I'm a new Teacher, How can I Effectively Teach Math Conceptually?

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May 7, 2005

Background Information

Teaching Context:

For the past year, I have been fortunate enough to work in a self contained first grade classroom of Ms. Sabrina Upcraft at Panorama Village Elementary School in the State College Area School District. In my classroom we have 18 students; 11 boys and 7 girls. Being a member of the PDS program and having the opportunity to spend an entire year in one classroom has afforded me the time to grow and develop myself into an effective teacher. Over the past year I believe that my first graders have taught me just as much if not more than I have taught them.

My Classroom and Students: Overall, my class of first graders is an average, typical first grade class. Reading is a big focus and my class has a wide range of reading abilities. There are students who are below grade level and are still struggling with phonemic awareness and there are also students who are above grade level reading chapter books. A majority of the students in the class are naturally inquisitive and are constantly asking questions. Sometimes these questions are meant to further their learning and understanding of a topic, sometimes they are just to waste time; nothing unusual for a group of 6 and 7 year olds.

The School District: The State College Area School District made the decision to pilot Investigations in Number, Data, and Space. This unit of study is published by Dale Seymour Publications. The resources in this unit focus on students developing a conceptual understanding of mathematical topics. Through a variety of activities and experiences with a topic, students begin to understand the reasoning behind the math process, not just the procedure and answer itself. While my mentor teacher has used the Investigations Resource for years in her classroom, this was the first year a district wide initiative was taken to include the resources as standard first grade curriculum.

The Resource: It was not until the fall of my internship, during MATHED 420, Mathematics Education, that I was introduced to the idea of teaching mathematics conceptually. I was very pleased when I realized that the mathematics teaching in my classroom coincided with my methods course. By using the Investigations resource, students are presented with the opportunity to develop an understanding of mathematical processes and how they apply to

different situations. Once students have an understanding of the processes and the reasoning behind them, they are able to apply them to a variety of situations. Investigations has been a wonderful resource to use, especially as a new teacher. Investigations is a unit comprised of a series of resource books. Each book nicely outlines the mathematical concepts addressed through the activities in the book. Investigations plans out each lesson for the teacher in what are referred to as "sessions." For each session the book provides a list of key concepts addressed, materials needed, questions to use during the lesson, and even a sample dialogue box so the teacher can anticipate how the lesson may pan out in their classroom. The books also offer suggestions for homework, extensions, or adaptations for those students who may need them. It has helped me as a first year teacher to know exactly what I want my students to take away from a lesson and how to help them achieve just that. By using Investigations I have been able to spend less time creating and planning a math lesson and more time focusing on how to help my students achieve the highest level of understanding possible for each topic.

What Led to My Questions?

As a child in elementary school I was taught math through a very traditional approach. My teacher introduced a new topic, such a addition, explained the process for adding numbers together, and then gave the class opportunities to practice this process, usually in the form of worksheets. The type of worksheet varied by the format of the question; there were story problems or number sentences. But, every worksheet had the same goal; can the student add numbers together and get the correct sum? Emphasis was never placed on whether or not I understand why I was adding the two numbers together or what really happens when I have to carry a number from the ones to the tens place. When I began my MATHED course in the fall and was introduced to the idea of teaching math to build conceptual understandings in students I was blown away. I thought to myself, "Why didn't anyone teach me math this way?" I can add, subtract, multiply, and divide, but I never knew the reasoning behind each. I began to think maybe this lack of understanding was why I never excelled in math as a child or even really liked the subject. I believed that this was a great way to teach math and that the students would benefit greatly from understanding the reasons behind all those complicated math procedures.

Then, I started to get nervous. Yes, I thought this was a great way to teach math to children, but I had never experienced it before. If I do not have a conceptual understanding of these topics how do I expect my students to? That is when I realized that first I need to completely understand a topic before I can expect the same of my students, which ultimately led to the question of how I

can effectively teach math so that students develop a conceptual understanding of a topic. As the year progressed I began to take on more and more teaching responsibilities. Then, the time came for me to take over math. We were just about to start our next unit in Investigations, Quilt Squares and Block Towns. This unit focuses on introducing students to geometry and geometrical concepts. What better time than this to develop my ability to help students create conceptual understandings in math?

