous grouping does not mean differentiation is taking place.
Bibliography


Appendix
Appendix A

Name: ____________________________

1. How do you rate yourself as a math student (how good are you at math)?

1 4 0 0

2. How much do you enjoy math class in school?

8 10 3 0

3. How much do you enjoy doing math outside of school?

9 6 2

4. In third grade, how well do you feel you understand the things being taught in math?

11 9 1 0
5. Of the topics you have learned about in third grade, which was your favorite?
   - Froggy = III
   - Rounding = I
   - ÷ = III
   - + = II
   - geometry = I
   - X = III
   - / = III
   - fractions = II
   - - = I
   - all = III
   - ? = III
   - flips/turns/area = I

6. Of the topics you have learned about in third grade, which was your least favorite?
   - Froggy = I
   - 100 chart = III
   - - = I

7. Which topic you have learned about in third grade was the easiest for you?
   - Froggy = I
   - geometry = I
   - X = III
   - adding = I
   - rounding = II
   - 100 chart = I
   - + = III
   - skip counting = II

8. Which topic you have learned about in third grade was the hardest for you?
   - Magic w/÷ = I
   - time = I
   - Froggy = I
   - ÷ = III
   - all = III
   - parenthesis = II
   - X = III
   - none = I

9. When do you think you learn best in math?
   - small groups = III
   - in school = I
   - Big group = I
   - self = III
   - total = 17
Appendix B

Name: _____________________________________

1. Susan is reading a book that is 112 pages. She has read 65 so far. How many more pages does she have to read? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!

2. Mrs. Klein’s class measured the snow outside their classroom. On Monday, they measured 28 inches of snow. By Friday they measured 14 inches of snow. How many inches had the snow melted? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!
3. I have $4.00 to spend at the gift shop. I buy a pencil for $0.89, and an art book for $1.35. How much money do I have left? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!

4. Paper clips come in boxes of 200. Room 82 started the year with 2 boxes. At the end of the year, we only had one box left, but there were only 52 left in the box. How many paper clips did we use up? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!
Appendix C
Name:

Solve each problem. Record how you solved it and then record how you double-checked your answer. Please circle your answer.

1. Sima is reading a book that has 133 pages. She has read 85 pages so far. How many more pages does she have left to read?

2. A class of third graders in Pennsylvania were keeping track of the amount of snow outside of their classroom. On Monday, they measured 33 inches of snow. By Friday, the snow measured to 16 inches. How many inches of snow had melted?
3. I have $3.00 to spend at the snack shop. I buy a bag of chips for $1.50, a bottle of juice $0.79, and an apple for $0.30. How much money do I have left?

4. Pencil-tip erasers come in boxes of 100. Our classroom started the year with 3 boxes. At the end of the year, we had 1 box left, but there were only 26 erasers left in that box. How many pencil-tip erasers did we use up this year?

5. Solve the problem in three different ways:

   \[ 23 + 46 + 94 \]

First way:

Second way:

Third way:
Appendix D

Pre-Assessment

Mrs. Klein’s class measured the snow outside their classroom. On Monday, they measured 28 inches of snow. By Friday they measured 14 inches of snow. How many inches had the snow melted? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!!

28 - 14 = 14

I know this because I took 14 then I kept adding 2s, too, until I got to 28. Then I added up all of the 2s, until I got 14.

Summative Assessment

A class of third graders in Pennsylvania were keeping track of the amount of snow outside of their classroom. On Monday, they measured 33 inches of snow. By Friday, the snow measured to 16 inches. How many inches of snow had melted?

33 - 16 = 17
Appendix E

Pre-Assessment

1. Susan is reading a book that is 112 pages. She has read 65 so far. How many more pages does she have to read? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!!

2. Mrs. Klein’s class measured the snow outside their classroom. On Monday, they measured 28 inches of snow. By Friday they measured 14 inches of snow. How many inches of snow did they lose?

Summer Assessment

Sima is reading a book that has 133 pages. She has read 85 pages so far. How many more pages does she have to read?

I got 48 because I added two numbers together.

48
Appendix F

Pre-Assessment

1. Susan is reading a book that is 112 pages. She has read 85 so far. How many more pages does she have to read? Circle your answer and be sure to write an explanation for how you solved this. Please show all work!

2. Mrs. Klein’s class measured the snow outside their classroom. On Monday, they measured 0.2 inches of snow. On Tuesday, they measured 0.1 inches of snow. How much snow did they measure that week?

Summative Assessment

Sima is reading a book that has 133 pages. She has read 85 pages so far. How many more pages does she have left to read?

\[
80 + 20 = 100 + 33 = 133 \quad \frac{28}{48} \\
85 + 20 = 105 + 28 = 133 \quad \frac{15}{48}
\]

Double Check

85 - 9.05 = 100.90 - 133 + 133 + 4

33 15
48
# Appendix G

## Combining and Comparing

### Task 1 (Assessment Master 33)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
</table>
| Advanced   | • Student solves the problem correctly by using a strategy that uses prior knowledge without using manipulatives.  
• Student uses standard notation to represent his or her solution.  
• Student double-checks his or her answer. |
| Proficient | • Student solves the problem correctly.  
• Student recognizes that this is a comparison problem and chooses either efficiently adding up or counting back by using landmark numbers.  
• Student uses standard notation.  
• Student double-checks his or her answer. |
| Basic      | • Student solves the problem correctly or reasonably closely using inefficient strategies (e.g., counting on or counting back by 1’s).  
• Student relies on manipulatives or the 300 chart to solve the problem.  
• Student uses some standard notation.  
• Student double-checks his or her answer using a similar strategy. |
| Below Basic| • Student shows no evidence of recognition that this is a comparison problem; doesn’t understand what the problem is asking him or her to do.  
• Student relies heavily on manipulatives.  
• Student uses little or no standard notation.  
• Student doesn’t double-check his or her answer. |
Appendix H

Baseline Data

A1: Consistent hand raiser/always paying attention
18 + 10 = 28  7 using fingers
28 + 1 = 29
*Counting on
*Uses # line but counts by 1's!

