“What are you thinking?” A Look Into Student and Teacher Understanding In A Conceptually Based Math Curriculum

A Teacher Inquiry
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Abstract

Throughout this year in third grade, math has been taught through a conceptually based program. Within each classroom there is a wide variety of learners who have left us wondering, “What are our students truly understanding?” and “How can we create better instruction to meet all of our students’ needs?” This inquiry has become an exploration into the students’ thinking and understanding, as well as, an evaluation of our own teaching practice.

Amanda Kameny is a third grade intern at Park Forest Elementary School (PFE), and Amanda Iachini is a third grade intern at Corl Street Elementary School (CS). This paper is the first endeavor into inquiry for both students.
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**Context and Rationale**

This inquiry was conducted in two self-contained third grade classrooms. Both classrooms that were involved in the data collection for this inquiry were located in schools within the State College Area School District, State College, PA. State College is home to a major university; therefore the students attending these elementary schools have an abundance of educational resources available to them. At Corl Street Elementary School, most families have some affiliation with the university, and this correlates with many of the students coming to school prepared and eager to learn. Park Forest Elementary is a diverse community of learners, some students having highly involved parents and academic backgrounds, while others may have less support from home. Regardless of the differences in these two schools’ learning communities, the inquiry wondering was based on a “felt difficulty” during math instruction.

The third grade students at Corl Street Elementary and Park Forest Elementary are a diverse group of learners. At Park Forest Elementary School, the third grade class consists of twenty-four students, half of whom are boys and half of whom are girls. There is a group of between five to seven lower achieving math students in this classroom. During math instruction, there is one paraprofessional in the classroom who assists a particular student who struggles with reading and writing. One student in the class is an English as a second language student.

At Corl Street Elementary, the math classroom has only eleven students, equally mixed with males and females. This class moves at a slower pace and with more support than in the higher achieving math class. There are usually three adults in the room during math class: classroom teacher, intern, and special education paraprofessional.
In both third grade classrooms, the students are instructed through a reformed mathematics approach called *Investigations in Number, Data, and Space*. Math instruction occurs five days a week, lasting approximately an hour each day. The students generally work with manipulatives in order to make the material more hands-on and visual. Most often, the teacher will review material that was covered in past units and introduce students to new concepts that will be covered in future units. At Park Forest Elementary, due to larger class size, it is difficult at times to give each student individual attention. On the contrary, at Corl Street the small nature of the class size, in addition to three adults in the room, makes it feasible to give the students immediate feedback and attention.

All year we, the interns, have contemplated the effectiveness of our own math instruction. In every district there is a set curriculum and State College has chosen to support *Investigations*, a more conceptually based approach to math instruction. Despite Corl Street’s small size class and Park Forest’s larger math group, we have seen a common trend of low student achievement during math instruction. Our inquiry wondering developed when we tried to differentiate instruction to assist lower achieving students, and then realized that we did not know exactly what each student did and did not understand. As two teachers to whom math generally came easily, we struggled with how to reach each student when we could not determine *why* some students were lower achieving. Throughout this inquiry, we have tried to determine better methods for understanding each math student, as well as examine our own teaching practice.
Main Wondering

In what ways can teachers become more aware of their students’ understandings, as well as their own teaching in order to accommodate the instructional needs of lower achieving math students?

Sub Wonderings

- How do I help my students communicate effectively in math class?
- What types of questioning during a math lesson will help lower achieving students express their understandings accurately?
- How can I use math journals to assess student understanding?
- How do you keep accurate and useful diagnostic records of each student’s math strengths and needs?

Data Collection

1. Student Analysis

Surveys (PFE/CS): At the very beginning of the inquiry study, it decided to give the students a survey (appendix A) to gauge their feelings towards math instruction, as well as what they personally believe are the most effective ways that they learn math. It was deemed important to assess students’ feelings about math instruction before the inquiry study began. Before administering the survey, both classes were made aware that responses should be as honest as possible, in order to decrease the subjectivity of the survey. Finally, the survey asked an open-ended statement regarding attitude toward independent versus collaborative work, and their personal confidence during math instruction.

The second survey (appendix B) that was given was administered towards the completion of the inquiry study. The goal of the questions was, again, to gain knowledge of the students’ attitudes towards math instruction. This survey was used to compare and contrast the results from the beginning of the inquiry with the conclusion of the study.
Interviews (PFE): Towards the beginning of the inquiry process, interviews were conducted (appendix C) in order to analyze which ways students could best explain and understand math problems. One basic subtraction problem was repeated throughout the entire interview in multiple ways, while students used a variety of manipulatives. Not only could it be determined which question the student could most accurately respond to, but also which method of learning and manipulative they enjoyed learning from the most. The interviews lasted approximately fifteen to twenty minutes with seven students whom were determined low achieving from the first two weeks of inquiry.

Student Journals (CS): One method of monitoring comprehension in regards to number sense, attitudes in math, and specific third grade math concepts (e.g. geometry), was through a system of student journaling (appendix D). Students were given an open ended prompt or a math problem to answer in their journals. The students were given feedback on their responses to look through and reflect upon after the completion of each entry.

2. Anecdotal Notes

Note Cards (CS): During math lessons, anecdotal records were kept of key comments made by students. Comments regarding issues of concern (appendix E), moments of strength (appendix F), and concerns in class (appendix G) were recorded on individual note cards for each student.

3. Question Analysis

Frequency Tally (PFE): During several consecutive math classes a frequency tally was recorded to distinguish which students were being called upon to answer questions (appendix H).
**Question/Response/Analysis (PFE):** During many math lessons, the questions and responses from students (appendix I) were recorded. The question sheet included a section in which the nature of the question could be determined (e.g. leading, tell me).

**4. Assessment**

*King’s Foot (PFE/CS):* This assessment was given to the students after a unit that addressed the difference between standard and non-standard measurement. For this assessment, the students were read a story orally and then given a scenario to respond to (appendix J).

*Fair/Unfair Spinner (PFE):* This assessment (appendix K) was given to the students following a unit on probability (fair versus unfair spinners). The assessment was designed to target a variety of learners, those who are more visual and those who are more literary. When grading these assessments, students were only required to answer one of the two questions correctly.

*Fractions (PFE):* This assessment that was given to the students after many lessons when the students used brownies as a representation as a whole and cut them into fractional parts. The students had to determine if the pieces were equal, using their prior knowledge of area. The students were allowed to use manipulatives in order to determine the answer to this question if they were struggling (appendix L).

**5. Teacher Journal**

*Question Reflection (PFE):* Following the frequency tally, a teacher journal was written (appendix M) as a way to reflect upon the variety of students that were being questioned during instruction.
Analysis Process

Once data was collected, there was a need for an organized and efficient method for analyzing the results. For the pieces of data that were opinion and reflection driven, such as anecdotal notes and journals, reading the data provided sufficient information to identify trends and to decide upon claims. For the surveys and interviews it was necessary to create a collective report, in the form of tally sheets and excel spreads, in order to visually see trends in student responses. Lastly, assessments were analyzed by determining the type of questions asked and then looking for accuracy in student responses.