Literature and Experts:

Experienced Classroom Teachers: My mentor teacher and my PDA (student teaching supervisor) were invaluable assets to my inquiry process. Both of these women helped in two different ways. My mentor was able to give me advice from her own first hand experience with teaching math conceptually and using the Investigations resource. My PDA was able to step back and observe my lessons, allowing her to often notice reactions, struggles, and the thinking of my students that I may have missed while managing the entire class.

As I stated before, my teacher has been using the Investigations resource for years in her classroom. So, she was an excellent resource for me to use. My teacher and I often discussed how students develop conceptual understandings in math. No matter how our discussions began, more often than not they came back to one key point: allow the students to have multiple, meaningful experiences with a topic. While my mentor is an advocate of using Investigations, she believes that it is too easy to become caught up in the convenience of the program. Since the program is so well mapped out for teachers, she believes that it is easy for teachers to lose sight of the mathematical concepts each unit focuses on; a teacher does not have to have a conceptual understanding of a topic to implement Investigations. Therefore, when working with my mentor teacher she constantly reinforced in my mind that as the teacher I need to have an understanding of the topic before I can expect my students to develop an understanding. Also, when working with my teacher she has stressed the importance of making the necessary extensions for those students whose understanding is above what is expected in Investigations. She encourages the use of a variety of resources to meet the needs of all the students in the classroom. Supplementing the already conceptually based Investigations text allows for the further development of conceptual understandings.

Throughout the inquiry process my PDA has been essential to pushing my thinking and wonderings further and further. When discussing my math lessons with her she would constantly ask questions to help clarify my thoughts about how I felt the lesson went and how I was gauging my students' understandings.

By talking with my PDA I was able to reflect back on my lessons and determine what went well and what did not. Also, we compared our observations of the students. My PDA helped me to realize the value of questioning in aiding my students' conceptual understanding of a topic. By using effective questioning techniques I was able to get a better feel for how well my students grasped a topic and I was able to improve their understanding by encouraging them to look at a topic from another point of view. To build a conceptual understanding of a topic my PDA believed that I needed to afford all students the opportunity to interact with a topic in a variety of settings so that those students who are visual, auditory, or kinesthetic learners will all have their needs met.

John A. Van de Walle: John Van de Walle is the author of Elementary and Middle School Mathematics: Teaching Developmentally. According to Van de Walle, students understanding of math is a common goal for teachers. "The most widely accepted theory, known as constructivism, suggests that students must be active participants in the development of their own understandings." (Van de Wall 22) By realizing this fact, as educators, our instructional strategies begin to focus more on the students, rather than on ourselves, the teachers. The principles of constructivism are based on Piaget's processes of assimilation and accommodation. Assimilation occurs when an existing schema is used to give meaning to new experiences. When accommodation occurs existing ways of viewing something are altered because the experience or idea does not fit into existing schema. Van de Walle also states that "Mathematical ideas cannot be poured into a passive learner. Children must be mentally active for learning to take place." (Van de Walle 23) Therefore, students must be engaged in a topic if they are expected to build a conceptual understanding. When it comes to knowledge and understanding, these are two different things. According to Van de Walle, "knowledge is something we either have or don't have. Understanding is another matter." (Van de Walle 24) He goes on to use the example of multiplication. Many adults know the rote procedure to use to solve a multiplication problem. But, each adult views the problem in a different manner from the next and not all understand the implications of a problem such as 3 x 5. When students create an understanding the idea being learned becomes associated with other existing schema and a "meaningful network of concepts and procedures" is created. (Van de Walle 24) By encouraging students to create these networks of ideas there is less for students to remember. Traditional math is often viewed as the isolated knowledge of various procedures, rules, symbols, concepts, and skills. (Van de Walle 26). By teaching math in a way that students develop a conceptual understanding there is less for them to remember because skills and procedures are just a small part of a larger idea.

My Wondering:

How can I guide my class of diverse students to a conceptual understanding of a new math topic, specifically the geometry of 2-D and 3-D shapes?

Other Wonderings:

- How can I use questioning effectively to meet the needs of diverse learners?
- How can I clarify directions so that students have a clear understanding of what is expected?
- How can I make sure that pre-planned activities meet the needs of all the learners in my class and address their diversity?
- Which geometric principles are developmentally appropriate to teach to first grade students?