A2: Consistently pays attention
18 + 1 = 19
10 + 8 = 18
10 + 10 = 20
10 + 10 + 9 = 29

A3: pays attention - GREAT strategies
13 - 9 = 4 \rightarrow 10 - 9 = 10 \rightarrow 10 - 4 = 6
*Uses landmarks
7 - 1 = 6 \rightarrow 30 - 1 = 29  *LANDMARKS*
C1: consistent hand raiser
+ FANTASTIC strategies!
+ Mental Math

C2: "I had a bunch of ideas, but they weren't as good!"

said when coming:

H1: counts by 1's
- uses fingers
- draws (unti tally marks
- very limited understanding of
10's and 1's places

I1: Double checks, but still
- uses fingers to count
K1: Counting by 1s
getting quicker/better at addition → showing progress at subtraction.
- Uses fingers
draws (00000) circles to count by.

M1: Counting by 1's

M1: Uses grouping method
18 + 29
11 + 11
10 + 8 + 20 + 9
10 + 20 = 30
8 + 9 = 17
30 + 17 = 47
11 = 1 + 10
Na: grouping nervous about giving answers out loud.

P1: seems to consider options - very precise
Strategic: 49 - 10 = 59
\[ (49 - \text{13}) \]
59 - 3 = 56.

S1: gets options in order, makes a strategy decision, grouping

18 29
10 8
10 + 0 = 10
20 - 10 = 10
9 - 8 = 1
10 + 1 = 11
52: had #'s 0, 1, 2, 9, 8, 9
used 90 + 10 = 100
not 99 + 01 or 98 + 02 to = 100
* goal was to get exactly 100
  * Rushing
  * using traditional math be fixed
  * if time was taken
  if time was taken
  * does stuff too fast
  * makes #'s/possibilities
  * pushes
  * based on 

52: 60 + 9 = 69
  10 + 3 = 13
  60 - 10 = 50
  9 - 3 = 6
  50 + 6 = 56

ALL IN HIS HEAD
was able to explain it, too!
Group 3:
S1  D1 -> no notes/pre-ass.
A3  A2
T2  N1
C1  T1 -> makes silly mistakes that could be fixed if time was taken to double check!

Mrs. M's note from Group 1:
6 quarters of Group 1

Based on today's lesson, N2 will be moving to Group 3.
Otherwise groups will remain the same.
Based on today's lesson, money assessment will need to be revisited. As well as time and traditional math style.

\[
\begin{array}{c}
58 \\
+416 \\
\hline
104
\end{array}
\]

Based on today's lesson, J1 will move from group 1 to group 2.

Group 1: now

K1, M1
A1, S2
H1, S3

Group 2: new


Appendix I

Name: ____________________________

1. Do you think that you are a better math student now than you were at the beginning of third grade?
   - [ ] 18
   - [ ] 2
   - [ ] 1
   - [ ] 1
   Total: 22

2. How much do you enjoy math class when you are in small groups?
   - [ ] 17  4
   - [ ] 0
   - [ ] 1

3. How much do you enjoy math class when you are learning as a whole class?
   - [ ] 2
   - [ ] 11
   - [ ] 1
   - [ ] 2

4. Do you feel like you can ask questions when you are in small groups?
   - [ ] 17
   - [ ] 3
   - [ ] 2
5. Do you feel like you can ask questions when you are learning with the whole class?

6. During the unit Combining and Comparing, do you feel like you learned a lot?

7. Combining and Comparing was my favorite unit!
## Checklist of Mathematical Emphases for Combining and Comparing

<table>
<thead>
<tr>
<th>Student's Name</th>
<th>Student's Name</th>
<th>Student's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **1.** Uses benchmark numbers in estimating, comparing, and computing quantities.
- **2.** Examines how the parts and the whole are related in addition and subtraction.
- **3.** Solves addition problems that have multiple addends.
- **4.** Has more than one way to solve a computation problem and uses one method to check another.
- **5.** Solves combining and comparing problems with numerical strategies and records solutions using standard addition and subtraction notation.
- **6.** Is confident in combining and comparing 3-digit numbers and kindness to 1000.
- **7.** Makes comparisons of how things change over time.
- **8.** Can weigh with a pan balance.
- **9.** Understands and uses important equivalences of time, money, and linear measurement.
- **10.** Estimates solutions and can adjust to construct an exact solution.
- **11.** Reads and writes numbers in the hundreds and thousands.
- **12.** Collects, represents, describes, and interprets data (Ten-Minute Math activity).
- **13.** Uses the calendar as a tool for problem solving.
- **14.** Has a numerical strategy for solving problems that involves both addition and subtraction (Ten-Minute Math activity).
Appendix K

Figure 1.1 The Flow of Instruction in a Differentiated Classroom

1. Teacher and the students engage in the exploration of a topic or concept.
2. Students engage in further study using varied materials based on readiness and learning style.
3. Students and the teacher together to share information and pose questions.
4. The whole class listens to individual presentations and establishes baseline criteria for success.
5. The whole class listens to the teacher's key ideas.
6. Students self-select projects, topics, or the level at which they extend their understanding.
7. The whole class is introduced to a new topic or concept and extends their study through sharing.
8. In small groups, students design tasks to apply key principles to solve real-world problems related to their study.

A differentiated classroom is marked by a repeated rhythm of whole-class preparation, review, and sharing, followed by open-group exploration, sense-making, extension, and production.