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**BUILDING BLOCKS TO NUMBER SENSE:  
CONSTRUCTIVISM IN FIRST GRADE MATHEMATICS**  
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## **ABSTRACT**

This qualitative research study documents the observed and reported experiences of a regular education teacher and her class of first grade students as they engage in using the constructivist approach to learning in their mathematics classroom. The study defines constructivism as a learning theory in which students are actively engaged in their own experiences. The study examines the students' use of manipulatives and hands-on techniques when used along with the school's traditional math curriculum. The study explores the participants making meaning of their own learning and applying what they learned in their real world experiences. All the students were actively involved in the study however, the author focused in on the low level learners in the classroom. The study suggests that low level students are able to be successful at mathematical tasks when given the opportunities to explore using manipulatives other than just pencil and paper to show their understanding of that task. The study documents the students' ongoing use of mathematical centers that used hands-on activities to approach the mathematical tasks that are required in first grade. Finally, the author questions whether using a single method such as constructivism is beneficial to all learners or if a combination of both constructivism and traditional math best suits all of the learners that enter the classroom.

## **ACKNOWLEDGEMENTS**

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## **RESEARCHER STANCE**

Mathematics has always been a dirty word to me. I went through my years in school hating math. I struggled with learning math concepts. I went through my everyday learning of math with the feeling that I was horrible at math and that I would never be a good math student. I dreaded those supposedly wonderful games of “Around the World.” I never made it out of my “country.” I just wasn’t a good math student. I would do well on my report cards in every other subject but math. I started looking forward to getting a C in this subject. The skills continued to get harder and I continued to fall further behind. I often felt as if I was a failure. This feeling followed me all through college. I came to terms that I would never be in an AP math class. I could learn the facts that I needed to know to survive the test and get a passing grade. However, after taking the test, all the information was gone from my memory. I learned enough to survive and graduated from college with a degree in Education.

“Experience and education cannot be directly equated to each other. For some experiences are mis-educative. Any experience is mis-educative that has effect of arresting or distorting the growth of further experience” (Dewey, 1938, p. 25). I believe Dewey was making the point that when students are mis-educated they are provided with negative experiences in learning. Students have a bad experience with a certain subject matter and they shut down completely. They do not express that desire to learn that subject because of their feelings of

frustration. When a student feels frustration day after day it begins to eat away at his/her confidence level. And, when that confidence level reaches a certain low, they shut down completely and will not learn. They begin to feel that they can't learn due to the bad experiences and they just stop trying.

As I look back on my own educational experiences, I think I was "mis-educated." I definitely had a bad experience and shut down. I believe that if I was given the same experiences that I want to provide for my students, I would have felt much better about myself as a math student. I might have grown up with a different outlook on math.

Despite all my reservations about math, I still had my hopes set on being a teacher. I was blessed to get a job teaching in an elementary school, and I was thankful that it was 2<sup>nd</sup> grade. Clearly, I would be able to teach my students how to add and subtract. When I began my teaching career 6 years ago, I was wearing rose-colored glasses. I thought everyone would learn the same way, right out of the math book. I realized after a few days that I had many different levels of learners in my class, and most were not going to learn by me standing up in front of the classroom and lecturing them on the math concepts. Some of my students were bored with our daily math lessons and others were struggling to even identify all of their numbers let alone do what the lesson called for. I realized that I needed to do something quickly before my students ended up feeling the way I had felt growing up. I knew that I was not reaching all of my students, and

at least some were disengaged during math time. Math quickly was becoming my least favorite subject to teach.

At this time a colleague was using the new Investigations math series. She taught our 2<sup>nd</sup> grade Inclusion class, and her students were identified with learning disabilities. I was impressed by how these students used manipulatives in math and were successful. At the same time, I was skeptical about what she was doing and intrigued by how her special education students were learning using this approach. I thought that I might like to teach using this approach, but I worried that it simply wasn't going to work for me. I was too new a teacher to throw away the math book and teach using hands-on approaches. I had a class of 22 students, and she only had 13, but the students enjoyed playing the math games. Of course, I wasn't even sure how to assess students who were playing games. The more I observed my colleague teaching this way, the more I thought I wanted to give it a try. I began to think more about this constructivist approach and slowly started to add it in to my curriculum.

In the fall of my 2<sup>nd</sup> year of teaching I decided to take a graduate course in elementary mathematics that was recommended by my principal. The class was based on the Investigations math series and demonstrated how to use constructivism in the math classroom. He had taken the class and wanted his staff to explore this approach with the students in our building. This approach intrigued me. I realized that this was the approach that I wanted to begin to use to

teach mathematics to my students. As I learned more, I no longer believed I was horrible at math. I started to feel that I could be a good math teacher and help my students to feel better about their learning. The Investigations series is based on the constructivist approach. It allows my students to have choice and learn through using manipulatives and games. It allows for me to reach all of my students, not just the ones who see themselves as “good at math.”

My main reservation for using constructivism in my classroom was the fear of losing control over my students. I feared that my classroom would look chaotic to an outsider looking in. Using math games during center time can get noisy. I often shy away from certain games that teach different math skills because of the noise factor. Would I be able to manage my class with all the freedom they would be given? And, would they actually be learning from these activities that allowed them to play? I decided that I was willing to try anything that would help my students not to feel the frustration that I had, even if it meant that my classroom might get a little noisy. As my study went on, I began to see what Vygotsky meant when he said that “a child’s greatest self-control occurs in play” (1978, p.99). The influence of play on a child’s development is enormous. They learn so much through the experience of play. But, the most beneficial lesson they learn is that of self-control. They need to learn how to solve conflicts when they arise and the will power to finish the game. They are learning that the games are helpful and there is a reason behind why we are playing them.

I started to base my math center lessons on “play” activities. I wanted to provide experiences for my students that allowed them to play as they were learning. Math centers was a way to fit in game/play time each week. I began to see how vital this playtime was for all of my students. “In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself” (Vygotsky, 1978, p.102). Through play, a child takes on a role of someone who is older, which gives children more confidence to do tasks that they feel they may be too young to do. This type of play creates a zone of proximal development for the child. It allows them to feel as if they are able to do the hardest of tasks when they are “playing”. They are allowed to be spontaneous within the constraints of the rules imposed by the play situation when they are playing. I think this allows them to feel more confident in their actions. The constructivist approach is about hands-on experiences that allow students to play. Constructivists believe that students learn best when they are allowed to play and make their own meaning of what they are playing. It is my hope that my students will be able to have this confidence and build upon their experiences during play and connect them to other areas of their learning.

As I began to think about how I would answer my research question; what are the experiences when using constructivism in the math classroom, I first needed to step back and see whether or not I am open to changing my teaching style. I am comfortable with the way I teach my math lessons at the present time.

But, I also think that I am ready to embrace the change and allow for some chaos in my classroom to benefit the growing needs of my students. I then ask: How does the constructivist approach to teaching math impact learners, especially those labeled as low leveled? How do they feel when asked to complete these tasks? I have seen this number of students grow and change from year to year. I want to be able to provide the best learning experiences that I can for all of my students, regardless of their ability level.

I know that when I learn myself, I learn best when I am able to actually touch and move objects that I am exploring. I am a tactile learner. It only makes sense to me that a constructivist approach will be useful to many of my students. I think back to my own personal struggles that I endured in grade school when it came to learning math. I can only wonder how I would have fared if an alternative approach had been used in my math classes. To this day, math is my least favorite subject to teach. I think that in itself has influenced my desire to pursue this topic in my study. I am hoping that at the very least, I will be able to reach those students who feel the way I did, and begin to change their attitude towards math.

The overall goal of my study is to help struggling learners in math. I expect that the students will develop a more positive attitude towards mathematics. I also hope to make math a more positive learning experience. I hope to give my students the understanding of how to develop strategies for

solving mathematical computations. I would like to make their math learning more meaningful. I want my students to take what they have learned in my class and apply it to their everyday life. It is important to answer my question because it will benefit my students who struggle with learning pencil and paper tasks.

Using the constructivist approach will enable my students to learn new ways to do “traditional” math without a pencil and a piece of paper.

Constructivism is about getting the students actively involved in their learning. I want my students to be involved in the learning that takes place in my classroom. I believe that “actions speak louder than words” when it comes to teaching. It isn’t meaningful for me to stand up in front of my class and talk at them. It is just words that some of them don’t even understand. Sometimes it turns into me talking to myself because most of them aren’t tuned into what I am saying. But, when I allow them to “play” I seem to have their attention. I often believe that I would have a different outlook on math if I were given these same opportunities in my math classes.

One area of concern is that I may be hindering my students in their ability to perform up to standards on the PSSA. I want them to learn new ways to solve problems and hopefully make that connection on the state tests. But, I am concerned that by teaching in this way that I may be holding them back when they get to 3<sup>rd</sup> grade. I believe that constructivist learning activities will help my low level learners succeed in math. I suggest that they will feel better about working

during math because they will be able to work at their own level. I also worry about not “getting through” the pages I need to cover in my math series. I believe that the standard philosophy of some veteran teachers during math time is “cover the skill, give them a page to work on and then move on.” They feel that it doesn’t matter if they understand it, you move on to the next page the next day. I am not comfortable with this philosophy. I want to teach in a way that all of my students are able to understand what I am teaching. However, it worries me that by doing this that I will not cover all the material in my curriculum. I believe that all students, regardless of the learning ability, are capable of being successful in math if they are given the proper instruction.

### **Research Design and Methodology**

I chose my study due to the frustration that I felt while teaching mathematics to my first grade students. The pace that my curriculum suggested I teach was not tailored to the needs of my students. My students were not all fully engaged in the learning process. Math time turned into the time of the day where you either “got it or didn’t get it at all.” I wanted to change this and make math time without so much frustration. I chose to incorporate the use of constructivism in my mathematics lessons. Constructivism allows the students to use hands-on methods to solve problems. I know that when I learn myself, I learn best when I

am able to touch and move objects that I am exploring. I am a tactile learner. It only made sense to me that a constructivist approach would be useful to many of my students.

I thought back to my own personal struggles that I endured in grade school when it came to mathematics. I can only wonder how I would have fared if an alternative approach had been used in my math classes. To this day, math is my least favorite subject to teach. I think that in itself influenced my desire to pursue this topic. I hoped that at the very least I would be able to reach those students who feel the way I did, and begin to change their attitudes towards math. First grade is a pivotal year in school. Early on I could see the frustrations in the eyes of my students, reminiscent of my feelings towards math. There was a big gap in the ability levels that my students walked through the classroom door with. I could sense the differences without even using a formal assessment. I worried that these differences would have a huge impact on my ability to reach all of my students.

At first I struggled with the thought of how I was going to introduce my study to my class of first graders. The beginning of first grade is often a challenge in itself without adding all of the extra big words such as study, observations and consent forms. Many of my students have never been in school all day. They come to school not being able to stay awake past lunchtime. So, I chose to wait until the end of September to begin my actual data collection. I

needed the time to allow my students to get adjusted to school and the routines of my classroom before I began my study.

Prior to handing out the parent/guardian consent forms, I sat down with my class as part of our morning meeting and had a discussion about my study. I explained to them that I am not only a teacher but also a student. I told them that I am going to college and I have homework to do just like them. I explained to them that part of my homework was to watch how they are learning and write about it. I showed my students my laptop computer and demonstrated that sometimes I may take it out and type my notes on it as they are working. I also told them that we would be having interviews and surveys throughout the study. I told them that I would be using fake names. I would not write anyone's real name down. They didn't have to worry about anyone knowing who they were. I would be the only person who knew what their fake name would be.

I then read the parent/guardian consent form out loud to them. Most of the students seemed very excited to be a part of the study. They were raising their hands and asking me to pick them to be in it. I explained to them that I would love to have everyone be a part of my study. But, they needed to talk it over with their parents/guardians at home and together decide if they wanted to be a part of my study. I then explained to them that they were going to participate in all of the activities that went along with my study as part of our math program. However, they didn't need to be in my study. I explained to them that if they or their

parents/guardians didn't give consent for them to be in the study that I simply would not use any of their information as part of my findings in my study. They all seemed anxious to begin helping me with my homework. I felt that I did my best to explain these big words to the curious little minds of my first graders.