My Inquiry Plan

How I Carried out Inquiry in the Classroom

Using the Investigations Resource: As I stated before, when teaching math to my class of first graders both my mentor teacher and I have used the Investigations resource. As the time to choose inquiry topics approached, we were just wrapping up the Survey Questions and Secret Rules unit of Investigations and preparing to move into Quilt Squares and Block Towns. Since I always had questions about my ability to teach math so that students develop a conceptual understanding, I thought this was the perfect opportunity to explore that question. So, I took over full planning and teaching of the Quilt Squares and Block Towns unit.

In my opinion, the Investigations resource is an asset to any teacher, especially first year educators. The book does a wonderful job of identifying the key concepts the students will develop through completing these activities. It begins by describing the Investigations curriculum and the format of the book. It clearly describes the different parts of the book and how to utilize them. For example, the book describes what exactly to plan ahead, such as materials,

extensions for those students who may need them, parts of the lessons that could be omitted without "harming the integrity of the unit" (Russell i-3), tips for teachers with linguistically diverse classrooms, and how to establish classroom routines.

The book also lists classroom materials that will be needed through the unit, student worksheets (See Appendix A), which can be found in the back of the book, and homework (See Appendix B) that will be used to supplement students learning in class. The book also describes what assessment will be used to analyze students' understandings and how to interpret the assessments. Throughout the Investigations series assessment is embedded in the lessons through teacher checkpoints. These checkpoints offer teachers the opportunity to observe students and look for the understanding of particular concepts while students are completing various activities (See Appendix C).

Finally, the book offers an overview of the unit. This overview includes concepts addressed, a list of the sessions (lessons), what activities are utilized in each session, and the estimated duration of the session. The book describes the "Mathematics in this Unit," meaning what topic is being studied and as a teacher, what mathematical understandings I want my students to walk away from this unit with. Quilt Squares and Block Towns is broken up into 3 investigations; Investigation 1: 2-D Shapes and Patterns, Investigation 2: Comparing and Constructing 3-D Shapes, and Investigation 3: Building a Block Town. From there, the investigations are broken down into sessions, or lessons to teach. Each session focuses on a different aspect of the investigation it is a part of. For example, Investigation 1, Session 1 is titled "What Shapes do You See?" The main focus of the lesson is to have students examine what geometrical shapes they see in their everyday lives.

By using the investigations resource to teach I was able to spend more of my time concentrating of the mathematical concepts I wanted my students to develop and how I, as teacher, could support this development and less time on planning lessons and activities to elicit these understandings. To better prepare myself for each lesson, oftentimes I sat and wrote out my own lesson plan, even though the lessons were provided for me. In my lessons I included the key concepts I wanted my students to develop, the activities I would use to help create these understandings, focus questions I would ask students who were struggling with a particular concept and questions for students who had a strong understanding and were ready to take that understanding to the next level. I also included adaptations or extensions I felt were necessary for the students in my classroom (See Appendix D). It was important to me to use differentiated instruction so that all of the needs of my students were met when teaching this unit. By offering these extensions and adaptations I was able to make sure that my students were getting the most from each lesson and creating the conceptual understandings they were ready for.

Teaching: In my classroom, we taught from the Investigations three days a week; Monday, Wednesday, and Friday. On Tuesdays and Thursdays the students participated in math centers. When planning, I looked not only at the sequence of the lessons, but I tried to anticipate how quickly or slowly my students would develop an understanding based on the activities offered. Often times, I found when using Investigations, they plan for more time than is necessary with a given topic. Therefore, when I was planning I made adjustments to the pacing of the sessions based on my students understanding of a topic. If I felt as though my students needed more time with a particular activity to help further their conceptual understanding I extended the lesson. At the same time if the students quickly developed an understanding I made sure I was prepared to move onto the next activity. I taught the first session of Quilt Squares and Block Towns on January 17, 2005 and taught the last session on March 25, 2005. Before teaching each lesson I sat down and made sure I had a clear understanding in my head of the concepts I wanted students to develop a conceptual understanding of and how I thought the activities I used would help to create this understanding. I also thought through each lesson and how I thought my students would respond to the activities. I tried to anticipate any areas I felt they would have difficulty with, for example using geometric language such as rectangular and triangular prism while describing geoblocks. In my mind, I then thought through questions I could ask the students to help guide their understandings to the ones I wanted them to develop. Assessment of the students' understandings was done continually throughout the unit through use of observations (See Appendix C) and analysis of student work. While watching the students work and asking them to describe what they were thinking while working, I was able to tell who had an understanding of what they were doing and who did not.