Surveys (PFE/CS): A master survey for each class with tally marks was compiled to depict the individual student responses. Then, the two master surveys were compared and contrasted across schools to identify any trends. Similarities in attitudes and practices were found in the two third grade classrooms. Only certain questions were analyzed, as other became irrelevant to the inquiry study.

Interviews (PFE): After listening to the interviews, the students were categorized according to their responses and learning styles. This process helped to better meet individual student needs.

Student Journals (CS): After each journal entry the students received responses to their writing. Later, all of the information was reread and reflected upon to analyze the spectrum of students in the classroom. This information provided insight into each student’s understandings, which, in turn, provided the teacher with the necessary information about each student’s capabilities in math.
Note Cards (CS): Note cards were used as a means for keeping track of the types of questions and responses students asked in class. This system became a time efficient method for recording students’ strengths and weaknesses during instruction. A check (✓) system was used to analyze the information written on the cards.

Frequency Tally (PFE): Tallies were taken while questioning students in math class. To analyze the data, it was reviewed and notes were taken on the answers students gave to different questions. The questions and responses were compared before the teacher reflected upon the data.

Assessments (King’s Foot, Fair/Unfair Spinner, Fractions) (PFE, CS): When looking at the different assessments, the wording of the questions and learning styles of the students were considered. Further, the assessments were analyzed for student growth, comprehension, and completeness.

Claims and Evidence

Claim 1: When you know the reason for student low achievement, the teacher is able to differentiate instruction to meet individual needs, which will increase student success in mathematics.

Evidence: Prior to the inquiry experience, it was assumed that the majority of the lower-achieving math students had a poor number sense. However, after imposing several communication techniques, it was found that the students needed a different means of expressing their solutions in mathematics. For example, the assessment “Spinner Fun!” (appendix K) was administered with two types of questions, visual and literary. After reviewing student responses, it is obvious that some of the students who struggled with the written answer could better explain their thinking through illustrations. The particular student’s work (appendix K) is a student who speaks English as a second language.
Although this had been considered throughout instruction this year, the instruction in math was rarely modified to meet his needs. Once he was interviewed, it was determined that he may not have been as “low achieving” if he did not struggled with the language barrier during math instruction. It was important to consider all students’ reading skills even during math instruction. This proves that knowing the *reason* for student difficulty can help differentiate and increase student success in math.

The surveys (appendix A and B) indicated that the majority of students preferred working with manipulatives and that they aided their understanding of math concepts. In the assessment “Different-Shaped Pieces” (appendix L), students were given the choice to use or not use manipulatives. The students who were struggling to complete the assignment were encouraged to use manipulatives to help them better understand the equality of the two halves. Since manipulatives were available to students, the teacher was able to see that the student did understand the concept being addressed. When recognizing the differences in student learning styles, a teacher may create instruction that targets all of her students to help them to better achieve.

*Claim 2:* A variety of communication methods with students are necessary to find out specifically what math students do and do not understand, which helps teachers differentiate their instruction.

*Evidence:* Throughout the inquiry process, different forms of communication have been used in the classroom to try and better understand what the students were retaining during math instruction. Prior to the inquiry study it was thought that students viewed themselves as struggling and frustrated during math instruction, but the opposite was found through the surveys (appendix A). The surveys showed that most students believe they excel and feel confident in math. Not one student in either class expressed that they
disliked math class or felt like they were a weak student. In tandem with this data, the surveys showed that students rarely enjoy working with a teacher during math class, but enjoy working collaboratively. A teacher, when planning instruction, should consider this information. It is important that students view the teacher as a person from whom they can seek help, rather than being viewed as an intimidating figure. This information will allow a teacher to modify her attitude to make herself more welcoming and available for student aid.

Student journals were also an effective way to communicate with students and gauge their math understanding. One student (appendix D) was thought to have a poor number sense prior to the math journaling. One question required that the students compare two, three-digit numbers. Surprisingly, the student was one of the only students in the class to answer the question clearly by explaining her answer using place value concepts. As a result of journaling, it became apparent that the student had a good number sense, yet struggles in some other area of math instruction. A teacher must then determine what obstacles are impeding upon student success.

Student interviews (appendix C) are a less time efficient method of student-teacher communication, but a very effective way to evaluate a student’s mathematical understanding. Throughout this process there was direct verbal communication with each student. During this process, most students who were thought to be low achieving because of a poor number sense, proved that their weaknesses actually come from difficulties with reading skills, number sense, or attention issues. This information was very useful in planning instruction during math to meet individual student needs and increase student success.
**Claim 3:** It is important for teachers to address appropriate questions to both high and low achieving students in order to increase student success in the mathematics classroom.

**Evidence:** One focus of the inquiry was to evaluate which students were being asked questions. Initially the frequency tally showed that most questions during mathematics instruction were being asked to “higher achieving” students. After recognizing this pattern, a teacher reflection was written in order to analyze the benefits and drawbacks of this questioning pattern (appendix M). After consideration of the high frequency of questions aimed at one ability group of students, it was determined that teachers often find comfort in calling upon students who will know the correct answers and keep the class moving at a fast pace. Although it is important to use “high achieving” math students as a valuable source of information for the class, and consider keeping those students challenged and involved, it is also important to consider the harm that neglecting to question lower achieving students will have on their understanding. It is much more valuable to have student understanding than to have a timely lesson. Following the journal reflection (appendix M), the frequency tally (appendix H) showed an increase in the variety of students being questioned during math instruction. As a result, the lower achieving students showed a greater understanding of math concepts in their work.

**Claim 4:** Questions that are open ended and incorporate “tell me”, encourage more detailed and comprehensive responses from students during mathematics instruction.

**Evidence:** As the inquiry study developed, it was necessary to look at teacher practice to see how it was affecting students’ understanding during mathematics instruction. *Tell Me* by Aidan Chambers expresses a profound idea about how to elicit elaborate responses from children about literature. Could this same concept be used as a questioning technique during math instruction to help “lower achieving” students elaborate in their
responses? Often times there was a “felt difficulty” when trying to address a concept with a “lower achieving” student, but not knowing the best way to ask questions.

During many class periods, data was collected regarding the types of questions that were asked during math, and the responses that were received (appendix I). As a result of this data collection, it was possible to analyze what types of questions received more comprehensive answers from students. During two particular math classes, questions were classified as either “tell me/how” or “what/why” questions and the student responses were evaluated for trends. It was determined that when the students were asked questions that began with the words “tell me” or “how”, their responses were much more detailed and comprehensive.

An example of a “tell me” question asked to a low achieving student that received a surprisingly accurate response is as follows:

“Tell me what you think will happen with the spinner today?” This student responded, “I think the games will go longer because the spots on the spinner are even”. This open-ended question allowed the student to show her understanding of the probability concept. The “tell me” question allows students more freedom in their answers, which inevitably may help a teacher gauge students’ understanding.

Secondly, a trend was found in the length and details in student responses (appendix L). The question data illustrated that when students were asked a question containing the word “what”, the responses from students were short and showed little understanding of the concept. Those questions that contained “tell me” allowed students to give more thorough answers. The use of open-ended questions and of “tell me” is a useful teaching tool during math instruction.
Reflections and Future Practice

Inquiry is a process that we will carry into our future careers. During this inquiry our time frame was limited, but that does not mean that the process of inquiry, or even this specific inquiry topic, will end. We are not only intrigued by the data we collected, but it has left us with answers, but many more questions regarding mathematics instruction and how children learn.