I finally began my study in September after obtaining the approval from my building principal and Moravian's Human Subjects Internal Review Board. This board reviews my plan for my research and makes sure that I am protecting the confidentiality of my research participants. Once I made the proper changes to my plan, I began to gather my data. As a teacher action researcher, I used mostly qualitative methods to gather my data. I collected my data using the following methods:

### **Field Log**

According to Arhar, Holly and Kasten (2001), recording notes about observations (as well as interviews, artifacts, and documents) is the most common method used by the action researcher to describe what is occurring. These notes become the field log of the researcher. They are taken in the classroom setting as the study is taking place. These notes are the direct observations of what is being said and done as well as impressions or hunches of the observer (Arhar, et al, 2001). I kept my field log, recording my field notes based on my participant

observations and thoughts on my students' attitudes and progress in mathematics.

I also included interviews, surveys, student work and all consent forms.

### **Participant Observations**

The foundation to all good research is observations (Arhar, et al, 2001).

Observations were a vital component in my field log. They were a primary source of data in my field log. There were times in my study that I was merely the observer. I observed as my students worked independently. I recorded student commentary as they worked with each other. At other times I was not just an observer but also an active participant in the teaching and also the observations. At these times I would reflect on the lesson and record any comments made during the lesson. I conducted these observations at least twice a week. I noted the date and type of lesson. I took anecdotal notes before, during and after the lesson. I then later typed up the observation making sure to include the comments made by my students.

I later went back over my observations and added my observer comments.

These comments are the parts of a field log that contains a researcher's thoughts and feelings (Bogdan & Biklen, 1998). I added comments that reflected how I felt or thought on that given day and time. I marked the letters "OC" in the margins to indicate that this was not observed but a thought afterwards.

### **Classroom Interviews**

I used classroom interviews to gather my students' views and opinions about how they felt during math time. I periodically conducted interviews on a selected group of students throughout my study. I was particularly interested in the likes and dislikes of my low ability leveled students as they worked in math during both direct instruction and constructivist activities. I also conducted whole class interviews in which my students and I had open discussions using the interview questions. This way my low level learners were given the opportunity to volunteer their input without the pressure of a one-on-one interview.

### **Parent Surveys**

I sent out a survey to each parent/guardian of the students in my class. The parent/guardian gave consent by completing and returning the survey. The surveys were used to gather background information on the parents/guardians and their attitudes and feelings towards mathematics both in their own schooling as well their child's education. The surveys provided useful information that allowed me to see how the parents/guardians views may have been linked to the attitudes and feelings of the students involved in my study.

### **Student Interviews**

I conducted student interviews before, during and after my study. I used the surveys to gain more in depth perception of the students' feelings and attitudes towards math. I interviewed my selected group of students bi-weekly. I asked each student the interview questions in a one-on-one setting. I recorded their responses and asked more questions if the answers needed to be clarified. Their responses were then recorded in my field notes and my reflections.

### **Student Surveys**

I administered student surveys to my students about their feelings towards math in general at the start and the end of my study. The survey used pictures of three different faces to depict how the student felt. The students were asked to circle one of the three faces to indicate how they felt about the question. The answers were yes, sometimes and no. I read the survey questions out loud to the whole class. Later I was able to analyze the surveys to determine if there were changes in their attitudes towards performing mathematical tasks and motivation to perform these tasks.

I also administered weekly surveys to a focus group of students. Students were asked to tell about math at each given week. Students were asked to identify the positive and negative experiences of math during that week. I later analyzed

the surveys to determine if there consistencies in the type of instruction that led to positive or negative experiences. The students were also required to identify one thing that they learned that week in math. I read the surveys out loud and recorded my students' responses to each question. This allowed for free-flowing responses from my low-ability learners.

### **Student Work**

Arhar, et.al (2001) stated that student essays, poetry, problem-solving work, journals, and the many types of performances that students use to demonstrate their understanding and appreciations are ways to document student learning. I gathered student work samples throughout the study. The work came from both direct instruction math pages as well as hands-on center activities. I used the work to monitor the progress of my low ability students while using the constructivist approach. I monitored this group closely and tracked their progress throughout the study. Their work helped me to see significant changes in the ways in which they are able to solve a math problem. I collected work from different areas of my math curriculum such as whole group instruction, small cooperative groups, independent assignments and formal assessments.

## **Trustworthiness Statement**

Trustworthiness and credibility are an important part of every study according to Holly, Arhar and Kasten (2005). I used various methods to analyze the effectiveness of my approach to teaching mathematics. I collected various forms of data that allowed me to triangulate all of the information. The area of my research allows my participants to be actively involved in the process. I have informed them of my work and asked them to be active in sharing questions and concerns. I believe that by talking about “my class” and “my work” allowed me to build a bond of trust with my students. They were able to see that I need to continue to learn just like them. I obtained permission from the parents/guardians of my students. Consent forms explaining my research study were sent home. In my consent letter, I provided a brief explanation of my study. They were made aware that all information pertaining to my study was confidential. I used pseudonyms to protect the identity and anonymity of my students. The parents gave their consent by returning the consent form. They were informed that they may withdraw their student at any time during my study without any penalty to the student. The consent letter also provided contact information for my principal, my advisor or myself if the parent/guardian wanted to discuss my study at any time.

I used participant and non-participant observations, student interviews, and student work and class surveys. I looked at both the positive and negative

responses from the students. I found out what their experiences and feelings were towards mathematics instruction. This was very crucial to my data collection and reporting the findings of my study. I used shadow logs on different students within my different ability groups as well as collections of student work.

I triangulated my data through using multiple forms of data collection. Triangulation is a way to cross-check data with three or more sources (Arhar, et al 2001). I reviewed the data throughout my study to make sure that I was focused on the direction that my study was going and make sure that my conclusions are reasonable. I did not want to prove that one type of instruction was better than another. I wanted to provide my students with as many possibilities in my curriculum that allowed them to feel success. I looked for the positive and negative aspects of using the constructivist approach to teach math to primary students. This approach required a lot of reflection and flexibility. I kept a journal of my teaching strategies that helped me keep track of my student's learning. I was self-reflective by looking at my logs and see how I can change. I shared my data with my support group and colleagues to obtain their viewpoint of the progress of my study.

I analyzed my data from as many different vantage points as possible. I looked at the positive and negative responses from my students as I collected data. I hoped that my findings would lead me to the conclusion that using a constructivist approach to teaching math will help my low level learners succeed

in math. I wanted to give my students as many opportunities to feel that they can “get it right.” The constructivist approach offered my students different strategies that they could use to solve a problem. It encouraged them to solve problems using words, numbers, pictures or manipulatives.

A trustworthy action researcher will look at as many different aspects of the data that they collected as possible. I reported any and all findings whether they are in support of my anticipated outcome or not. I followed the guidelines for an ethical teacher researcher. I hoped that my data supported my expected findings but I was open to other outcomes. I believe that every child is capable of learning. I am willing to be open to other ideas if that is what my research leads to.

## Literature Review

*“As long as there were people asking each other questions, we have had constructivist classrooms. Constructivism, the study of learning, is about how we all make sense of our world, and that really hasn’t changed.”*

**Jacqueline Grennan Brooks(1999)**

*Concept to Classroom Interview*

### What is Constructivism?

Constructivism, according to Jean Piaget, is a theory about how people learn to construct their own understanding and knowledge about the world around them through exploration and experience and reflection (Brooks & Brooks, 1993). Other researchers such as Lev Vygotsky suggest that constructivism is when students play an active role in their development. He has also suggested that learning precedes development and constructivism is when people are given the opportunity to observe and approximate a new skill, then practice it, and eventually incorporate it into their cognitive development (Mallory & New, 1994). Constructivism is when students become engaged by applying their existing knowledge and real world experiences, test out their theories and draw their own conclusions from their findings.

Jerome Bruner also defined constructivism as a learning theory in which learning is seen as an active process in which learners construct new ideas or concepts based upon their current or past knowledge (Kearsley, 1999). There are many different interpretations of the word constructivism. However, two major

similarities have been identified: 1. learning is an active process of constructing rather than acquiring knowledge and 2. instruction is a process of supporting that construction rather than communicating knowledge (Cunningham & Duffy, 1996, p. 172)

### **Where did constructivism come from?**

The concept of constructivism in mathematics is not a new one. Constructivist learning has emerged as a prominent approach to teaching during the past decade. “The works of Dewey, Montessori, Piaget, Bruner and Vygotsky among others provides historical precedents for constructivist learning theory. Constructivist education gets its name from Jean Piaget’s theory that children construct their own knowledge and children have many ideas that are not taught to them. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory” (Fosnot, 1996). Constructivism gained a lot of attention in 1989 when the National Council of Teaching Mathematics endorsed a new set of standards, urging teachers to relate math to situations that may arise in everyday life and to use more teaching tools such as manipulatives.

The students we teach are not blank slates that we need to etch information onto. Students acquire a vast amount of knowledge before they even set foot in a classroom. This knowledge is the raw material for the new knowledge they will continue to create. Dewey(1938) has stated, “the

environment, the world of experience constantly grows larger and so to speak, thicker. The educator who receives the child at the end of this period has to find ways for doing consciously and deliberately what nature has accomplished in the earlier years.” Dewey believed that it was logical to continue this progression throughout the time spent in school. Constructivism allows this progression to occur. It encourages the child to learn in the way that seems only the natural for them to learn.

### **Characteristics of a constructivist classroom**

In a constructivist classroom the focus seems to shift from the teacher to the students. The classroom no longer is a place where the teacher pours knowledge into the students like they are an empty vessels waiting to be filled. The students become active in their own learning. Brooks & Brooks (1993) state that the goals of constructivism are for students to take responsibility for their own learning and become autonomous thinkers. The teacher is not the sole provider of the information learned. Instead he or she serves as a facilitator who coaches, mediates, prompts and helps students to develop their own knowledge. Asking good questions becomes the teacher’s most important role in the constructivist classroom.

Learning in a constructivist classroom is interactive, building on what the student already knows. The teachers keep this interaction going by having a

dialogue with the students while helping them construct their own knowledge. Each dialogue will bring about a new learning experience for both the students and the teachers. Schiffer(1996) states that for teachers who base their principles on this type of learning there is no point of arrival, but rather a path that leads on to further growth and change. Students are viewed as thinkers with their own emerging ideas about the world. Teachers look for the students' point of view in order to gain their understanding. The students are given choice when showing how they understand the topic instead of just taking a written test. The classroom is democratic and more teacher-student contact is possible. Negotiation is an important aspect in the classroom. Smith (1993) explains that negotiating means that the curriculum is "custom built" to fit the individual needs of the students in the classroom. The environment should be one in which the teacher teaches the students how to learn. A constructivist-centered approach places the focus on the students' learning rather than the teacher's teaching (Lindfors, 1984).

In a constructivist classroom, the students are encouraged to ask questions. Calkins (1986) laments that in classrooms we neither teach students to ask questions nor allow them to even ask questions. Yet, we require the students to answer our questions. The constructivist classroom encourages the students to ask questions of themselves and others. By asking their own questions, students acquire more consciousness of and control over their own thinking. The teacher relinquishes power and control to empower the students to be active seekers of

knowledge. Belenky, Clinchy, Goldberger and Tarule (1986) state that “real talk” and careful listening create an environment within emerging ideas can grow. This purposeful talk by students in a student-centered classroom develops cooperation and collaborative involvement within that classroom. This student-to-student dialogue is the foundation upon which constructivism is structured (Slavin 1990).