Overall, I used the Investigations resource Quilt Squares and Block Towns to carry out my inquiry plan. I used the sequencing of lessons offered by the book and extended and adapted the lessons where I felt needed to better aide my students in developing a conceptual understanding of geometry.

How I Collected Data

My main form of data collection was student work (See Appendix E). Throughout the unit students completed a variety of activities, such as pattern block fill ins, drawing a 3-D object, and sorting geometric shapes into categories. I kept all of my students work from throughout the unit so that I could compare work from the beginning of the unit when they lacked a conceptual understanding of geometry to the end of the unit, when they were given ample time to develop these understandings.

I also collected data by using the teacher checkpoints, as I mentioned before, to check in with each of my students and analyze their understandings (See Appendix C). While students completed various activities I had a list of questions to ask the students about what they were doing and why. Some of the questions allowed me to just observe the students while working and determine from their actions whether or not they had an understanding of the topic.

Another form of data collection I utilized was videotaping of lessons. My PDA was kind enough to come into my classroom on several occasions and videotape me teaching a new topic to the students and the students engaged in activities that allowed them to further explore the topic. Videotaping lessons offered me the opportunity to go back and watch the lessons and listen for students comments that I would not have necessarily heard while I was teaching. Also, the videotaped lessons allowed me to view students working for a longer period of time than I have when I am managing a classroom of 18 students. My PDA was able to focus in on different groups of students who I might have only checked in with for 2-3 minutes while they were working.

An additional form of data collection was lesson observations taken by my PDA (See Appendix E). During various lessons my PDA would observe the lesson, note the activities students were engaged in, and also write any comments she heard students making in regards to the activities. For example, during an activity called Quick Images, where shapes are quickly flashed on an overhead and students must draw the shape they saw, my PDA was able to record each student's verbal description of the shapes when we discussed the activity as a whole group.

My last form of data collection was my personal journal entries and reflections (See Appendix F). Throughout the investigation I would write journal entries that dealt with how I felt my students were progressing with their understandings. I also reflected on my teaching and how the actions I took affected my students' development of these understandings. I would reflect on how I perceived an activity went and what I might have done to improve or change the activity to make it more useful and engaging for my students.

How I Analyzed my Data

(See Appendix F)

Analyzing my data was a very daunting task. I had so much data that I had collected I did not even know where to begin. I started by dividing my data into different groups. I had a pile of my journals and reflections, a pile of my PDA's observations, a pile of students' work which was also sorted by which investigation it was completed in, a pile of my observations, and a list of student quotes from the videotaped lessons.

I started with my journals and reflections. I reread each one. While reading, I took an orange marker and wrote any claim or statement that popped out at me while I was reading. Then, I took a green marker and went back and underlined any statements in my journal that supported that claim. For example, when reading my reflection of Session 1, Investigation 1, I had written "They were able to tell me that we use the geoboards to make shapes…The kids were able to make the connection that maybe geometry has something to do with shapes." I underlined this statement in green and next to it, using my orange marker, I wrote "Students use prior knowledge to begin to understand the unknown." I then went on reading the rest of the journal to check for any other statements that could be used to support this claim. Sometimes after underlining a supporting statement I thought back to a particular lesson and the work my students did during that lesson. I made a note to myself of students' names whose work I thought would also support one of my claims. I continued with this process of underlining in green and writing statements in orange until I had reread all of my journals/reflections.

Next, I looked through my PDA's observational notes of the lessons. From her notes I made more concentrated notes for myself of students' comments. For example, from her observations of the Quick Images activity, I was able to make a short list of students' comments on each shape. I drew a picture of the shape and next to it wrote all of the comments that were made concerning these shapes. For example, when viewing a picture of a diamond my students commented that it had 4 sides, looked like 2 triangles, it was a diamond, and said it looked like a "square lying down."