During our inquiry study, our wondering developed from a very broad “felt difficulty” into a specific wondering. At the very start we felt frustrated with mathematics instructions. Although the inquiry first developed when we had a need to find a way to help lower achieving math students find success, we ended at a very different point. Our inquiry evolved into a study of not just our students, but also gave us a look into our own teaching practice.

During math instruction, it is difficult to differentiate instruction without knowing what students do and do not understand. In our future teaching, it is imperative to take the time to evaluate not just who achieves within our math classroom, but why they are achieving or not achieving. Interviewing students, although time consuming, was a very informative assessment of student understanding. In the future we will consider the variety of student learning styles and how they should impact our instruction. Surveying students is another way we will gather information about our students’ attitudes and understandings.

One of the most interesting and useful methods of understanding students learning that we will carry into our future practice is the use of math journals. This method of assessing student understanding is both time efficient and very telling of students
thoughts, without that bias that a survey may bring. We will remember that the questions that are asked should be open ended in order to elicit a comprehensive view of our students.

Another important aspect from this inquiry that we will carry into our own teaching practice is the use of questioning within the classroom. We will try to become aware of the types of questions we ask and what questions best fit our students’ needs. In our teaching we will continue to use the “tell me” questions during math instruction to try to gather detailed responses from students.

This inquiry study has been a learning experience not only in mathematics, but also for our entire teaching careers. We know that we will come across situations and questions for which we do not have the perfect answer or solution. These questions or “felt difficulties” will pertain to different aspects of teaching such as, our students, our own teaching, or the curriculums we are expected to teach. Regardless of the nature of the questions that we encounter, it is important to explore solutions for this problem through data collection and the process of inquiry. We understand that inquiry is not a temporary project, but an ongoing process of wondering and inquiring that will occur in our future classrooms.
Appendix A

Master Survey
Student Survey # 1

Put an X in the box that best describes you.

<table>
<thead>
<tr>
<th></th>
<th>YES!</th>
<th>Sometimes</th>
<th>NO!</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am an excellent math student.</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<td>I like my math class.</td>
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<td>I like to play math games.</td>
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<td>![Rating]</td>
<td>![Rating]</td>
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<td>Math is fun.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<tr>
<td>I practice my math facts.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<tr>
<td>I do my math homework.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<tr>
<td>I go to after school math club.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
</tr>
<tr>
<td>I ask for help when I don’t understand something.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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<td>Using manipulatives (play money, uni-fix cubes, etc) help me learn math.</td>
<td>![Rating]</td>
<td>![Rating]</td>
<td>![Rating]</td>
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Circle the choice that best describes how you are feeling about math.

<table>
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<tr>
<th>I am very confident in math.</th>
<th>I usually understand math.</th>
<th>I need more practice and help.</th>
<th>I worry about math.</th>
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<td>![Rating]</td>
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<td>I like to work on math with a group.</td>
</tr>
</tbody>
</table>
Appendix B

Survey

1. How much do you enjoy math?

2. Do you enjoy calendar math?

3. Would you rather write your answer to a math problem or explain it out loud?

   WRITE
   EXPLAIN IN WORDS

4. Do you like playing math games?

5. Do you do your homework by yourself or does someone help you?

ALL BY MYSELF    SOME BY MYSELF    PARENT HELP

The easiest thing for me in math class is...

1. addition/subtraction
2. multiplication facts
3. measurement
4. geometry (shapes)

The hardest thing for me in math class is...

1. addition/subtraction
2. multiplication facts
3. measurement
4. geometry (shapes)
Survey

1. How much do you enjoy math?

2. Do you enjoy calendar math?

3. Would you rather write your answer to a math problem or explain it out loud?

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4. geometry (shapes)

The hardest thing for me in math class is...

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2. multiplication facts
3. measurement
4. geometry (shapes)
Appendix C

Interview Questions:

Rote count up to 35  
Count down from 50

-Can you count for me by 10’s up to 100?  
-What is ten more then 5? How did you get that? Keep counting by tens  
-What is ten less then 30? Ten less then 29?

-Counters
Have the child always tell the number of cubes on the table.  
Place ten cubes on the table  
put another ten stick on the table  
Take one cube away  
Keep putting ten sticks on the table

-Money
Give the child ten dollars  
Place another ten on the table. Keep putting tens down on the table up to 100  
Take away three dollars  
Have the child count down from 97 taking away a ten-dollar bill each time.

-Base ten blocks
Use the blocks to have students count.

-Story Problems
You went to the store to buy ten apples. Then your friend called you and asked if you could pick up ten more for a pie. How many apples did you have to buy in total?

-I had 30 pizzas to bring to Park Forest Elementary. I got twenty more from another school to bring for a party. How many pizzas did I have in total?

-My dog came and ate one of the pizza pies before the kids got to eat them. How many pizza pies did I have left to bring to the school?

Which way was easiest for you to understand? Money, cubes, real life problems?

What is your attitude about math?
My favorite thing about math is games kaboom. Counting by fives.

I know 621 is bigger than 612 because 21 is higher than 12.

Super thinking! I love that you wrote 21 and 12, not 2 and 1.
My favorite thing about math is games like close to 100 and I also like addition, subtraction, multiplication, and division. 😊

621 + 612

I know that 621 was greater because 2 is bigger than 1.

Do you mean the last digits in the numbers or the middle digits?

I meant the middle digit.
Appendix E

Confidence - High ✓+
Claim for help - ✓ (Sometimes)

2/29  8:55am - turned in homework wrong during morning work. Ms D looked over it saw it was wrong and asked him about it. He said he didn't understand it. She asked why he didn't ask for help? He shrugged his shoulders.

Appendix F

Confidence - High ✓+
Claim for help - ✓+ (always)

Showed CC how to build a pyramid while building shapes.
Appendix G

Confidence - High ✓+

Claims to ask for help ✓+ (always)

3/3 (building 3-D shapes) "Why doesn't anyone help me?" (Miss Jachini: I didn't know you needed help) "Mrs. Davis helped Cydia and she didn't ask for help."
Appendix H

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<th>Question Frequency Tally</th>
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Appendix I