### **Characteristics of the constructivist teacher**

Teachers need to know that their jobs are important (Ziegler, 2001). They are molding the minds of the future. But many teachers do not realize the impact of their job on the students in their classrooms. Constructivist teachers see the importance in what they do. The most crucial part of the constructivist teacher’s job is watching, listening and asking questions of the students in the classroom. This allows the teacher to learn more about the students and how they learn as individuals. This in turn will allow the teacher to be more helpful to the students. Calkins (1986) notes, that there is a thin line between research and teaching. The teacher teaches the students. But, the students also teach the teachers. The teachers use the data they gather during this observation to develop more meaningful lessons that will be the most beneficial to the students in their classrooms. The teacher will allow the students’ responses to drive the lessons in the right direction for the students’ needs.

The constructivist teacher does everything within his or her power to provide the students in their classrooms with the skills and abilities to be confident and autonomous learners, empowering the students to feel success and competence in their own learning. The lessons prepared by the teacher are done in a way in which will best provide the appropriate learning experiences for the students in their classroom. Hanley (1994) states that the constructivist teacher should become one of many resources that the student may learn from, not the primary source of information. The teacher should engage the students in experiences that build upon their existing knowledge. Brooks and Brooks (1993) agree that it is the constructivist teacher's job to provide the opportunities for the learners to expand their knowledge in an active and engaging way. Chaille and Britain (1991) agree that a constructivist teacher is no longer the transmitter of knowledge, but a facilitator of learning. They keep in mind that the learning will vary depending on the learners in their classroom. The teacher cannot assume that all of their students have the same background knowledge or experiences. They need to build their instruction to fill in the missing pieces and facilitate the learning process for all of their students.

### **Characteristics of the students**

The students in a constructivist classroom have a different role than of those in a traditional classroom. These students are active participants in the

learning that is taking place. They may set the goals of what they want to learn and help to plan the tasks to make sure the goals are met. These students often work together in small groups rather than alone. They work together to discuss their goals. These students work together actively from start to finish. They are encouraged to be independent thinkers and problem solvers (Jonassen, 1999).

Children learn early on in life by making choices. The constructivist student is given the opportunities to make his or her own choices. These students are then viewed as thinkers with their own emerging ideas about the world around them. They are actively engaged in experiences that go beyond just giving an answer to a question. They communicate and collaborate with others to find a solution to a given problem (Mayer, 1995). Thus allowing for reinforcement and elaboration of ideas and concepts.

Students are encouraged to take their own initiative and ownership over their learning. This in turn helps them to develop their own intellectual identity (Brooks & Brooks, 1993). The students' ideas are respected and they are encouraged to think out their answers on their own. The students are challenged and encouraged to connect and summarize concepts by analyzing, predicting, justifying and defending their ideas (Brooks & Brooks, 1993).

## Examples of constructivism

*“A schools inspector is walking around an elementary school math classroom observing the children engaged in various tasks. One little girl is carefully placing square blocks in a tray to make an array four blocks by six. When she has finished, the inspector says “Nice job! Now can you tell me what is four times 6?” The child raises her eyes to the ceiling, furrows her brow and chants “one six is six, two sixes are twelve, three sixes are eighteen and four sixes are twenty-four.” The inspector, somewhat disconcerted says: “Well, that is the right answer. But why were you stacking those blocks in that tray?” The child answers: “Because the teacher told me to!” (J. Derbyshire, 2000)*

This scenario is one that may be seen throughout many classrooms in America. Students are working hard at a task. Yet, they do not know the purpose of the task they are working on. They have been taught to memorize the task and repeat it back to the teacher. But the task has no meaning to the students.

Research shows that children learn effectively when they are able to construct their own knowledge. However, the constructivist model is not widely used in American classrooms. Many feel that this is due to the pressure to teach to the standards (Fosnot, 1996). Two teachers from Glen Forest Elementary School in Fairfax Virginia felt the same pressure. Clare Stenger and Bernadette Garfinkel felt the pressure to rush and get the material covered in their first grade classes to teach everything that they needed to get their students ready for Virginia’s standardized test. The outcome was frustrated teachers and unhappy learners. Together these teachers felt the need to change their methods of instruction. They wanted to teach in a constructivist way and allow their students time to explore ideas at their own pace.

Stenger and Garfinkel's project was on measurement, which was part of their first grade curriculum. The study began with a 'class meeting' to discuss the project that they were going to do. After this discussion, the teachers knew that the students had varying levels of understanding of measurement. The children were given choice of whether they wanted to measure a table or a desk and what manipulatives they wanted to use. The teachers then stepped back and observed as the students worked, recording their findings and sharing what they were working on. The students had discussions about what they were using to measure.

Throughout the project, many different theories came up. The class met daily and shared what they were working on: measuring with body parts, links, yarn, cubes, etc. One such discussion led to using a ruler, which allowed the teachers to introduce the standard form of measurement. At this point the focus shifted to using a ruler versus a non-standard form of measurement.

The teachers administered a formal assessment at the end of the unit, concluding that 9 out of 12 students performed well on the assessment and the other 3 had a difficult time. The teachers stated that overall the students were actively engaged in the learning process and had successfully mastered the task of using measurement in a constructivist way. They demonstrated how to measure a given object using different manipulatives other than a ruler.

Ms. Stenger realized that her learners had met the academic standards of learning by working together on an open-ended project. She noted that at times her students struggled in certain areas such as beginning the discussions amongst peers, but with her guidance they were able to stay excited about what they were learning. She also enjoyed the process of being a co-learner as opposed to the sole distributor of knowledge. She was part of the exploration team. The goal was to have her students learn standard and non-standard measurement by exploring the world around them. She met this goal and enjoyed working and listening alongside of her students.

### **Assessments for constructivism**

Brooks and Brooks (1993) suggest that instead of saying “no” when a student gives an incorrect answer, but rather attempt to understand that student’s manner of thinking by posing additional questions to them. The teacher can lead the student to constructing new knowledge about the skill through nonjudgmental questioning. Assessment should be used as a tool to further enhance both the student’s learning and the teacher’s understanding of that learning. Assessment should not be used for accountability. It is not used to see who understands the knowledge and who does not. Using assessments just for a grade on a topic usually either makes students feel good about them or feel worthless altogether according to Brooks and Brooks (1993).

Constructivist teachers assess what the students are learning in order to gain further insight into the students' individual understanding. The students knowing right and wrong answers are important to them. But equally important are the opportunities to enhance understanding by building upon their current knowledge. One assessment tool used is the KWL chart. This is where students will list what they know, what they want to know and what they have learned throughout a unit of study. Portfolio assessment is also used. This is where student work is compiled over time for the purpose of showing growth. Both teachers and students can choose work to place in the portfolios. Constructivist teachers don't view assessment of student learning as separate and distinct from the classroom's normal activities but, rather, the assessment is part of the activities (Brooks & Brooks, 1993).

### **Benefits of constructivism**

Constructivism gives students the feeling of ownership when it comes to their learning (Brooks & Brooks, 1993). The learning is based on the students' explorations and questions that arise during the exploration. The students are encouraged to express their knowledge in a variety of ways. The students are then more likely to retain and transfer the knowledge they learned into real life situations. Constructivist learning is also transferable to other learning settings.

Children learn more when they are actively engaged in the process. Hanley (1994) states that the teacher can allow this to happen by guiding and supporting the students as they are working rather than transmit the correct adult ways of doing math. Constructivism concentrates on learning how to think and understand rather than rote memorization. Murray (1996, p.6) suggests that children who actively construct knowledge rather than just absorb it from the teacher perform much better in the long run. They learn to make connections between what they learn in school with what goes on in their real life. The learning becomes more meaningful.

### **Shortcomings of constructivism**

Funk (2003) states that even though constructivism is the most powerful form of learning that exists in the educational world, it is not widely used. This is linked to teachers being held accountable for the performance of students on state mandated tests. American children lag far behind those from other countries when it comes to their scores on their state tests. Recent findings from the international math testing have ranked American students third from last in mathematics literacy out of 21 nations. Students often struggle with connecting the hands-on approaches with the abstract operations or find math tools distracting (Murray, 1998). The hands-on approach may be effective in the classroom learning setting. But, it may hinder the students when taking an

achievement test. These tests do not allow for manipulatives to be used when taking the test. Students need to complete the test using a pencil and paper only.

Another shortcoming of constructivism is that school boards, administrators and/or parents do not always accept it. It can be misconstrued as chaos in the classroom. Parents question whether or not learning is actually taking place when students are using manipulatives. Administrators and school boards often want pencil and paper assessments to validate the growth being made. All want concrete evidence that learning is taking place. And all feel that using manipulatives is undermining elementary students' abilities to be prepared to take math courses later in their life.

Perkins(1999) believes that constructivist learning experiences place high cognitive demands on learners, and not all learners respond well to this challenge. Some students just want teachers to tell them what they need to know instead of making a big secret out of it and having them explore the possibilities. The use of manipulatives distracts other students. They would rather just learn the formula to solve problems than investigate a way to get to the final answer.

### **Summary**

Teachers need to prepare our students to become adaptive learners. They should be able to apply what they learn in school to the situations that arise outside of school. These students come into school with their own experiences. The constructivist teacher allows for the students to build upon those experiences

and make new learning experiences. The constructivist approach offers a bold contrast to the traditional approach to teaching (Hanley, 1994). The goal is for the learners to be active in their role of acquiring knowledge. Constructivism promotes social and communication skills by creating a classroom environment that emphasizes the exchange of ideas. It also promotes mathematical thinking and student achievement. The students will learn more and enjoy learning more when they are actively involved rather than just be passive listeners (Brooks and Brooks, 1993). Education works best when students are able to concentrate on thinking and understanding, rather than memorizing skills and spitting them back to a teacher. Constructivism focuses on learning how to think and understand, not rote memorization.

However, Murray (1998) believes that maybe there needs to be a combination of constructivism along with traditional methods of teaching mathematics. Some school psychologists value math drills and using hands-on learning approaches. They think that schools should be teaching both, not just one or the other. There is a considerable overlap in the way that both approaches are taught. Yet, both approaches exaggerated each other's stances without considering that they have many similarities. Many teachers today use a blend of both approaches to teach to the students within their classrooms.

### **My Story**

## **School and Student Profiles**

The school district in which my study took place is comprised of a mix of urban and suburban areas. It is made up of five elementary schools, a middle school, an intermediate school and a high school. I teach first grade at one of the elementary schools. The school houses approximately 530 students ranging from kindergarten to fourth grade. My school is considered a Title One school. This means that over 50% of the students come from low-income households that qualify for free and reduced lunches. The school has a very transient population. They move in and out of the district often. My school is located in the center of the community and is considered a neighborhood school. The majority of our students live in the neighborhood surrounding the school. A small percentage lives outside the neighborhood and is bused to the school. The students come from many different ethnic backgrounds. However, the majority of the students are either African-American or Hispanic.

I presently have 21 students in my classroom. There are nine girls and twelve boys. Due to the fact we have a transient population, three of my students were not a part of my study. They were enrolled in my class near the end of my study. I also had two students move out of the district during my study. I had a total of 18 students that were asked to participate in my study. Sixteen out of the eighteen gave consent to be a part of my study. Eleven of these students come

from either an African-American or Hispanic background. These students are in my classroom all day and I teach all subjects to them.

All of the students in my class participated in my study as part of the school's math curriculum. I only included the work of the students who were given consent to participate in my study. I chose my focus participants based on the scores they received on a beginning of the year Title One assessment. I chose two students that I felt were low-level learners and two others that were working above grade level. I chose these participants because I wanted to see the benefits of using constructivism on both ends of the academic spectrum. I realized that these groups had varying needs when it came to academics, I wanted to see how using this type of instruction impacted on all learners within my classroom.

### **My Mathematical Journey in First Grade**

I began my journey into first grade a year ago. I taught 2<sup>nd</sup> grade for 4 years and was very comfortable with teaching the concepts to my students. I was asked to move grade levels. I went into first grade not knowing what to expect. How hard could it be to teach first graders how to add and subtract? I was able to get by my first year without too many struggles. I walked into my classroom this year with my head held high that the outcome would be the same. Well, a few days into the new school year I realized that my students were not going to be like

those from last year. I was going to have to change my approach to teaching math if I was going to have successful students.