Then, I began the task of looking through all of my students work throughout the Investigation. They did a lot of work and therefore I had a lot to look through. I started with the work that was completed during the first investigation. The students had a number of opportunities to complete pattern block fill ins, where they were required to fit paper pattern pieces into various outlines, and pattern block counts, where they were given a specific number of pattern block pieces that they needed to use to create their own design. When going through the students work I made a list of any students who had trouble staying in the lines of the pattern, overlapping pattern block pieces, or those who left open spaces in the pattern. I was then able to compare these students initial

experiences with the pattern block fill ins to the ones they completed for assessment at the conclusion of the unit. By comparing the two I was able to note any improvement the students had from their first experience to their last. I then was able to make a claim about the number of opportunities students are given to work with a topic and how it affects their understanding and ability to complete an activity successfully. So overall, I analyzed students work by comparing work they completed when first introduced to a topic to work they completed at the conclusion of the unit, after they had been given a number of opportunities to explore and work with a given topic.

At this point, I had established a solid list of claims as a result of my data analysis. But, I had yet to analyze the list of student comments I had from watching the videotaped lessons. So, I started with my first claim. I then read over my list of students quotes and determined if any of the quotes support that particular claim. I then listed the claim number next to the particular quote. I continued to do this until I had gone through each claim and matched it with all possible student quotes. In the end, not every one of the quotes I had listed supported a claim of mine, but I had at least one student quote to support each claim.

What I Know Now

My Claims and Evidence

1. **Students use prior math understandings to help them learn about the unknown.**

Evidence: When first beginning our geometry unit, on January 17th, I had a conversation with my students about what they thought geometry was and what we would be studying. I asked the students "What is geometry?" No one raised their hands or offered thought or even a guess. Then I realized, students have had experience with geometry, they just did not realize it yet; we had worked with geoboards in our classroom to create different shapes. So, I tried again and I asked the students "What do we make when we are using geoboards?" They answered "Shapes." Then you could see the light bulbs going off in their heads. "If we use geoboards to make shapes," I asked "how can I use that knowledge to answer my question of what is geometry?" All of a sudden the hands shot up and the students replied "Shapes! We will learn about shapes when we study geometry." (See Appendix F, pg. 1)

Also, on January 28th students completed an activity called Quick Images. During Quick Images a shape is flashed on the screen for 3 seconds. Students

then have to draw the shape, to the best of their ability, from memory (See Appendix G). After students drew the shapes we discussed what we saw as a class before turning the projector back on and revealing the actual shape. The first couple of shapes we examined students were relatively familiar with and therefore they had prior knowledge of the shapes. These shapes were a square, a circle, a triangle, and a rectangle. The students were easily able to identify these shapes by name and describe them. During this time we also looked at a diamond and a half circle; these are two shapes the students were less familiar with. Therefore, they used their knowledge of other shapes to describe these two. When describing the diamond my students said "It looks like 2 triangles put together," and "It looks like a square that is lying down." Next we looked at the half circle. Students described it as a "half moon" and the letter "D facing the wrong way." The use of prior knowledge to understand the unknown can also be linked to the processes of assimilation and accommodation, as described by Piaget. According to Piaget and other proponents of the constructivist movement, assimilation occurs when existing schema are used to give meaning to experiences (Van de Walle 23). My students' description of the diamond and half a circle demonstrates their use of existing schema, or knowledge, to give meaning and create an understanding of the unknown.

On February 21, students were met with the task of describing geoblocks. Students had been previously introduced to geoblocks during free time in the classroom to play with, but they had never used them in a mathematical setting. The lesson began with one student choosing a block and then sharing one thought about the block. For example, when working with a rectangular prism on student said "it has 6 sides." Another student then had to choose a block they felt had the same characteristic. The second student chose a smaller rectangular prism. The whole class was then asked to compare the two shapes. One of the students commented that "If you glue a couple of his together (the student with the smaller shape) it will make one of his (the student with the larger rectangular prism)." This student used his knowledge of pattern block fill ins, where they are required to use various shapes to fill in an outline, to describe the geoblocks. From his experience with pattern block fill ins the student realized that he can put shapes together to make other shapes.