Date: March 27, 2008
Lesson: Fair Shares---Fractions

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<th>Question</th>
<th>Response</th>
<th>Question Type (Check all that apply)</th>
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<tbody>
<tr>
<td>Someone tell me something we learned about fractions yesterday?</td>
<td>(L.K.) The smallest number is on the top.</td>
<td>__ What __ probing</td>
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<td>(D.M.) A proper fraction has a small number on top and a larger number on the bottom.</td>
<td>__ Why __ leading</td>
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<td></td>
<td>(C.B.) The top number is the numerator and the bottom number is the denominator.</td>
<td>__ How __</td>
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<td>__ Tell me</td>
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<td></td>
<td>__ Real life example</td>
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<tr>
<td>What is the numerator and the denominator?</td>
<td>(L.W.) the numerator is the part and the bottom number is the whole.</td>
<td>✓ What __ probing</td>
</tr>
<tr>
<td>Anyone remember the trick when you are reading a fraction?</td>
<td>(S.M.) The line means out of.</td>
<td>__ Why __ leading</td>
</tr>
<tr>
<td>What did we do to split this brownie among 2 people?</td>
<td>(G.M.) We split the brownie down the middle into 2 pieces.</td>
<td>__ How __</td>
</tr>
<tr>
<td>If I have one brownie and I split it down the middle, and I give one piece to Donovan and one to Maggie. What fraction does Donovan have?</td>
<td>(M.S.) He has one half.</td>
<td>__ Tell me</td>
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<td>__ Real life example</td>
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<td>Question</td>
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<tr>
<td>What is another way to say one out of four?</td>
<td>(L.W.) It means one fourth.</td>
<td></td>
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<tr>
<td>What if we had 3 people sharing one brownie. Can anyone propose an idea for me?</td>
<td>(L.H.) Still thinking.</td>
<td></td>
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<td></td>
<td>(D.W.) We can split it into 3 equal parts.</td>
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<tr>
<td>How else do we say one third to make it clearer?</td>
<td>(C.A.L.) You would say that they have one out of the 3 pieces.</td>
<td></td>
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<tr>
<td>How could we split this large brownie equally and fairly among 2 people?</td>
<td>(L.K.) Find the middle of the paper (brownie).</td>
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<td></td>
<td>(D.M.) Turn your paper then match this corner to the opposite corner</td>
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<tr>
<td>Do you think Donovan’s way of folding the brownie is equal?</td>
<td>(L.G.) They don’t look equal, but if you turn them, they are the same.</td>
<td></td>
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<tr>
<td>Who can tell me what fraction this part of my brownie is?</td>
<td>(J.C.) It is one half.</td>
<td></td>
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<tr>
<td>Lee if I added up one half and one half, what do I get?</td>
<td>(L.K.) I would get one whole.</td>
<td></td>
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<tr>
<td>How did you split your next brownie into 3 equal parts?</td>
<td>(G.B.) I made a tube and I squished it.</td>
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<td></td>
<td>(J.F.) I folded it into an</td>
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<td>Question</td>
<td>Response</td>
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<td>-------------------------------------------------------------------------</td>
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<tr>
<td>What do you think I am going to ask you to do next?</td>
<td>(M.Y.) I think we are going to do one fourths.</td>
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<tr>
<td>What fraction is one of these 4 parts?</td>
<td>(K.G.) One fourth.</td>
<td></td>
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<tr>
<td>(J.C.) One quarter</td>
<td></td>
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<tr>
<td>Are the samples I have up here different or are they all equally split</td>
<td>(M.J.) The first paper, the one on the bottom and the one on the top are bigger than the</td>
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<tr>
<td>into fourths?</td>
<td>sides. So they are not all exactly equal.</td>
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<td>(J.A.) First I folded it into one half. Then, I folded it into 4ths,</td>
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<td>one more time to get 8 pieces.</td>
<td></td>
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<td>How would I split this piece that is in 3 parts, into 6 parts?</td>
<td>(J.A.) I could fold it another 3 times.</td>
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<tr>
<td>(M.Y.) You could fold it in half one way then fold it in half again.</td>
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___ What ___ probing
___ Why ___ leading
___ How ___ telling
___ Tell me
___ Real life example

___ What ___ probing
___ Why ___ leading
___ How ___ telling
___ Tell me
___ Real life example

___ What ___ probing
___ Why ___ leading
___ How ___ telling
___ Tell me
Date: March 19, 2008

Lesson: Fair/Unfair Spinners---Probability

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<tr>
<th>Question</th>
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<th>Question Type (Check all that apply)</th>
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<tbody>
<tr>
<td>What did we discover once we placed our strips on the board yesterday?</td>
<td>(H.Y.) Three was more likely to win yesterday. (I.K.) Because sometimes you spin different or faster than your friend and can get a different number than that person.</td>
<td>✅ How</td>
</tr>
<tr>
<td>How come 3 did not win for everyone if it was the number that was more likely to occur on yesterday’s spinner?</td>
<td>(C.B.) I think the games will go longer because the spots on the spinner are even.</td>
<td><strong>Tell Me</strong></td>
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<tr>
<td>Tell me what you think will happen with this spinner today? (fair spinner)</td>
<td></td>
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<tr>
<td>Are any of the numbers more or less likely for the spinner to land on?</td>
<td>(M.S.) I think it matters where you start your spinner. (G.B.) There are about even amounts in each column 1, 2 and 3.</td>
<td>✅ Notice</td>
</tr>
<tr>
<td>Do you notice anything about these strips taped up today that is different from yesterday?</td>
<td>(N.E.) They all have 7 strips in them. (I.H.) There were more strips on 3 yesterday and today there are more strips on 1.</td>
<td>✅ Notice</td>
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<td>Question</td>
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<tr>
<td>Does anybody have a suggestion on how we can show this data in a</td>
<td>(L.K.) Maybe a tally chart.</td>
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<td>different way that would be easier to see/read?</td>
<td>(M.G.) We could line them all up to see them better.</td>
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<td>What are we trying to show on our line plot?</td>
<td>(M.Y.) We are trying to show what the lines mean.</td>
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<td>Where should the 1-2-3 go on the graph, the X or Y axis?</td>
<td>(N.E.) They should go on the X axis because you can put the x's on top</td>
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<td>of the 1, on top of the 2 and on top of the 3.</td>
<td>of the 1, on top of the 2 and on top of the 3.</td>
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<tr>
<td>What should the Y axis be called?</td>
<td>(L.K.) It shows how many people won.</td>
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<tr>
<td>Tell me something you notice about the line plot since we played</td>
<td>(H.Y.) It is basically the opposite of what we had last time.</td>
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<td>this game? Tell me about the class data?</td>
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<td>Do all three if the sections on today's spinner have an equal</td>
<td>(L.W.) each one of these numbers is one-third of the spinner, so yes.</td>
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<td>chance of winning?</td>
<td>(S.M.) They look different and 3 is bigger in the other.</td>
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<td>How is today's spinner different from yesterday's spinner?</td>
<td>(J.F.) I think everyone's names should only be put in once because if</td>
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<td>If we had a raffle, should I put my name in 25 times and the rest of</td>
<td>your name goes in 25</td>
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<td>your names are put in</td>
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<td>once?</td>
<td>times and ours only goes in once, then you have a much more likely chance of winning.</td>
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|       | __ Why __ leading
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|       | __ Tell me
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|       | __ What __ probing
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|       | __ What __ probing
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|       | __ How
|       | __ Tell me
|       | __ Real life example
Read the story to your students. They might act out the story as you read it.

Tip for the Linguistically Diverse Classroom  If you are using the book *How Big Is a Foot?*, be sure to show the pictures as you read it. If you are reading “The King’s Foot” aloud, having students enact the story will help make it comprehensible to students with limited English proficiency. Simple props (a king’s crown, a yarn mane for the pony, a carpenter’s hammer, an area marked off for the horse’s stall) will also help.

The King’s Foot

Once upon a time there was a king who kept ponies. His daughter, the princess, had a little pony of her own that she dearly loved. As the princess grew older she grew bigger, but the pony did not. The day came when she climbed on her pony and her feet dragged on the ground. That was the day the king decided that he would surprise his daughter with a beautiful new full-size horse.