First grade is such an important year in a child's education. It is a year filled with many milestones. It is also filled with many frustrations. For many of my students, it was a challenge to make it to lunch time and still be awake. I spent the first few weeks of school laying out the rules of my classroom and allowing my students time to get adjusted to being in first grade. They needed this time before moving towards the academics. After a few weeks of rules and routines, I felt that they were ready to take the plunge into my study.

My school district requires that each student be given a pre-assessment on the skills that they should know by the end of first grade. I administered this assessment at the end of September to my class. I divided the assessment into parts and gave it over a period of four days. This assessment proved to be another frustration for my students as well as myself. I read the questions out loud and the students attempted to answer them. Most of my students fell into the below basic category. However, it allowed me to get a baseline of where the students fell when it came to their understanding of how mathematical concepts are solved. Some students could solve an addition problem already and yet others did not know what numbers even looked like. I had so many levels of learners in my classroom. I couldn't expect them all to learn in the same way. For this reason, I chose to explore the benefits of using constructivism in my math classroom.

## **Math: Chapter One**

The first chapter in our math series is called Patterns and Readiness for Addition and Subtraction. The chapter is all about getting the students prepared for learning how to add and subtract numbers. It builds upon the students' basic number sense. They were introduced to numbers in kindergarten. This chapter is used as a review. Each chapter in the math book begins with a math story. We read the story together and discuss the topic of the chapter. In this case we were looking at the number words. I asked the students to identify the number words that begin with similar sounds such as six and seven. I called on a few volunteers. I had 2 students who couldn't identify the beginning sound. One student told me that the numbers six and nine sounded the same. They could not hear the difference in the sounds. I made a note of this and then moved on to the next task. I called on different students to write down numbers on the board. I called on Charlie and asked him to write the number 6 on the board. He looked at me and said, "What does a 6 look like?" This turned out to be a question that I would hear over and over during my math lessons. In just a short time I realized that I had a group of students who could not write or identify all their numbers 0-10.

This was going to be a big problem for my students and me. Chapter One is all about identifying and writing numbers. Number sense is the backbone to all other mathematical tasks. If my students did not have basic number sense how would they be able to solve addition and subtraction problems? I realized that I

needed to do something in my math lessons that would help this group with their number sense. They needed to be able to identify and write their numbers to be successful in math.

### **My First Aha With Constructivism**

After a few days of struggling with this small group during math time I decided that in order to maintain some of my sanity that I needed to make a change. I couldn't continue to teach from the math book. I began to use math games that taught the same concept from the math book but in a different way.

I noticed a big difference from the very first day I used a game. We played a game called counters in a cup. The game allowed them to use manipulatives to figure out a given number. My students didn't seem frustrated when asked to complete the task. They only needed to look at the counters and differentiate the colors of the counters. At the end of the game, I asked if they liked the game. All of my students agreed that this was fun and easy. They all seemed very excited to play games during math instead of just doing a workbook page. This excitement prompted me to start using more of these constructivist activities during my math lessons.

## **Introduction to *Investigations***

My school had purchased the *Investigations* math series a few years ago. Each classroom teacher has a complete kit that includes all the books and the manipulatives. The district made sure that each class had a kit but never really pushed the teachers to use the kit. After taking Dr. Fluck's course on this series, I realized that I had the materials I needed to use the constructivist approach in my classroom.

The *Investigations* series embodies a new approach based on the research about how children learn mathematics (Kliman and Russell 1998). This program is aligned with the constructivist approach to teaching math.

*Investigations* helps students to develop flexibility and confidence in approaching mathematical problems. Students are able to build a repertoire of ways to talk about their thinking.

The investigations are designed to reach all students. The curriculum allows for all academic levels to work together regardless of their backgrounds. The curriculum ensures that all students spend time exploring problems in depth. They are also encouraged to find more than one solution to a problem. They may express their thinking through drawing, writing or talking. Students also experience working in various group settings such as whole group, small group, pairs or alone. The students are also encouraged to explore the environment around them and talk with their peers.

Reading and language are often given a great deal of emphasis in the elementary classroom. Mathematics often does not get the time it needs. This program allows for the time needed for students to explore math in depth by allowing students to become engaged in real mathematical thinking. This type of learning exemplifies the constructivist approach. The students are exploring and constructing their own knowledge of the world around them.

I started to incorporate using this program on a weekly basis in my classroom. I blocked out an hour every week to work in math centers. The centers allowed them to explore the mathematical concepts without having to use a pencil and paper to write out an answer. In the beginning I repeated centers from week to week. This helped to establish a routine as to what was expected of the students while working in centers. I spent the first two weeks just allowing the students to play with the manipulatives that we would be using throughout our centers. This was important because it helped them to get the urge to play with the materials out of the way. This helped them to use the manipulatives as a learning tool and not as a toy.

After I allowed the students to explore with the pattern blocks, cubes, dice, counters, etc., it was time to start the actual math centers. The first week I started off with three different activities that are designed to help students develop their basic number sense. The activities were Quick Images, Compare Dots and Copying Cubes. Quick Images is an activity in which the students are shown an

image of dots on the overhead. The students are then asked to recreate that image using counters. This activity helps the students to visualize what numbers look like. Compare Dots is an activity in which students use playing cards that have numbers on them in the form of the same dot images. This game asks the students to identify the card that has more dots on it. This activity also helps the students to visualize what the numbers look like. In Copying Cubes the teacher makes a shape out of cubes and the students are asked to make the same shape with their cubes. All of these centers helped the students to visualize what numbers look like and build upon their knowledge of what numbers mean. The activities continued to build upon each other as we went through the Investigations book. I introduced each center to the class in a whole group lesson. I modeled each center with a student helper and we played the game until I felt the students had an understanding. I then divided the class into 3 groups and allowed them to work in their center for about 20 minutes. The class rotated through each center.

I was beginning to think that I had hit the jackpot. Why didn't I think of using this approach before? My students didn't seem to feel the same frustrations that I was seeing when I was teaching using the math book. They were excited on the days when they knew we would be using math centers instead of our books. I noticed a change in the behaviors of my low level learners. They seemed a lot more confident to perform the tasks during centers. They didn't shut down.

I had figured out what I needed to do to allow my students to make progress in their math skills. Now it came time to choose my focus group. I had eighteen participants to choose from. I originally wanted to focus on my low level learners. But after a few days of struggling through my math lessons I decided to focus on 2 of my low level learners and then also 2 of my above average students. This would allow me to see how the constructivist approach benefits my students at both ends of the academic spectrum.

### **Student Participants**

#### **Annie**

I chose Annie for my study because of her lack of experience with numbers. This was her first experience being in a public school classroom. She attended a private kindergarten. She came to school with very little background knowledge about what numbers were and how they worked. She is a young first grader. Annie is very shy and lacks the confidence to participate in class activities. She often puts her head down and plays inside her desk to avoid class work. Annie often will not even try to begin a task if she feels that it is too hard for her. She needs a lot of repetition of the tasks before she begins to attempt to perform independent work. Annie began to get a fearful look on her face when she knew it was math time. I found myself also beginning to fear math time. It was beginning to be as frustrating for me as it was for her.

### **Charlie**

Charlie is another student who lacks the confidence to participate in class activities. He is quick to give up if he doesn't understand a task. Charlie attended kindergarten in our school. He had similar struggles in kindergarten. Charlie struggled with what numbers looked like. He could figure out the answer to a problem but did not know what that number looked like. Charlie would deal with his frustration by shutting down completely. He would crawl under his desk or cry. Charlie did not enjoy math time. It became a daily struggle for him. No matter what the task was, Charlie did not like math.

### **Tom**

Tom is one of my slightly above average students. He is a hard worker and most tasks come easily to him. Tom is usually willing to attempt new tasks. He is not afraid to ask questions if he is uncertain of how to follow through a task. Tom does struggle at times with his emotions during academic tasks. If he can't figure out a task on his own or he is unsure of the directions he often sits and cries to himself instead of asking for help. I chose Tom because of his lack of emotional maturity. Academically he is a good student who usually gets A's on all of his work. But his emotions sometimes get the best of him and he loses all of his confidence.

### **Amy**

Amy is one of my top students in my class. She does well academically in all areas of the curriculum. She works extremely hard and puts 100% effort into all tasks. Learning seems to come easily for her. She learns from teacher directed instruction and then is able to apply it in her independent work. She puts forth a lot of effort in all tasks. Amy is the ideal student to have in class. She does not show any signs of frustration while completing any tasks. I chose Amy for my study because I wanted to see the effects that using constructivism would have on my above average learners as well as my low leveled learners.

### **Charlotte**

Charlotte is another one of my low level learners. Her Kindergarten teacher told me that she should have been retained last year. She struggles with just about all of the academic tasks she is asked to complete. She often can't even identify her name in print. Charlotte has had a lot of absences this year. This has not helped her in anyway with her success. Charlotte was not one of my focus students. I did not choose her because she was not able to perform the tasks that were required of my students throughout the study.

## **Mathematical Journey: Continued**

I was a bit nervous when I began my study. Would using constructivism during my math lessons hinder my students' abilities to perform written tasks? Would I fall behind where my colleagues were in the math book? How would I effectively assess my students on the work they were producing? Would my math classroom look like chaos to the outsiders looking in? Could I handle sharing the teaching with my students? I had many reservations about what I was getting myself into. But, I wanted to do the best job I could to make my students feel success.

I put all of these reservations on the back burner and decided that this was the way to go to make sure that my students were making progress in their learning. I began introducing the investigations activities that were provide in my teacher's math manual. Each lesson has a hands-on activity that you can use during instruction. I started out by using these activities at least twice a week along with my regular math lesson. The students really seemed to understand the task during these activities. But, some then still struggled when asked to apply that same skill in written work. I could see the frustration on some of their faces when they were asked to take out their math workbook. Some would pout, others would make excuses to be out of their seat doing other things. I then decided to use these activities prior to every lesson in my math manual. I began spending more time focusing on these activities and less time on the written work. I began

assessing my students on their performance during the hands-on activities. They could demonstrate their understanding in more ways than just a written paper. I started to see less frustration and more excitement when it was time to do math.

I was so excited about the small progress I was beginning to see while using constructivism in my classroom that I approached 2 of my colleagues and asked them about using Investigations centers every week. We used 3 different activities from Investigations as our math center activities. The students were divided into 3 random groups and rotated through each center. They spent about 20 minutes in each classroom working on their particular center. The students were divided into 3 random groups and rotated through each center. They spent about 20 minutes in each classroom working on their particular center. We decided together that this would benefit all of our students. Every Friday afternoon we would do math centers for an hour. We planned out the lessons together using the book *Building Number Sense: Investigations in Numbers, Data and Space*. Each teacher modeled and played a different activity in their classroom. I collected data from just my center activity and only from my students who gave consent to participate in my study. I could see the excitement in my students' faces from the first week we started centers. I began to see less frustration and more willingness when they knew it was Friday and that meant math centers. They started to ask me on Wednesday what centers they would be

doing this week. I was beginning to feel more at ease with my decision to use these hands-on approaches in my math classroom.

Doing math centers this way also helped me to continue to use them in my classroom. I would then use at least one of the centers that we did on Friday in my weekly centers within my classroom. The students were already exposed to the activity. After a few weeks of using these activities my students built up a collection of activities that they could choose from during “choice time.” Choice time is when you set out a group of different activities and allow the students to decide what they want to play that day. These activities are generally ones that the students have played before and they don’t need a lot of instruction from the teacher.

**Pastiche: Annie’s feelings about Counters in a Cup**

I like Counters in a cup.

It is fun to dump the counters on the floor.

It is the best game we have played in math.

I don’t have to be smart to play the game.

I dump the cup and just count the red and yellow chips.