2. **Students need to be presented with a variety of topics and activities so that those who struggle with one concept are presented with the opportunity to excel and succeed. This includes multiple experiences with a variety of materials.**

Evidence: Pattern block fill ins (See Appendix G) were a completely different activity then students had ever completed during math. Up till this point in

the year we had worked solely with numbers; different ways to use them and represent them, putting them together and taking them apart. Pattern block fill ins required students to use spatial thinking, rather than their number sense. During the activity, one little boy in my class exclaimed "This is so much fun! Can I do another one?" I was so glad to see the student take an active interest in the activity because often in the past he was very passive during math time because he struggled with his understanding of numbers. Since the student felt successful, he took an active interest in his learning and even wanted to go above and beyond what was required of him.

When working with pattern block fill ins, throughout the unit, students had the chance to use both paper shape pieces, which the glued to the paper, and wooden shapes. One student in particular struggled with filling in the outline using the paper pieces. This was not because he did not have a spatial understanding of the pieces and the shape, but he could not physically keep the pieces in place, they were too hard for him to manipulate. The student struggled with the activity, but did eventually complete it (See Appendix G). When I discussed with the students the challenges he faced he told me it was difficult because "I couldn't keep the pieces from moving. They wouldn't stay where I wanted them to."

The next math session I introduced the wooden pattern block pieces for students to use as part of choice time. Again, the students were required to fill in an outline using the pieces. But this time, instead of having to glue the pieces down, they just had to record the number of each shape they worked with. For example, 3 squares, 2 triangles, etc. and the total number of pieces they used. During choice time I went to check in with the same student while he was working with the wooden shapes. This time when working the student was enjoying the activity much more because he could focus his attention on filling in the outline, instead of worrying about gluing down the paper shapes and keeping them in place. The student's enjoyment and ability to complete the task easily showed me that it was not the concept he was struggling with, but instead he struggled with physically manipulating the paper pattern block pieces. When given the opportunity to work with different materials, the student was able to demonstrate his understanding of the concept.

3. **The teacher needs to first have a conceptual understanding of a topic and approach it through the eyes of the students to anticipate where struggles may arise.**

Evidence: Throughout the geometry unit, I focused on helping those students who were struggling with a topic so that they would not become frustrated and just give up. It was a challenge for me to help students realize

something that to me is so blatantly obvious, but they cannot see. So, before each lesson I sat and thought out exactly what I wanted my students develop an understanding of and how to go about aiding them in doing so. I developed a list of focus questions that I would ask those students who are struggling with a topic to help elicit these understandings (See Appendix D). By having these focus questions in the back of my mind I was able to spend my time and attention during the lesson focused on the students and their experiences, rather than focusing on how I am going to help those students who are struggling.

As Van de Walle states, "Conceptual knowledge of mathematics consists of logical relationships constructed internally and existing in the mind as a part of a network of ideas." It is this time of knowledge and understanding I was hoping to guide my students toward throughout the unit of study. When sitting down to initially plan out the unit, I though to myself "If I don't understand the concepts, how can I expect my students to?" I believe it is this exact reason and teacher thinking that prompted the Investigations resource to include background reading for the topic in the introduction of each book (See Appendix G). By including the information right there, where it is convenient for teachers, Investigations is almost assuring that the teacher will develop their understanding of a topic before trying to aide the development in their students.

On February 18th , I thought a lesson where students were examining geoblocks, describing them, and comparing the shapes. I did not clearly think about what understandings I wanted my students to develop through this lesson and I did not anticipate and problems arising. Therefore, when students started to struggle to come up with descriptions of their geoblocks I was unsure of how to guide them. I believe that my lack of a clear conceptual understanding was evident to the students and therefore they struggled to develop and understanding as well. So, after the lesson I went back and reexamined exactly what understandings I wanted my students to develop during the lesson. Once I had a clear understanding that I wanted my students to describe the blocks faces, shapes of the faces, and number of faces I was able to go back and reteach the lesson. So, on February 21st, my students and I gathered again on the green rug to describe geoblocks. This time, I had a clear understanding in my mind and it was evident to the students. I was able to guide the students to examine the faces of the geoblocks and they in turn used descriptions such as "It has 6 sides," and "if I put 2 triangular prisms together it will make a square."