The king went to the best stable in the kingdom and chose a sleek Arabian mare. “Because it’s a surprise,” the king said, “I want to leave the mare here at your stable until I can get a new stall built in the royal barns to fit such a grand, large horse.”

The king knew that he would have to tell the royal carpenter how large to make the stall. So, using heel-to-toe baby steps, the king carefully walked around the mare, imagining how big the stall for this beautiful horse should be.

“... 5, 6, 7, 8, 9 feet long,” he murmured, “and 3, 4, 5 feet wide. I will tell the royal carpenter to build a stall that is 9 feet long and 5 feet wide.”

*Continued on next page*
The king jotted down the numbers: 9 feet long and 5 feet wide. The message was sent to the carpenter, and she set to work at once.

Soon the stall was ready and the king sent for the mare. He thought he would have a little fun with the princess, so he had the royal groom hide the mare behind the barn. Then he said to the princess, "Come with me and see if you can guess your surprise."

Together they walked into the royal barn, past all the stalls of little ponies. They stopped in front of the empty new stall. But no sooner had the princess inspected the new stall than she burst into tears.

"I truly hoped that my surprise would be a horse, because I have outgrown my little pony. But now that I see the size of the stall, I know that you are just giving me another little pony, no larger than the first."

The king was puzzled. He saw that indeed, the new stall was much too small for a full-size horse. The groom quickly brought the new Arabian mare out of hiding, and as soon as the princess laid eyes on her, she forgot her tears. Only the king did not forget. He called angrily for the royal carpenter to account for her terrible mistake.

The carpenter was shocked. She knew she was good at her trade; her work always drew high praise. And she had made the stall just as the king had said—9 feet long and 5 feet wide. She had been very careful to use heel-to-toe baby steps, 9 feet long and 5 feet wide, when she measured the size of the stall. What could have happened?

[At this point in the story, pause so that students can do the assessment task. See Introducing the Assessment Task (p. 31).]

The carpenter stared sadly at her work. She paced thoughtfully around the little stall, carefully counting her foot-lengths. Then she sat down beside the king to think, staring at her feet.

That was when the carpenter noticed something—when she saw the king's foot next to hers. "That's it!" she cried. "Your foot is much longer than mine! I made the stall 9 feet long, but I used 9 of my feet instead of 9 king's feet."

Then the carpenter had a truly remarkable idea. She took a flat stick of wood, and she cut it just exactly the same length as the king's foot. "This way," she told the king, "I can always know exactly how big you want things made."

Now the carpenter made a stall for the new horse that was 9 king's feet long and 5 king's feet wide. This time the stall fit perfectly. So the king was happy, and the princess was happy, and the carpenter was happiest of all. She started a factory and made lots of sticks just as long as the king's foot, which she called rulers. Selling these sticks, she became rich and famous.
The King’s Foot

The carpenter made a new stall for the king, but it was too small to fit the new horse for the princess. Write a letter to the carpenter. Your letter should answer these questions:

Why did the stall end up too small for the new horse?

What could the carpenter do to correct her mistake?

Also make a diagram or picture to show why the stall was too small.

```
Dear carpenter, the new horse is big, the stall is too small, it cannot fit the new horse. The carpenter the king's foot 9 feet long 5 feet wide so make the stall 9 feet long 5 feet wide. From your friend, Ishtiaq.
```

Diagram or picture:
The King’s Foot

The carpenter made a new stall for the king, but it was too small to fit the new horse for the princess. Write a letter to the carpenter. Your letter should answer these questions:

Why did the stall end up too small for the new horse?

What could the carpenter do to correct her mistake?

Also make a diagram or picture to show why the stall was too small.

Dear Mrs. Carpenter,

Your stall was too small because your feet might be smaller than the king’s feet. So when you measured it, it was only 8 feet long and 9 feet wide. It became smaller. You could have a mold of the king’s foot and use that to measure.

Diagram or picture:

[Diagram of king’s foot and carpenter’s foot]
Appendix K

Spinner Fun!

Answer the following questions.

1. It is your lucky day! I am going to pick certain people in our class to win prizes. In order to choose winners I am going to use a spinner. Instead of having numbers on the spinner I will have everyone’s names in the spaces. How could I make this spinner fair?

   You could make 2 lines in the circle.

   How would the lines be?

2. You are in charge of making a spinner with four numbers/spaces on it. Draw a spinner that would be fair and draw a spinner that would be unfair.
Different-Shaped Pieces

Here is a picture of a brownie cut into four pieces:

Some people think these are not fair shares. Write what you believe.

I believe that the rectangle pieces and the triangle pieces are the same size because if you took the top off the triangles and put it at the bottom it would look exactly like the rectangles.
Appendix M

Amanda Kameny
Observation Journal
March 7, 2008

This week I began teaching math for my inquiry study. I am focusing my study on differentiating instruction in the math classroom to meet the needs of all students. I am trying to focus my study on different methods and strategies to meet the needs of the math students that are “lower achieving”. Originally I had many different ideas to implement in the classroom in order to assist the needs of these students. One idea I thought of was to examine the questions that I ask during math class, and to analyze which types of questions will be easier for the “lower achieving” students to understand. I have made different categories of questions such as probing, leading, how, why, tell me, and real life questions. I want to analyze which of these types of questions receive the most detailed and accurate responses from students.

This week as I was teaching I noticed that one of the main problems is not necessarily the type of question I ask, but whom I ask the questions too. As a teacher it is easy to fall into the trap of calling on the “safe” students. What I mean by this is that there are some students who are constantly raising their hands and can give the correct response. Sometimes I think it is tempting to call on these students because you know they will keep the class moving smoothly and at a quick pace. I think with calling on students who may not have their hand raised leaves the possibility for the student to be confused or not understand the concept. It is at this point where a teacher will have to improvise and help the child. Often it is simpler to ignore the needs of these students because of the fear of not knowing exactly how to help a “weaker” student understand the
material. Although it is important to call on a variety of students, it is probably the most important to call on the students without their hands rose.

I believe if teachers confront their fear of not knowing how to help and address the students who remain silent when asked questions, they will make the biggest changes in their classroom. Even if a “weaker” student is stuck on a concept when called on, the teacher will at least know what the particular student is struggling with. It is at this point where the “stronger” students in the class can be called on to try and explain and clear up the misconceptions that the others may have.

By only addressing the “safe” students there will be little progress in the classroom. The fear of having to explain a concept is one that needs to be eliminated. Teachers are often seen having the mindset of a fast paced classroom, but sometimes it is better to just slow down and work through the problems that even your “weakest” student may have.

Now that I have made this observation I would like to tweak my inquiry study data. I still want to examine which types of questions are the most effective in having students explain themselves during math class, but I also would like to take note of how often I call on the students who are struggling in math class. I wonder if I increase the frequency of calling on these students, will it affect the understanding of the “weaker” math students? In turn I need to make sure that by calling more on the “weaker” students, the “stronger” math students are not becoming frustrated with the pace and being negatively impacted.