My buddy helps me if I get stuck.

Miss Steely I get it. This is easy.

This game is so much fun to play.

It doesn’t make me feel sad inside.

Annie really struggles on a daily basis when working during math time. She needs a lot of repetition. She has a hard time working on task when we are using a math workbook page. But Annie is transformed into a new student when we use games to learn about numbers. She actually enjoys working when we use the manipulatives. She is able to work with a buddy and at her own speed. She thinks the tasks are easy for her to complete. The pressure of getting it right is not weighing on her mind. She can just play the game and feel success when she gets the answer right.

### **Charlie and Chapter 2**

The classroom is busy working on the introduction to Chapter 2. The whole class is seated in front of me without any books or papers, just themselves. Student volunteers were called up to put on either a dog or cat mask. I asked the dogs to stand on one side and the cats to stand on the other. The remaining the students were asked to identify how many dogs and cats there were. Those numbers were written on the board. The numbers were 3 and 2. I then shared the following story: I had 3 dogs. My mom bought 2 cats. How many animals do we have in all? I pointed to the numbers and asked them to identify what the names of the numbers were. We continued the lesson by counting our volunteer animals. Together we came up with the answer of 5. I then demonstrated how to write a number sentence using all of our numbers. I wrote  $3+2=5$  on the board. As a

class we discussed what we did and when I thought they understood the task, they were asked to do it on their own.

The students were sent back to their seats and took out their math journals. I read this problem out loud: Farmer Brown has 4 pigs and 3 cows. How many animals does he have on his farm? I then asked them to draw a picture to solve it. Charlie, who usually cries during math time, had fun during this task. He was able to figure out how many of each animal to draw. He drew 4 pigs and 3 cows in his journal. Next I asked them to write the numbers for each. Charlie had trouble writing down the numbers. He wasn't sure what the numbers looked like. So I asked him how many there were in all. He counted his pictures and told me 7. I smiled at him and told him good job. He looked up at me with a big smile and said "I get it now!" He was so proud of himself for doing it right. Charlie is not a confident math student. He believes that drawing the pictures help him solve the problem. But, he gets frustrated when he is asked to just solve an addition problem. He can't sit down and solve  $3+4=$  without being able to draw a picture. This is a security blanket for him. To Charlie, without this tool math is extremely hard for him. But when he can draw instead of add he is confident that he can solve the problem. He is a totally different student when he is allowed to use drawing as a tool.

## **How Old is Charlotte?**

Charlotte really struggles at math. She enjoys playing our math games during center time in which she gets to use manipulatives and play with a buddy. It is easier for her to get the right answer when she has a buddy to help her. She doesn't like math when I ask her to do pencil and paper task or when she is left to think for herself. I asked Charlotte how old she was after a behavior incident in the classroom. She shrugged her shoulders at me and didn't know the answer to what I thought was a fairly easy question. I asked her again but this time she held up 6 fingers. I asked her how old that was. She still didn't know. I then held up my six fingers to help her out. I asked yet again. She answered using another shrug of her shoulders. I told her to count my fingers. She did, counting them one at a time. She then looked at me and asked: "Am I six?" She could count my six fingers but still didn't know that this was how old she was. It amazed me that she didn't know how many fingers she was holding up or how old she was. Most students can tell you how old they are by telling you a number not necessarily show you on their fingers. Charlotte had no clue that she held up six fingers. To her, she was as old as the fingers she held up. She had trouble counting the fingers and coming up with a number. How can I expect her to participate in math activities when she doesn't even know what numbers are? Charlotte is a different learner when she is allowed to work with a buddy and use games. But, underneath it all she is still a struggling student who doesn't have the basic

number sense to be successful in our math curriculum. Charlotte is the type of student that makes a teacher frustrated when trying to teach a whole group lesson using direct instruction. She doesn't have the background knowledge or the understanding to be successful at this type of lesson. She is lost from the time the lesson begins. She will never learn what success feels like when not given the opportunities to be successful in her own way.

### **Breakdown or Breakthrough**

I started out today's lesson with a whole group instruction lesson on the overhead. I introduced the lesson by placing counters on the overhead. I asked for a volunteer to tell me how many counters I had. I called on Annie. She counted out 7 counters. I then took away 3 counters and placed them on the bottom of the screen. I asked the class to tell me how many counters I had left. I called on Charlie. He told me that I still had 4 counters left. I was very excited that both of them could tell me the right answers. We repeated this exercise a few more times until I felt that most of them understood what we were doing. I then handed out 10 counters each. I asked them to start out with all 10 counters. I walked around to see that they all put all their counters into 2 rows. I asked them to take away 6 counters. I walked around and watched as they took counters away. Most of them counted one at a time. I asked how many were left. Just

about everyone raised his or her hand to give the answer. I called on Annie again. She told me that there were 4 left. She got it right. I was excited for her. We practiced a few more examples using just the counters. It seemed to me that they all understood the task. I decided that it was time to take out their math page and give it a shot. They took out their books and attempted to tear it out. This was hard because some still are struggling at locating the right page number.

I read the directions out loud and modeled the problem on the board. It was the same concept that we were doing with the counters. They all had their counters at their seats and were allowed to use them. But, almost immediately Charlie shut down. He saw the math page and it shut him down. He didn't know what to do. I walked over to him and modeled what he needed to do. Together we moved the counters around and worked out the first problem. He knew how to move the counters around. But he struggled with writing down the numbers that went along with the problem. He was having a hard time connecting what he was doing with the counters to what he needed to write down on his paper. I took his finger and helped him to "air write" the number and then make the same movements on his paper. I then showed him the numbers on his number line and how to count on that to get to the number he needed to write. He still was sad but had a little better understanding. Annie sits right beside him. She also usually struggles during math time. Yet, as I was helping Charlie, I noticed that she was whizzing right through her paper. She didn't need any help from me at all. She

was able to make the connection between using the counters and what she needed to write on her math paper. She was actually smiling as she was working. I think she felt confident today during the lesson. It was good to see her this way instead of crying that she can't do it. Overall the lesson went very well for a majority of the class. I still had 2 students who couldn't even get their book out and ready to go. But I was pleased with the results I observed as they worked.

### **Pastiche: What I Like About Math Centers**

This week math was fun.

I like when we build with blocks.

I like centers because we get to play with things.

We get to talk out loud with our buddies.

Math centers are not boring.

We get to play on the computers.

Miss Steely lets us play on the floor with stuff.

Math is easy for me when I play games and draw.

I like centers because we don't use our workbooks.

### **Pastiche: What I Don't Like About Math Centers**

Math centers are noisy.

I like to work by myself.

I can't always work with my friends.

I don't get to do my workbook page.

The students in my class really seem to enjoy working in centers. There are a few who would rather work in the math workbook using pencil and paper tasks. But a majority of students had positive experiences with our centers and showed success while working using a hands-on approach. My low-level learners aren't as anxious as when they are able to demonstrate their understanding while using manipulatives.

### **Teacher's Expectations: Highs and Lows**

We have been working on strategies to use while subtracting numbers. We are just about finished with the chapter. As we work daily, it is no surprise to me, which students are struggling. They are the same core group of 5 students who have been struggling all along in math. Each day I am pulling them aside and giving them extra attention on the tasks we are learning. I am not sure that this is even proving to be effective or not. But, for me in my heart I know that I am giving it my all to help them feel success. Today was a huge success for me and

for my students. The lesson was on choosing an operation to use when solving story problems. I started the lesson by having my students act out story problems. I called different volunteers up to the floor. I would either ask more students to join them or ask some of them to sit down. I explained to my students that if I asked more to join them then we are adding. And, if I asked students to sit down then we were subtracting. We modeled problems over and over until I felt that they had a good grasp on what we were doing.

After a few examples, I began to write down the story problem that we were acting out. I asked them as a class to read the number sentence out loud. They all seemed to really get this! I was so pleased. Next we moved on to trying to solve a story problem without acting it out. I asked my students to use their fingers to show me either a plus or minus sign. I read the following “3 cows were in the field, 4 more joined them, how many were there in all?” They all put up a plus sign. I told them a few more stories and asked them to do the same thing. Most of them got the hang of this. I felt that they were ready to move on to the workbook page.

I sent them back to their seats and asked them to tear out pg. 63. I asked them to do the same thing about holding up their fingers after I read the story problem. Well, some of them got frustrated right away. It was almost like they shut down as soon as that page was ripped out. This was the same concept that we had been doing all along. I couldn't understand why they couldn't get it now.

They seemed to get it when we did a whole group lesson. We weren't doing anything new. The task was the same. They had the confidence when we were acting the problems out. But seeing that same task on a workbook page made them frustrated. I truly believed that they understood this task. They were participating the whole time. But, when it came to showing me understanding on a pencil/paper task they couldn't do it.

I pulled that group of 5 students aside again after the rest of the class completed the page with me. I sat them around me at our reading table. I read the problems again. I asked them to help me decide if we needed to add or subtract. They still struggled. We worked through it together but it was tough. I still had Charlie who did not know what certain numbers looked like. He kept solving the problem but then would ask 'what does an 8 look like?' So, he eventually could decide add or subtract but could not write the answer out because he did not know what the numbers look like. So I basically was conquering one task only to be met with another. But, overall I was very pleased with the way this lesson went today. It kept everyone's attention and most seemed to understand the task.

Later in the Chapter, I taught a lesson from the math book on how to use the number line. I modeled the lesson with my whole group. I drew a number line on the board. I asked if anyone knew what it was. Amy raised her hand and told us it was a number line. I then asked if they knew what we did with it. Charlie said that it is what his name is written on. We have nametags with

number lines on them. I am hoping that was what he meant. Tom then told us that it was to count with. I explained that a number line was another strategy that we could use to help us add and subtract. I wrote  $5+2=$  on the board. I showed them how to start at 5 and make 2 jumps to find the answer. We figured out that it equaled 7. I modeled a few more number problems on the board using the number line I made. I felt that most of them understood the task. I then asked them to go back to their seats and try it out on their workbook page. Well, I guess I thought wrong. I had over  $\frac{1}{2}$  of the class not sure what to do. I was running back and forth from group to group trying to help as many of them as I could. After about 20 minutes of pure confusion and frustration I gave up. I decided to throw in the towel and collect their papers until tomorrow. I guess I will re-teach this task tomorrow in a different way. I guess I will end up behind the rest of my colleagues because I refuse to move on to the next lesson if they don't understand this one. One of the reasons I am behind to begin with.

Since yesterday was a total flop I decided to try something different. I found out that a colleague had a walk on number line. I was talking about how my lesson bombed at lunch and she told me then that she had one. I changed my plans for today and decided to try this lesson again in a more hands-on way.

I started the lesson by reviewing what we did yesterday. I asked again what a number line was. I told them that today we were going to use a number line again but in a different way. I unrolled the walk on line and taped it to the

floor. I told them that this was an extra large number line but it is the same thing as the one I drew on the board. I reviewed how we ‘jump’ to find the answer. I wrote  $5+4=$  on the board. I called up Annie to show us where to start. She wasn’t sure so I called on Tom to help her out. He told her that the first number is 5 so she needed to be there. Annie walked down to the number 5. I called on another volunteer to tell us how many jumps Annie needed to do. John told her that she needed to jump 4 times. The class counted as Annie jumped. She then looked down at her feet and say 9. I wrote 9 as the answer. I modeled more examples by calling up volunteers and having them act out a given number problem. I repeated the same format as above.

They enjoyed this lesson. We did not use books or pencils at all. They were very attentive and on task. I closed out the lesson by calling each student up one at a time to act out a problem on the number line. I wrote the problem on the board and they then acted it out and gave me the answer. I wrote out their answer so they could see the connection. It was a totally different lesson than the one from yesterday. I could see the looks of success on their faces. Annie said to me “I get it now this is easy”. They all demonstrated to me that they understood this task.