Also, when working with a student who struggled with pattern block fill ins, I was able to use my conceptual understanding of the topic and pieces to guide him to see how shapes fit together. This student struggled to complete his first pattern block fill in and did so with a large amount of support (See Appendix G). Because I had a clear understanding in my head of how the

pieces fit together I was able to help this students develop his understanding so that by the end of the unit he could easily see what shapes fit into the outline independently and quickly. Therefore, the student demonstrated his development of a conceptual understanding of how shapes are related. The student showed his understanding of how shapes are related and how smaller shapes can fit together to create one larger shape. This was an important conceptual understanding that was developed in all students throughout the unit through work with the pattern block fill ins.

4. **Group discussions should be guided by student's descriptions and comments because students will deepen and expand upon their own understandings when listening to others.**

Evidence: When describing geoblocks on February 18th, as I mentioned before, my students struggled to use the descriptions I had anticipated. Rather than letting the students' descriptions guide the lesson, I struggled to direct them to use the descriptions I had been hoping for (See Appendix F pg. 4 & 7). When they still were not describing the blocks as I had hoped I started to tell them my descriptions of the blocks. By doing so, all meaning was lost. The students were not developing their own understandings of the geoblocks and how to describe them, but instead were using the words that I had because that is what I wanted to hear. So, on February 21st, may class gathered again on the green rug to describe geoblocks. This time, I allowed the students to use any descriptions they thought of and encouraged them to build off of one another's comments. When comparing two rectangular prisms the discussion began with one student making the comment "John's* is bigger." Immediatley another students hand flew into the air. He said "If you glue a couple of John's together it will make one of Brian's because Brian's is the same as John's, only squooshed down." Later in the discussion, when comparing two other rectangular prisms a student commented that "You can't glue two of Brett's together to make one of Erin's." But, another student quickly commented "But if you saw it (Brett's) in half it will make two of Erin's." The students were using the comments they had heard earlier in the discussion and applying them to their geoblocks to help build meaningful connections and understandings.

After building a town of geoblocks, students were met with the task of giving directions through the town. As a group, we practiced how to give directions and also how to make our directions more clear. Once we had established a clear method for giving someone directions we turned to the task of how to record the directions. The class decided that it would take too long to write out go four blocks east, turn south and go three blocks, etc. So, we needed to brainstorm easier ways to write our directions. One student

raised his hand and offered the suggestion of "write them smaller," but, the class decided that was still too much writing. Another student raised her hand and said "We could right E instead of East." Then another student quickly raised her hand and said "we can write 4 BL, for blocks, E so it would be 4 BL E." The class agreed that this would be the easiest and most efficient way to write our directions. During this whole group discussion the students did an excellent job of listening to each other and building their ideas off of the comments of their classmates. As a class we were able to make a meaningful connection to the lesson and topic by listening to each other.

*Names have been changed.

Future Directions

Implications for my Future Practice as a Teacher

Throughout this experience I have learned a lot about my ability to teach math to students. I am able to teach and help my students develop conceptual understandings much better than I thought I would be able to. By taking the steps I did when teaching I have developed a list of essential factors to consider when teaching math; my claims. But looking back at my claims I believe they can be applied to all subject areas, not just math. It is always important to take into consideration student's prior knowledge, allow them to experience a topic in a variety of ways, as a teacher have a clear understanding of the concepts you are trying to convey to your students, and allow students' comments to guide a discussion.

Even though I had a wonderful resource, whose goal is to develop a conceptual understanding in students, I still learned the essential elements for creating that type of understanding. So now, no matter where I teach, and whether or not they use the Investigations resource, or something similar, I have an understanding of the key components that need to be present in each lesson in order to help children develop those understandings. Therefore, during my future practice as a teacher I will be more conscious of the decisions I am making and how they impact my students' development of a conceptual understanding. I will be sure to offer my students a variety of topics to study and multiple experiences with in that topic. I will allow my students comments to guide our discussions. I will have a clear understanding in my head of the concepts I want my students to develop an understanding of.

New Wonderings

1. As I become a more experienced teacher and more familiar with the curriculum, will including those essential elements in each lesson become automatic?

2. What happens when student's discussions never take the direction you anticipate or address the topics you need to discuss?

3. If students have absolutely no prior knowledge of a topic, how will this impact their experiences with the topic throughout the lessons?

4. How can I continue to use differentiated questioning to meet the diverse needs of students?

5. How also can I continue to use alternative/extended activities to meet the needs of the diverse learners in my classroom?