It is a difficult balance to have in the classroom during math instruction. The students levels vary greatly but it is imperative for teachers to examine their own teaching
practice to better the students’ instruction. Once a teacher can identify their own flaws in teaching and differentiate depending on their students’ needs, there will be better understanding within the math classroom.
Appendix N

INQUIRY BRIEF

Context

I teach in a third grade classroom at Park Forest Elementary School in State College, Pennsylvania. The class is made up of twenty-four students, half of which are boys and half are girls. Within the math classroom, there is a large range of abilities. There is a group of five-seven higher achieving students are actively involved in school, hard working, and motivated. Although these students are excelling in math instruction, the majority of higher achieving math students are males whom have some difficulty being leaders in the classroom and staying on task. The lower achieving math students are often found off task during math class, most likely because the material presented in the lessons, as well as, the directions during the lessons are unclear and too difficult. Many of these lower achieving students lack the ability to even count past one hundred or count by tens up to and past one hundred. During math instruction there is one Para professional in the classroom to assist with one particular student. One student in the class is an ESL student. Five students in the class see the school counselor for issues regarding social behavior or family support.

Rationale

All year I have contemplated the effectiveness of my own math instruction, as well as my mentors teaching of mathematics. In every district there is a set curriculum and State College has chosen to support Investigations, a more conceptually based approach to math instruction. There is a constant battle as to whether this conceptually based curriculum is more or less effective then the traditional algorithm based math instruction. There has been much research in support of Investigations and the lasting impact on students’ math base, but others still argue that this curriculum is missing a large piece of the efficient math teaching that we are used to from our own youth. Regardless of which curriculum is better or worse for math instruction, there is a “felt difficulty” that I have noticed during math instruction. Although some students receive title I instruction during math, there is still an overwhelming ability range within our third
Differentiated instruction is necessary during all subjects of instruction but with such a quick paced and conceptual curriculum, I feel as though some students are being left behind.

Looking at math instruction from a teaching perspective, I have always been interested in math and someone who math has come easily to, I find it relatively simple to add challenges and extensions in my lessons. My biggest concern is for the lower achieving math students within the third grade class. Now that the concepts have gotten more difficult, measurement and subtraction for example, those lower achieving students are being left behind. Often they spend math class looking out the window or writing down any number they know just to look like they have written something down. I believe that these students do not always understand the instructions, lack the basic facts to complete this level of math, or just do not understand the conceptual nature of the material. Often times I find myself running from desk to desk trying to assist these students but logistically there is not enough time to sit with each of these students and help them through the lesson. Due to these factors, I find that I just barely reach these struggling math students. I think a different seat arrangement, different questioning and instructions, as well as, the use of different manipulatives could make a large difference in helping these students to understand the math lessons within the larger third grade instructional group.

Wondering

Can you differentiate in a third grade math classroom in order to accommodate to the wide range of needs, in particular, the lower achieving math students.

Sub Questions:
Will grouping the lower students in one table set assist management and instruction within the math classroom.

What types of questioning during a math lesson will help lower achieving students understand the math concepts better?

Do lower achieving math students benefit from the use of a variety of manipulatives?

If you are trying to help the lower achieving students, what are ways that the other students can be challenged during the same lessons?
Projected Timeline

FEBRUARY

14, 15, 18, 19 Baseline data collection: Wednesday/Thursday- collect student work from the “King’s Feet” lesson

20, 21, 22 Interview lower ability math students, which way do they like to learn math the best, asking a question in multiple ways

20, 21, 22 Journal and Student survey to collect the baseline data and put students into ability groups

25-29 Takes notes on the types of questions I ask during instruction, takes checklist on student progress and understanding during and after lessons, introduce different manipulatives for lower achieving students

MARCH

3-7 Continue questioning, add multiple manipulatives into instruction, survey students

10-14 Group students differently around the room during math instruction, journal, checklist, collect student work

17-21 Keep lower achieving students in a focus group

24-28 End of project survey and data collection, final student interviews asking about understanding and math learning preferences

APRIL

DATA ANALYSIS

Data Collection Ideas

1. homework/assessment
   -in class v. out of class
2. seating arrangements
   -ability grouping v. not ability grouping
3. how do I question students? Multiple entry points?
-checklist for all types of questions I ask during a lesson
  -leading, probing, connections to real life, how, why, what
  -In turn I need to see how students respond to the different types of questions
4. different use of manipulatives for different groups
  -money, cubes
5. centers- similar to choice time but aimed to target the lower achieving students’ issues with basic skills and numbers
6. interview students
  -ask the lower achieving students the same question in all different ways (conceptual, procedural, real life word problem), also ask them which ways they prefer to learn math
7. PROCESS v PRODUCT
  See how different teaching strategies effect student learning (journaling)
  -document growth- collect student work
8. checklists during class monitoring student progress and understanding (do they understand the directions? The concepts?)
Appendix O

Amanda Iachini
Inquiry Brief
February 27, 2008

CONTEXT

Corl Street Elementary School is located in State College, PA. State College is home to a major university. Many students who live in State College have parents that either work for the university or attend the university as graduate students. Education is a major focus in this location. Many of the students come to school prepared and eager to learn. Corl Street is one of the smaller elementary schools in the district. Kindergarten through fifth grade is located in the building, each grade consisting of two classrooms. Many students live in neighborhoods with their peers and are close enough to the school building that they can walk to school each day. It is likely that most of these students will complete their entire elementary and secondary education together. This inquiry will be conducted with third grade students. Each third grade class has less than 20 students in each classroom. The two classes are regrouped for math instruction. Students who learn math concepts quickly and with less support from the teacher are in one math teacher’s group. The second class, which will be the focus of this inquiry, moves at a slower pace and with more support from the other third grade teacher. There are 11 students in this math class. The students work with manipulatives to make the class more hands-on. As an introduction to class everyday, students are given several warm-up problems. Problems range in difficulty and concepts. They review material that was covered in past units and introduce students to new concepts that will be covered in future units. After the warm-up, students are either introduced to new material or continue working on a concept relating to the unit of study.
This group of students is instructed through a reformed mathematics approach called *Investigations in Number, Data, and Space*. Math instruction occurs five days a week lasting 50 minutes to an hour each day. There are usually three adults in the room during math class: classroom teacher, intern, and special education paraprofessional. Because there are eleven students in the room with three adults, students often receive immediate feedback and support.

**RATIONALE**

Throughout my education, math has always been one of my favorite subjects. In my school experience, my peers either loved math or hated it. There never seemed to be students who were “in the middle”. It was always interesting to me that we all started out in the same math classes in elementary school and continued to be in the same classes in junior high. I began wondering what happened between elementary school and high school that caused the divide in attitudes towards math. I was interested in researching my own students to see what they like and dislike about our math class. Because of this wondering, I decided to focus my inquiry on math. I began my inquiry by developing and conducting a survey to find out how my students were feeling about math and what they liked about it. From this survey, I found that seventy-three percent of the students said that they were excellent math students. This is interesting because several of these students do not always portray confidence in math. I am interested in researching this more with my students to see if they consistently feel this way about math. Another finding illustrated that many students like multiplication and division, but worry about subtraction. This grabbed my attention because students usually, in my experience, become comfortable with
addition and subtraction before they are comfortable with multiplication and division.