I guess I was feeling brave. I handed back their math page from yesterday. I walked around as they worked. And it was amazing. They all actually were able to complete this task today. I couldn’t believe my eyes. They

got it today. I was extremely pleased that this worked. It amazed me to see the difference in the levels of their understanding. Even my low kids seemed to get it today. They all finished their math page without any help from me. This approach allowed them to use a different strategy other than just figuring it out with their pencil. They were able to get up and physically act out how to solve a problem.

### **Interviews and Surveys**

I sent home a survey to the parents/guardians of my students. The survey was 1½ pages long. I asked parents some questions that I think are important to the development of my students in math. I strongly believe that these questions would help me better to understand where my students are coming from, their background and the importance that is placed on math at home. Well out of 21 students, I only had 4 parents return the survey. One of them was a Spanish-speaking parent who tried her best to answer the questions. Her responses were in Spanish and English. These surveys were to give me valuable information about my students' backgrounds. It frustrates me that my parents can't take a few minutes and write down their feelings about math. I understand that some of them did not want me to use their information in my study. But, it makes me sad that they can't take a few minutes to help better their child's education. It really wouldn't take them that long to answer some questions and it shouldn't require

much too much thinking on their part. But I am coming to the conclusion that my parents this year are not going to be very involved in their learning process. It is just another frustration for me. How can I get my parents to be excited about what I am trying to teach their children? Will they be supportive of the experiences that their children are going to have in math class?

### **Pastiche: Parents' Feelings on Math**

Mathematics is confusing to me.

Mathematics has always been one of my favorite subjects.

I use math everyday at my job.

Math is extremely important in a grown-up world.

### **Pastiche: Parents' Feelings on Math Games**

Math games make learning fun.

They keep a child interested in the activity longer.

Games are important but they need reinforcement like homework.

Students can learn when they are playing a game.

Games teach the children how to have fun while learning.

I interviewed my students on a random basis throughout my study. I either interviewed them in a small group or on an individual basis. I used the

same list of interview questions. (Appendix H) This task proved to be difficult for some of my students to handle. At this time in the school year it was difficult for some of them to understand the questions I was asking. They had trouble understanding the question no matter how I asked it. I couldn't seem to make them understand or they would answer the question the same way their friend did.

Below is some dialogue from a group interview on the students' feelings on math in general.

Teacher: Math is....

Student 1: Important

Student 2: Fun

Student 3: Learning

Student 4: All about numbers

Teacher: The best thing about math is.....

Student 1: It is fun.

Student 2: We get to learn.

Student 3: Learning new things.

Student 4: Doing separating problems

Teacher: The worst thing about math is.....

Student 1: Nothing, I really like math.

Student 2: If you get stuck and the teacher can't help you.

Student 3: Nothing, I like it.

Student 4: Writing it all out.

Teacher: In math class I like to work alone/in groups because....

Student 1: I like to work together. We can help each other.

Student 2: I like to work alone so I don't have to stop and help someone.

Student 3: I like groups because it is more fun.

Student 4: I like working with my friends.

### **Student Surveys or Pulling Out My Hair?**

I surveyed my students on their feelings about doing math. I completed the survey in a whole group setting. I handed out the surveys (Appendix E) to the students. I literally went step by step with each question. I had them put their finger on each number. I read the question out loud and reviewed where the smiley face was that they needed to circle and what each face meant. They were then to choose their answer. This was a lot easier said than done. I had students circling the smiley at the top of the page. I had some putting 'x' all over their papers. And I also had some that just were circling every smiley in the row. This added to my frustrations. This activity showed me how difficult it is for my students to follow step-by-step directions. I imagined that this activity should

have been 10 minutes. But, in the end it took us half an hour to answer just 5 survey questions.

I surveyed my class again at the end of my study. The experience was a little less stressful this time. I think that my students have begun to mature and were able to follow the directions. My students enjoyed helping me with my “homework” for my class and they were excited to know that this survey was part of my study.

### **Mathematical Journey: The End of my Story.....But Not the Journey**

I continued to work using the constructivist approach in my math classroom. In addition to doing math centers every Friday, I also implemented using the hands-on approach daily as part of my regular teacher directed lessons. I would either begin or end my lesson with a hands-on activity. I wanted my students to continue to use this approach in their daily math activities alongside the teacher directed activities of my math series.

My students really seemed to enjoy using hands-on activities in our classroom. They now ask me if we are doing math centers on Friday. They look forward to doing a whole hour of math games and activities. The games take the stress off of knowing how to answer the question right and instead turn it into learning how to figure it out through problem solving.

My journey began out of pure frustration over trying to get it all done. I was trying to fit in everything that I needed to cover to meet the standards provided by my school district. I realized that my students this year were not mentally ready to handle what I was trying to teach them. I needed to take a step back and look at their academic needs and change my curriculum to try to meet all of them. I couldn't sit back and watch my students struggle like a fish out of water. I wanted to change my teaching in order to make them feel more comfortable and allow my students to gain the confidence that they needed to be successful in their math journey. This is one journey that I continue in my teaching on a daily basis. My study is done and over but this mathematical journey is one that I intend to continue.

## **Methods Of Analysis**

According to Ely, et al. (1997), “Qualitative analysis requires that the researcher go back again and again over the accumulated log material in a process that for many has a cyclical feel” (p.175). I reviewed the data I gathered in my researcher field log on a frequent basis. I went back to my data at the end of that school day and reread over my field log entries. I then wrote in my observer comments, I revisited my log often and reread my entries and observer comments again and added any new insights that I had. I labeled any additional comments that I had “OC” and I dated them when I wrote them (Bogdan & Biklen, 1998).

After I wrote an entry in my field log, I went back to that entry and labeled the data with codes. Ely, et al. (1997) state that coding is a common starting point for researchers. These codes allow researchers to identify a common meaning within the data. As I read through my data, I searched for common connections between the information that I was gathering. For example, when my lesson in math called for using a hands on approach or a math game, I labeled that section HANDS ON APPROACH. I used this code in my field log whenever I felt that the lesson was using constructivism. I then organized all of my codes into an alphabetized list. The list included the page numbers on which all of the codes could be found throughout my log.

The process of coding my field log was on going. Ely, et al. (1997) stated that the interweaving of data collection and analysis is highly transitional, each

activity shedding new light on and enriching the other. I went back to my field log periodically and added new codes on top of the codes I already wrote down. This process was not finished until my study was finished. I was always looking for different codes that lead themselves to my data.

When I was finished coding my log, I then sorted my codes into different categories called bins. According to Ely, et al. (1997), bins are the ‘original rough categories’ that we place our codes in to and “sorting coded data into bins helps to bring order to the mass of otherwise unmanageable data” (p. 164). I sorted my codes into bins that I thought related to each other. For example, I took my codes STUDENT NEGATIVE REACTION, TEACHER NEGATIVE REACTION and TEACHER CONCERNS and put them all into a bin titled CONCERNS. All of these codes dealt with concerns that I had. After coming up with bins for my codes, I arranged my bins into a graphic organizer. I organized my bins in an order that allowed me to look for their connections to one another. (see Figure 1 on p.68 )

After I completed my graphic organizer, I used the connections I made to form my theme statements. Ely, et al. (1997) defines a theme as a “statement of meaning that runs through all or most of the pertinent data” (p. 206). I searched my bins looking for all of the similarities. I then took those similarities and arranged them into an organized list of themes that I felt were seen throughout my data.

I went back through my data often. I reviewed and coded it frequently. By doing this, I began to see the small successes that my students were making and where in my curriculum they continued to struggle. I was able to track their experiences using constructivism and see whether they were able to make the connection between what they were doing with manipulatives to their pencil and paper tasks. I then wrote analytic memos (Bogdan & Biklen, 1998; Ely, et al. 1997), about the positive and negative experiences that my students and I had while using this approach in our math classroom. I then compared the memos to confirm or dispute my findings.

I also surveyed my students weekly on their feelings about the math activities. I asked them what was best and worst part of math that week. This information allowed me to see if there were any connections between my students enjoying math and using the constructivist approach. The survey also allowed my students to share what they learned in math that week.

I intended to gather information from my district's Title One math assessment. However, after administering the pre-test, I decided that at this time in the year I would not get enough results for it to be relevant to my study.

I collected and analyzed student work samples to monitor the progress or failures of my students while using the constructivist approach in my math class. Their work samples helped me to see the progress they were making and change my plans accordingly.

I also analyzed my data by looking through the “lenses” of other researchers. Their work allowed me to see other perspectives that guided my study and provided with the support needed to move forward. Their research allowed me to gain insights about other “lenses” that I might not have seen without reading their work. I examined my practice through traditional, progressive, dialogical, social constructivist, linguistic, cultural, and socioeconomic lenses. I found similarities in their theories that worked in my classroom. I wrote reflective memos throughout the course of my study that related to my teaching practice and my study. These memos were based on my readings of Delpit and Dowdy (2002); Dewey (1938); Freire (1970); and Vygotsky (1978). Reading their work gave me insight to my own teaching practices.

Figure 1. *Bins and Theme Statements*

<p><b>Research Question:</b> <i>What are the observed and reported experiences when using constructivism in a first grade math classroom?</i></p>	<p>1. Classroom routines</p>	<p>2. Background knowledge *Review</p>	<p>3. Grouping *Small group *Whole group *One on one *Behavior</p>
<p>4. Discussions *Student Talk *Teacher led activities *Share time</p>	<p>5. Observations *Student interactions *Hands-on activities *Written tasks *Frustrations</p>	<p>6. Student interaction *classroom management</p>	<p>7. Colleague assistance  8. Parent Involvement *Home experiences</p>
<p>9. Assessment *Written *Pencil/paper tasks *Problem solving strategies *Student work *Surveys *Interviews</p>	<p>10. Frustrations *Student *Teacher *Behavior concerns  11. Concerns *Teacher *Student</p>	<p>12. Benefits *Student reaction – positive *Teacher self-reflection *Student successes</p>	

### **Theme Statements**

1. Classroom routines lay the groundwork for student achievement and engagement.
2. Background knowledge is a vital part of a student's success in their mathematical learning.
3. Student grouping determines the success of students when working on math tasks.
4. Observations of student interaction, hands on tasks and written tasks provide valuable information that links success and frustrations to the constructivist approach.
5. Discussions, both student to student and student to teacher are a constant key element of constructivism.
6. Student/teacher interaction is a vital component in my classroom, students need to explore together with other students.
7. Colleague assistance provides support to the teacher, helps in assessing student achievement and allows the teacher to look at data from another point of view.
8. Parent involvement or lack of involvement is linked to the success or failure of students in math.
9. Assessments should be used to assist in the development of instruction not just as a grade.
10. Frustrations, both student and teacher should be expected when implementing the use of constructivism during math time and maintaining its success
11. Constructivism provides solutions to the problems faced by teachers and students

## **Findings**

The overall theme of my study is that using constructivism during math time is crucial to struggling students in order for them to feel success. The constructivist approach allows students to use materials other than just a paper and a pencil to solve their work. Through constructivism, the students are exposed to using manipulatives. Constructivism provides a framework for students to solve a problem in a way that is comfortable to them. Some of my more capable learners have the background needed to be successful in math with teacher directed activities however; many of my students have not yet developed basic number sense that is needed to be able to move forward in my math curriculum.

Classroom routines lay the groundwork for student achievement and engagement. Establishing the basic routines in the classroom is a vital part of the beginning of the school year. When setting up the routines, students are seeing and learning the expectations of their classroom. Students at the beginning of first grade need a lot of modeling and repetition in order to learn how the class flows. Many of them have not been exposed to being in school all day. This is a big transition for them. When the teacher takes the time to lay out the class routines at the beginning of the year, there is less time spent on dealing with classroom management problems teaching later on. It may seem repetitious at first, but it is

worthwhile to spend the time repeating the routines. Over time the students learn the routines and are confident to carry them out on their own.

I use the same routine daily as part of our calendar activities. I spent about two weeks modeling the routine each day. After that, the students knew the expectation and began to do this on their own. Each day a student volunteer completes calendar and shares with the class. They have developed the confidence to complete this routine on their own. I allowed them to be active in the modeling of the class routine and it soon became part of their ritual. This routine stresses many of the mathematical tasks that are taught as part of our math curriculum such as counting tens and ones, money and graphs.

Background knowledge is a vital part of a students' success in his/her mathematical learning. Vygotsky (1978) states, " Any learning a child encounters in school always has a previous history" (p. 84). It is important for the teacher to take the time at the start of each school year to learn the background knowledge of each student. The students all come to school with different experiences and knowledge about the world around them. They are all individual students not carbon copies of each other. Not all first grade students come into the class knowing all their numbers or even what a number represents. The teacher needs to take all of this into consideration when planning out his/her math lessons. It is important to spend the time reviewing the skills that were introduced previously

and giving the students multiple exposures to these skills. It is important for teachers to build upon what students can already do by themselves.

For me, this was one of the hardest aspects of my study. I found that I had so many different levels of students. I have students who can count to 100 without stopping and I have those who can't count to 10. It was extremely frustrating to do a whole group, direct instruction lesson on number patterns when a small group of students can't identify the numbers. I found it very valuable to spend time getting to know each student's background knowledge. This helped me to plan my instruction for each student or small groups of students. I was able to group students with similar needs together and work on the skills that they were lacking. Knowing your students background knowledge is important in the beginning of the school year.

Student grouping determines the success of students when working on math tasks. I used four different types of student groups during my study; whole group, small group of 4-5 students, partners and one on one instruction. I initially started my constructivist lessons in a whole group setting. My lessons required a lot of teacher guidance and instruction. I started off each lesson in a whole group setting by introducing the materials and modeling the task with a student volunteer. After the students had an understanding of the task, they were divided either into small groups or partners. I began to rely on student partners helping each other out if one of their group members didn't understand the task. I felt that

sometimes students learn better when they were allowed to work with a peer rather than just the teacher. If the student continued to struggle, then I pulled them one on one for more instruction and guidance away from their group.

I thought that all students enjoyed working with a partner or a small group. And when I analyzed my student surveys and interviews this seemed to be the case. Most of my students liked working together with their friends. They said it was more fun to work with someone who can help them out if they get stuck. However, there were a group of students who preferred to work alone. They did not like having to stop their work to help someone and they could work at their own pace and not have to wait for a partner to catch up. In some instances, I did have to pick a partner for several peers. Charlie, Annie and Charlotte needed the consistent help of a more capable peer. I made sure they were with a peer that would not get upset by their challenges but, work with them in a way that was helpful to building their confidence.

Annie demonstrated that she had confidence while working with a partner during a game of “Off and On”. This concept was one of adding 2 numbers together to figure out how many there were in all. Annie played this game with so much confidence. At one point I overheard saying “I get this, it is so easy!” She was very excited to play. Her partner helped her out if she got stuck. However, the next day I asked her to complete the same type of task on her own

in her workbook. She was a totally different student. The smile was gone from her face and she didn't seem to have the confidence she had the day before.

Charlie and Charlotte still seemed to need a little extra support from me during partner activities. But, I did notice that they seemed less frustrated during center activities.

I had a concern about classroom management during math center time. I feared that it would be extremely noisy and chaotic. At the beginning of my study it was a bit noisy. My students needed the time to explore and play with the manipulatives before we got into using them as a learning tool. After a few days of practicing our routines and rules of the math centers I was no longer concerned with the noise. Through observations, I noted the noise was related to the tasks they were working on. Vygotsky (1978) believed that "A child's greatest self-control occurs in play" (p.99). My observations noted that my students had developed a great deal of self-control while playing our math games. The child learns so much through the experience of play. But, the most beneficial lesson they learn is that of self-control. They learned how to solve conflicts when they arose and the will power to finish the game. Many times the reason behind playing a game is simply just to learn how to play a game. The students learned so much while playing simple games. Using constructivism allowed them to opportunity to explore the game while learning the math concept behind the game.

My students know to expect math games every week. They have learned the self-control to play these games that is needed to move from noise and chaos to actual learning from the game. I noticed during one particular game of On and Off that John, a student who is usually off task, was on task and playing the game with his partner. He struggles with keeping in his space. But, during the game he was doing exactly what was expected of him. He had the self-control that I would like to see in him all throughout the day. It really surprised me. He could have this self-control during a “play” activity.

Observations provided the most valuable information for my study. I observed the students interacting with each other and myself. I found that my students were more comfortable asking for help from a peer than they were asking me. They enjoyed taking on the role of teacher instead of student. I was concerned at first that my shy students wouldn't interact when paired with a more outgoing student. But, this wasn't the case. They didn't feel threatened by each other but viewed each other as equals. I credit this peer interaction to the success of my students during math centers. They learned just as much from each other as they learned from me. The students were able to become active in their own learning (Brooks & Brooks, 1993). They worked through a problem together, talking it out as they went along. Using the observational checklists (Appendix I) allowed me to take note of the methods my students used to solve problems.

I also observed the use of manipulatives during math centers. I was interested in seeing if there was a link between the use of these manipulatives to the success of my students, especially my low level learners. I modeled and reviewed how to use the manipulatives in a whole group setting prior to letting the students use them in small groups. At first my low level students continued to struggle with the math tasks even with the manipulatives. But after a few lessons, I saw the improvement in their abilities. They began to gain more confidence in what they could do. These students could work on improving their ability in math while exploring with the math counters, blocks and cubes instead of just writing an answer on a piece of paper.

Charlie continues to have difficulty with identifying and writing his numbers. He can use manipulatives to demonstrate to me that he knows how to get the answer. But, he then struggles with knowing how to write the answer down. He can demonstrate that he figured out how to solve  $3+4=$  by using counters. He knows the answer is 7 but he doesn't know what a 7 looks like to write it down. Is it enough to show me how to solve a problem? Or does he need to write the answer? Constructivism allows students like Charlie to demonstrate their understanding in a way that they can, not by just writing down an answer.

I quickly began to come to the conclusion that I did not only want to rely on written tasks as an assessment of my students' understanding of the math task. I saw my low level learners go from confident to frustrated in a blink of an eye

when they were asked to complete a written task. I realized that I was in control of the materials they could use to complete the task, but I am not in control of the emotions that they feel when asked to actually complete it. I can't control the fears, tears or tantrums. But I could provide the experiences that allowed them to explore a way in which they feel comfortable using. They still needed reassurance that they could solve the math problems with the counters, etc. and still get to the right answer in the end.

There was a lot of discussions going on in my classroom, both student-student and student-teacher. I abandoned the thought of me just being the one who is doing the talking in my classroom. I wanted my classroom to be full of dialogue that leads to learning. Freire (1970) states that "The teacher is no longer merely the one who teaches, but the one who himself taught in dialogue with the students, who in turn while being taught also teach. They become jointly responsible for a process in which all grow" (p.80). This was evident in my study. Through allowing this dialogue, my students became more comfortable helping each other out and accepting help from each other. They looked at their peers as another teacher, not someone who was smarter than them. These discussions opened the door for my students to learn how to take responsibility for their learning and not just repeat what they hear me say. Dialogue provides an important part in constructing one's own knowledge. The students and teachers talk with each other about the mathematic concept or problem that they are working on. This

talking leads to conversations or discussions that build upon knowledge that the students already have. With these conversations, the teacher is not the sole source for knowledge and each individual is provided with the opportunities to communicate their ideas.

Dialogues and conversations help to benefit the students to meet some of the Pennsylvania State Standards for math. Some of these standards require that students be able to describe appropriate problem solving strategies (2.5 A) and describe what information is needed to solve a problem (2.5 B), name and order the months of the year (2.3 C), etc. The words describe, explain and name are mentioned in many of the standards for first grade. I believe that by allowing my students to hear me model the dialogue with them and also use the dialogue with each other, that I am making it easier for them to be able to talk about what they are doing in their math situations. I think that these conversations and dialogues allow the students to feel comfortable talking about math. These standards continue to build upon each other through each grade. I think that using the constructivist approach allows for the foundation to be put into place for these standards to continue to be met.

I realized that this was the hardest part of my study. I had to learn to take a step back and allow for these discussions to take place. I have a talkative bunch of students in my class. At first they enjoyed talking about anything and everything. I needed to step in and redirect the conversations back on task. I

spent a lot of time modeling how the discussions should flow. I modeled and joined the conversations a lot at the beginning. But, overtime I was able to take that step back and allow my students to do the talking. They were able to contribute more to the talking and in turn take the responsibility for their learning.

By allowing my students the opportunities to have these discussions, also allowed for more student/teacher interaction in the classroom. Using constructivism provided the opportunities for my students to explore together with each other in mathematical situations. I needed to take a step back and loosen my control over the lessons and allow my students more freedom to explore on their own and with each other. Vygotsky (1978 ) states “learning awakens a variety of internal developmental processes that are able to operate only when a child is interacting with people in his environment and in cooperation with his peers” (p.90). Student interaction was a vital part of my study. My students were actively involved in all aspects of their own learning. They are grouped cooperatively and given many opportunities to talk with their peers as they are working. I realized that many of my students learned as a result of engaging in these discussions rather than listening to me just teach it out loud to them.

In addition to doing math centers in my classroom, I also worked with 2 colleagues every Friday on Investigations centers. This provided me with support in assessing my students’ achievements and allowed me to look at my data from another point of view. I was able to take my concerns and celebrate my

excitements with them. These colleagues provided me with valuable assistance and much support throughout my study. It was also very beneficial to me to have my teacher inquiry support group. They also provided me with the support and encouragement that I needed to continue when I thought all hope was lost. Was I helping my students learn to be autonomous thinkers? Was all of this just making more work for myself? It was important to have my colleagues that showed me that I was headed in the right direction and using the constructivist approach were working to help my students feel success.

Another important component of my study was parental involvement. I strongly believe that their involvement or lack of involvement is linked to the success or failure of some of my students. For some students, it doesn't matter what their home life is like. They have natural ability to do well at academic tasks. But for others, they need as much support as they can get to be successful. The teacher's role is to provide the opportunities at school for his/her students to explore. It is important for the parents to reinforce the skills learned in school at home. Unfortunately this was not the case for the majority of my students. It was evident in my parent surveys that many of my parents do not put education first. They do not take the time to work with their child at home and did not complete my survey. Those few parents who did take the time for my survey are those of the students who do well in my math class. They all are actively involved in my class activities and volunteer their time. I realized after my parent surveys that I

would not have the parental involvement this year that I was hoping for. I needed to give my students as much support as I could at school because they would not get it at home.

I was hesitant at the beginning of my study because I wasn't sure that I would be able to assess my students in a way that would be reflected on their report card. How could I justify a grade for playing with math cubes? I was always told to make sure that you have grades in your grade book to support the letter grade that you gave on a report card. I was concerned that I wouldn't be able to do this if I was using the constructivist approach in my classroom. I put these fears on the back burner and decided that this was the approach I wanted to use. I soon realized that it was more important for me to use my assessments to assist in the development of my instruction not just as a letter grade in my grade book. If a lesson did not go well, I re-taught that lesson again using a different means of instruction. It was important for my students to understand the task at hand, not that I had a grade to show for it.

I also used many different forms of assessment, not just an end of chapter test. Many of my students could show me their understanding on the task when allowed to explore with manipulatives. However, could not transfer that understanding when given a pencil/paper task. Does this mean they didn't understand the task? They could show me what 3 red counters and 4 yellow counters equals, but couldn't figure out on paper  $3+4=$ . After a few conversations

with myself, I convinced myself that it was enough to use the counters. They showed me they understood how to add 2 quantities together regardless of the method they used to get to the answer.