Likewise, about half of my students communicated that they do not ask for help when they do not understand something in math. This can become very frustrating for the student because math builds on itself. This finding made me wonder how I can really know what my students understand in math. What can I do to help my students communicate more in math class?

**MAIN WONDERING**

**How can I be aware of what my students actually understand and learn in math?**

**SUB-QUESTIONS**

- How do I help my students communicate more in math class?
- How can I help students to explain their thoughts about math?
- Will math journals help students think more about math while showing me what they understand?
- How can I use math journals to assess student understanding?
- Why don’t students ask for help when adults are nearby?
- How do you keep accurate and useful diagnostic records of each student’s math strengths and needs?
- How does a student’s confidence and interest level affect his/her performance in math?
- What can I do to boost interest among students?
- Will peer tutoring help students develop their thinking because they have to explain it to another student?

**TIMELINE**

<table>
<thead>
<tr>
<th>Date</th>
<th>Plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/11</td>
<td>Brainstorm inquiry topics and how they would fit into my classroom</td>
</tr>
<tr>
<td>1/12</td>
<td>Research literature on music &amp; management and math understanding</td>
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<tr>
<td>1/13</td>
<td></td>
</tr>
<tr>
<td>1/14</td>
<td>Write first inquiry update</td>
</tr>
<tr>
<td>1/16</td>
<td>Attend inquiry seminar</td>
</tr>
<tr>
<td></td>
<td>Read Dana and Silva Chapter 1</td>
</tr>
<tr>
<td>Date</td>
<td>Activities</td>
</tr>
<tr>
<td>--------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 1/23   | Attend inquiry seminar  
Attend inquiry seminar- means of finding resources for inquiry |
|        | Discuss inquiry main wonderings with PDAs and peers  
Research resources  
Read Dana and Silva Chapter 2 |
| 1/26   | Develop main wondering  
Develop survey questions for both math classes  
Research past inquiries  
Research resources |
| 1/27   | Research past inquiries  
Research resources |
| 1/28   | Write second inquiry update |
| 1/29   | Write third inquiry update |
| 1/30   | Attend inquiry seminar |
| 2/2    | Write third inquiry update |
| 2/4    | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/5    | Revise survey  
Research materials for annotated bibliography  
Work on Inquiry Brief |
| 2/6    | Read Dana and Silva Chapter 2 |
| 2/7    | Develop main wondering  
Develop survey questions for both math classes  
Research past inquiries  
Research resources |
| 2/8    | Administer survey to two third grade math classes |
| 2/9    | Compile survey data  
Organize note cards for each student to keep diagnostic information/ record some information from survey |
| 2/10   | Research past inquiries  
Research resources |
| 2/11   | Write reflection on survey findings  
Inquiry Brief draft due |
| 2/12   | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/13   | Revise survey  
Research materials for annotated bibliography  
Work on Inquiry Brief |
| 2/14   | Read Dana and Silva Chapter 2 |
| 2/15   | Develop main wondering  
Develop survey questions for both math classes  
Research past inquiries  
Research resources |
| 2/16   | Administer survey to two third grade math classes |
| 2/17   | Compile survey data  
Organize note cards for each student to keep diagnostic information/ record some information from survey |
| 2/18   | Write reflection on inquiry project and narrowing down wondering |
| 2/19   | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/20   | Revise inquiry brief |
| 2/21   | Final Inquiry brief due  
Attend inquiry seminar- data analysis/ claims and evidence |
| 2/22   | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/23   | Revise inquiry brief |
| 2/24   | Final Inquiry brief due  
Attend inquiry seminar- data analysis/ claims and evidence |
| 2/25   | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/26   | Final Inquiry brief due  
Attend inquiry seminar- data analysis/ claims and evidence |
| 2/27   | Conference about wonderings with Paije and Lynne  
Conference about survey with Paije and Lynne  
Attend inquiry seminar-work with other students researching similar topics |
| 2/28   | Final Inquiry brief due  
Attend inquiry seminar- data analysis/ claims and evidence |
| 3/3    | Introduce math journals/ short writing activity  
Take diagnostic notes on students during math class (note cards) |
| 3/4    | Attend after school math club (students write a math problem in journals??)  
Take diagnostic notes on students during math class (note cards) |
| 3/5    | Attend after school math club (students write a math problem in journals??)  
Take diagnostic notes on students during math class (note cards) |
| 3/6    | Students write in math journals  
Take diagnostic notes on students during math class (note cards) |
| 3/7    | Interview teachers/CSTs  
Students write in math journals (math problem) |
| 3/8    | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/9    | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/10   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/11   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/12   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/13   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/14   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/15   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/16   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/17   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/18   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/19   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/20   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/21   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/22   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/23   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/24   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/25   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/26   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/27   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/28   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/29   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
| 3/30   | Attend Inquiry seminar- Data Analysis Part 2 & Writing up your Inquiry Results/  
Writing mechanics |
DATA COLLECTION IDEAS

- Survey of students: gather information about how students feel about math and themselves as math students
- Keep organized note cards for each student
- Math journals: track how the students are feeling about math and what they are understanding

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/20</td>
<td>Interview students</td>
</tr>
<tr>
<td></td>
<td>Students write in math journals</td>
</tr>
<tr>
<td>3/24-3/28</td>
<td>Compile information and analyze data from student interviews</td>
</tr>
<tr>
<td></td>
<td>Attend after school math club</td>
</tr>
<tr>
<td></td>
<td>Students write math problems and responses in their math journals</td>
</tr>
<tr>
<td>3/29</td>
<td>Compile information from math journals</td>
</tr>
<tr>
<td>3/30</td>
<td>Meet with Amanda to begin writing paper, Analyze data</td>
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<tr>
<td>3/31-4/4</td>
<td>Attend after school math club</td>
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<tr>
<td></td>
<td>Class meeting</td>
</tr>
<tr>
<td>4/6</td>
<td>Meet with Amanda to analyze data and continue writing paper and</td>
</tr>
<tr>
<td>4/8-4/9</td>
<td>Meet Amanda to finish draft</td>
</tr>
<tr>
<td>4/10</td>
<td>Scan all appendices into paper</td>
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<tr>
<td>4/12</td>
<td>Inquiry paper draft due</td>
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<tr>
<td>4/16</td>
<td>Attend Inquiry seminar- Peer editing inquiry papers &amp; Tips for Inquiry Presentations</td>
</tr>
<tr>
<td>4/21-4/25</td>
<td>Practice presentation</td>
</tr>
<tr>
<td>4/26</td>
<td>Inquiry Conference at PFE</td>
</tr>
</tbody>
</table>
Appendix P

Inquiry Annotated Bibliography


- Mastering the basic number system is a problem that I see my students have during math instruction and leads to many problems when trying to teach students higher and more complex math problems and concepts. This particular article is very easy to read and has a layout that is conducive to analyzing one's own students in mathematics. Baroody does an excellent job giving concrete examples of children struggling with the number system for a means for myself to assess my own students. Further the article outlines why students would have difficulties with the basic number system, and more importantly, how to tackle these issues during mathematics instruction. The suggestions that are given of how to help students, correlate directly with why the student may be having difficulties with the number system and will help in assisting my own struggling students.


- This article addresses the National Council Of Teachers of Mathematics (NCTM) standards and how they can be met. It gives information about how best to engage students in meaningful math. This report is helpful to me because it explains how teachers can get their students involved and excited about math. It suggests ways in which teachers can assess a student’s interest and intellect in math class.


- This report addresses a new curriculum that focuses on the abilities of students from kindergarten through sixth grade. The program supports students' understanding of key math concepts and skills and covers a range of mathematical content. The curriculum focuses on questioning strategies, problem-solving skills, embedded assessment, and exercises tailored to students of different ability levels. This helps with my inquiry because I am wondering how to ask questions to get students to express their
understandings in math. Also, this program addresses differentiated instruction.


- *Making Sense* is a helpful resource for teacher knowledge in elementary math instruction. As opposed to many math resources, this book covers math issues and gives an overview of math instruction in a variety of settings, for example a conceptual classroom, a cognitively guided classroom, or a Latino classroom. This book is very interesting for my inquiry because it offers insight into what the teachers’ role is in teaching math, via questioning and instruction (my biggest concerns), rather than just providing examples of student activities. Throughout the book there are real student examples, which I will be able to use for comparison to the students in my own classroom.


- Heid, Zbiek, and Edwards do an excellent job in this article explaining the importance of student interviews and gathering data on student preference and learning style prior to teaching mathematics. Many teachers overlook the importance of student needs and preferences but it is necessary to assess students before the teaching even begins. This article focuses in on one specific project, but also offers general ideas and suggestions for interviewing students to inquire about their math abilities and learning styles. In my own inquiry, the interviews will directly impact the expectations for my students, as well as, the strategies and questions I use during teaching.


- This article is very useful if you are trying to examine what types of questions to ask your students, in particular when teaching mathematics. In a conceptually based math classroom it is hard to find the right questions to move from figuring out if students understand material from the moment of instruction to finding out whether your students truly understand the concepts being addressed during instruction. This article explains the importance of questions and offers information on how to better question your students during math instructional time. This is the exact problem I want to confront in my own teaching.
• This is a very comprehensive and useful resource when looking at the problems within your own elementary math classroom. This book addresses the concerns across America with math instruction and the research that politicians and math experts have done dealing with elementary math education. This book also has specific sections pertaining to specific math skills and issues, for example whole numbers. During mine own inquiry, I can use specific sections of this book to find information on how to teach certain math topics.


• The article describes objectives for teaching future teachers to teach math at different grade levels. The article explains that a teacher’s own feelings about math can strongly affect students’ feelings/attitudes toward math. After reading this source, I began wondering how a teacher’s attitude toward math could affect a student’s feelings about math. This article will help me to understand how I can behave in a way that will allow my students to be eager and interested in math. This article also gives questioning strategies.


• *On the Shoulder of Giants* is a very complex and deep look into five different math concepts. Although the majority of the concepts are difficult to apply directly to an elementary classroom, it does give insight for teachers as to why mathematics instruction is moving away from what most of us are traditionally used to. The essays explore delving into the conceptual nature of math, and the book argues for why math instruction should move toward a conceptual approach. I have always thought that conceptual math is difficult for all students to learn from but this book provides the justification for this type of teaching.


• This book is designed to help teachers better understand problem-solving instruction. It gives information on how to help students understand the problem-solving process. It also gives information on how to teach specific strategies. This source will help me develop ways to help students understand math better if my findings show me that students are not understanding math
with our current methods. It suggests different strategies to use to help your students understand new math concepts.


- This article addresses components of self-determination in young math learners. It explains how goal setting can affect the attitudes and skills of students. After reading this article, I began wondering if having my students set goals in math would help them to be consistently successful. If students had the goal of asking for help when they don’t understand something, would they be more successful in math? This article describes ways to use goals to promote success and positive attitudes in math.


- This article interviewed over 200 hundred students to gather information about what they understood in math. The surveys also gave information about the students’ perceptions about math. The authors then make generalizations about the different types of teaching styles each of the teachers possessed. This article will help with my inquiry because it discussed the effectiveness of the different teaching strategies with different types of students. It also explains what strategies can be used to increase meaningful social interaction with other students and the teacher.


- This paper explores the use of pen pal letters to allow students to communicate about math. The students wrote to college students taking a math methods course. Teachers used the letters to gain information about the students’ understandings in math. This information was valuable to the classroom teacher and the students taking the college course. This is useful for my inquiry because it gives me another idea to get my students to communicate about math. I’m not sure that I would like to try pen pal letters for math class, but it gives useful ideas about what students can be writing about.

- This book includes narratives from 48 teachers. The teachers in the book discuss changing social needs in the classroom. They describe the social needs of students in a math class. One of the narratives specifically addresses the “challenge of reflective practice” in a math class. This will help with my inquiry because I want to know what my students understand in math. This book gives strategies for getting your students to communicate more in math class. It also explains how to get your students to reflect on what they are learning and understanding in math.


- This article gives insight into how one question can be asked multiple ways. It addresses the responses from students in numerous grade levels, and offers interesting information as to how students can respond differently if given multiple entry points for one question. I will use this for my inquiry when interviewing students. Part of my own inquiry is, which way will lower achieving math students understand questions that best? This article will help me to organize my interview questions and find out the learning styles that fit my students the best.


- This article discusses how students feel about math in comparison with social studies. It addresses student’s confidence levels between the two subjects. It explains what students feel are the positives and negatives in both subjects along with their likes and dislikes. This article will help with my inquiry because it will allow me to compare my findings with another person’s findings. It gives information about the things students enjoy in class; therefore, giving me ideas that I can try in my own class.


- This article is a comprehensive resource in terms of differentiating instruction in math. It offers a reason for differences in student learning based on four different learning styles. Not only does this article give example of student work but it offers suggestions on how to compensate for the variety of
learning styles, specifically during math instruction. Although a bulk of this article is dedicated to an example using a unit on teaching division, it offers ways to differentiate in all different math areas, and even gives examples of surveys, which I can modify, that would be helpful to give students and questions to ask them to better your own math instruction.


- This text book is a must have resource for teaching students mathematics whether you are teaching in a school district with a conceptual based or traditional mathematics curriculum. The Van De Walle Text offers information on how to teach students of all different levels and grades mathematics. Van De Walle compiles a large amount of activities to use when teaching students specific math skills and additionally, it gives teachers new ideas on how to use manipulatives in the classroom. I will use these suggestions to try to vary my math teaching and reach my students in multiple ways.

- Van De Walle’s book describes ways in which students can make sense of math through their own thinking. The book describes ways that teachers can help their students through reformed mathematics. It informs teachers how they can introduce math in a way that allows students to explore and develop their own understandings about math. This book will help with my inquiry because it describes strategies that I can use with my students. It describes ways that teachers can communicate with their students and explains ways that math journals can be implemented.


- This article pertains to the students within an elementary class that naturally understand the concepts being addressed during math, and tend to work ahead of the majority of students. Often teachers are neglecting the needs of these students who fall behind. This article offers suggestions of alternate activities to enrich the gifted math students during class. Since my inquiry focuses on differentiation, but mostly on the lower achieving students, it is still important to keep in mind the needs of all students in the classroom. This article outlines the importance of meeting the needs of gifted students and offers solutions on how to integrate this instruction within the everyday math lessons.