Throughout my study I also used student work as a form of assessment. I collected work samples as my study went along. The samples documented the growth of my students over the course of my study. In the beginning my low level students still had a difficult time with completing the tasks. But, after a few times modeling and reviewing the expectations, they caught on and felt more at ease and were able to complete the tasks on their own or with the help of a peer. The games that I used demonstrated their understanding of the mathematical task that we were working on in our math book. I realized that the method they used to show me that they understood wasn't important as long as they understood the task.

Using the constructivist method in my classroom provided me with the solutions to my problems that I was having in my classroom with my low level learners. I would teach a lesson to the whole group and then turn around and re-teach the same lesson to my small group of low level learners who didn't understand the lesson. This was taking too much time away from the rest of my learners. I felt that it wasn't fair to them to miss out on more instruction time because I needed to spend the additional time with this small group. I wanted to be fair to all of my students. Constructivism allowed me to work with all of my

students at the same pace. It gave me more time to monitor all of my students as they worked. I was able to step back and take on more of a role as facilitator and not just teacher. It was difficult at first for me to give up this control. But, the more I stepped back, the more my students were able to accomplish on their own. They were starting to figure things out how to problem solve without always asking me for help. I observed conversations where students were problem solving to figure out how to combine 2 numbers to equal 10. They were talking how to lay out the colored counters in two different piles and then count how many were in each pile. These were students who were always quiet during our math lessons. They were afraid to talk for fear that they didn't know how to do the math problem. Now, they were talking like they had all the confidence in the world. Those fears of not knowing were alleviated and replaced with feelings of success.

As with starting anything new in the classroom, it is important to expect some frustrations from both the teacher and the students when implementing and maintaining the success of the constructivist approach. It takes time to get this approach up and running in the classroom. It is important for the teacher to spend the time reviewing and modeling the classroom expectations during hands-on activities or they run the risk of creating a chaotic classroom. But if the teacher takes that time, it will be worth it in the end to create a classroom full of autonomous thinkers.

My biggest frustration was the lack of parental involvement. Most of my parents this year do not know what our math curriculum is let alone that I made the change to add constructivism into it. I believe that it is extremely important to have the support of the parents. If they don't understand the constructivist approach, they may not feel that math is being taught in the classroom. It is important for my students to be excited about the learning that is going on. But, how can I get the parents to be excited about what I am trying to teach their children?

It was also difficult for me to not to feel frustrated with my students who came to my class without knowing what their numbers were. I was expected to keep plugging away at the curriculum with students who can't identify and write their numbers. They needed more support from me. But, in our jam-packed day it was hard to find the time to give them that support. And, if I could find a few spare minutes, I ran into the problem of what to do with the rest of my class while I am working with them. It wasn't fair for those who were done to wait for those who needed the help. And it also wasn't fair for those who struggled to fall farther behind because they need the extra help. The more involved the math lessons got, the more my low level learners struggled. How was I supposed to teach them how to add 2 numbers when they don't know what those numbers are? Using constructivism, in the form of math centers, allowed me to group these students together and spend more time working with them as the rest of the class

worked at their center. I wasn't just giving them something to do while I worked with those who needed extra support. It wasn't a waste of time or just a period of busy seatwork. I was able to give the extra support to my low level learners while they worked at their center. It was a fair solution for the whole class.

My students also felt some frustrations throughout my study. They were connected to the frustrations that I felt. They struggled with identifying and writing numbers. It was hard for my low group to take what they learned during our hands-on activities and apply it to the written tasks in their math book. They could show me their understanding by manipulating counters but as soon as I asked them to take out a page from the book they shut down. They were allowed to still use the counters. But, seeing the problems on the page frustrated them. At times students in my low group would shut down completely and not even attempt to try their work. According to Delpit & Dowdy (2002) "refusal to do work was not just stubbornness but a ploy to cover up their inability...." (p. 110). I see this daily in my classroom. I see students using avoidance techniques because they simply do not know how to do the work. The teacher gets frustrated when the students do not finish the work. They fall farther behind. The teacher usually just accepts what they have done because they need to move on, this, in turn, allows the students to fail and they see that the teacher is accepting of the failure.

I was not willing to accept this failure in my students. I saw the best in all of them and I wanted them to see it as well. I wanted to teach my students that instead of refusing to do a task because it is too hard that they need to try another approach. Their inability shouldn't be a reason to not complete their work. The constructivist approach allows for student choice. I enabled my students to see that they have a choice. I showed them that I will not permit them to fail but instead teach them how to success.

However, putting all frustrations aside, it was worth it to see the smile on some of my students' faces when they understood the task. They gained confidence in themselves that they were capable of doing what they thought were hard math tasks. Using constructivism allowed me to actively involve my students in their own learning. The students were given the opportunities to make their own choices.

Constructivism is looked upon as the "new way" to teach. It has been around for quite some time. Many educators are just now hearing about and trying this approach to teaching. It is a proven method to use to teach young children. Yet many shy away from using it due to the extensive planning that goes into using it on a daily basis in the classroom. It is a lot harder to "set up" a constructivist lesson than it is to a traditional, from the book lesson. I just know from my own experiences that much more thinking goes into my lessons now that I have used this approach in my math lessons. Students do benefit from using this

approach in the math classroom. They are able to learn at their own pace. It is worth the time and effort that need to go into using this approach. The “new” road of constructivism is more strenuous than the “old” way of traditional teaching. But, using a combination of both is worth it in the end.

### **Where Do We Go From Here?**

I have continued to use hands-on activities along with my regular math curriculum. I have found this to be very beneficial to all of my students. It allows my average and above average students a different and sometimes more challenging way to look at math. And it offers my low level students the extra support that they need to gain their confidence. I believe that there should be a blend of both constructivism and “regular” math being used in the classroom. There isn’t one right answer to which method is best for all students. Just as all students are different, each of these methods is also different. They both offer so much to the learners when used separately. But, I think when a teacher can combine both methods into one they are giving the students the best of both worlds, so to speak.

My students still look forward to doing math centers. But, since my study has ended, we only meet every other week instead of weekly. My students ask me every Friday if it is “math center day.” They get so excited when it is. They

don't know what 3 centers we are doing that day but they still can't wait to get started. They just enjoy doing math in a fun and different way.

I am very pleased with the progress I have seen in all of my students throughout my study. My low learners were given the boost that they needed to believe that they could be successful at a task that always brought them frustration before. And my average and above average students were given an additional tool that they can use to continue to be successful.

I plan to continue to use constructivism in my classroom for the remainder of this year. My students know the routines and the manipulatives. I am able to allow more time exploring and less time modeling the expectations. I believe that giving my students the opportunities to explore has also given them the confidence to be more independent learners. I will continue to use this approach in my future classes, regardless of the grade I am teaching.



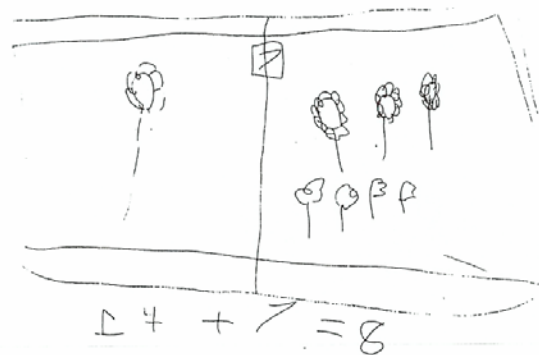
**Examples of Student Work**

*Figure 3:* Sample of Counters in a Cup.

*Figure 4:* Sample of How Many.

$$\begin{array}{l} 2 + 8 = 10 \quad 8 + 2 = 10 \\ 1 + 9 = 10 \\ 3 + 7 = 10 \end{array}$$

*Figure 3:* This student showed how many counters they had by writing out the addition sentence.



*Figure 4:* This is an example of "How Many." This student drew flowers to solve their number sentence.

### Examples of Student Work

Figure 5: Samples of On and Off math activity

Total number	<u>9</u>
On	Off
2	2
7	1
3	5
5	3
8	0
6	2
7	1

Total number	<u>8</u>
On	Off
5	3
5	3
6	2
8	0
5	3
7	1
8	0
8	0

Figure 5: These are two samples of student recording sheets for the game "On and Off." Students record counters that land on and off their papers.

### Examples of Student Work

Figure 6 : Sample of Counters in a Cup

Figure 7: Sample of On and Off

Total number 8

On	Off
4	4
4	4
5	3
3	5
6	2
5	3

Figure 6: Another sample of Counters in a Cup.

yellow red

9 and 3

8 and 6

3 and 9

2 and 6 ✓

2 and 4

7 and 5 ✓

2 and 2

and 8

Figure 7: Another student sample of On and Off game.

Examples of Student Work  
Figure 8: Sample of How Many

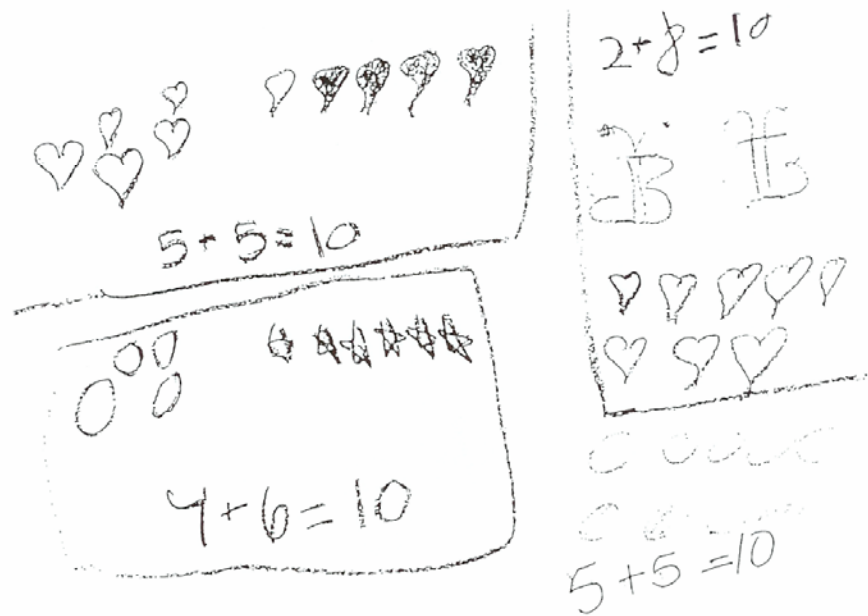
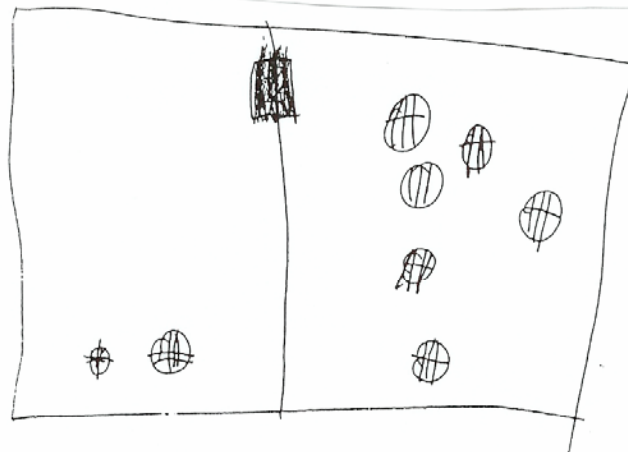
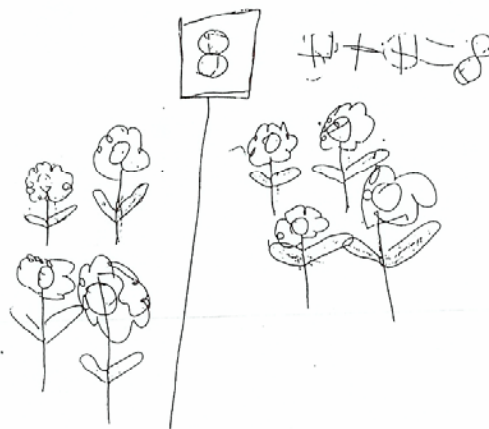


Figure 8: This student used various shapes to depict how many they had when writing a number sentence for the number ten..

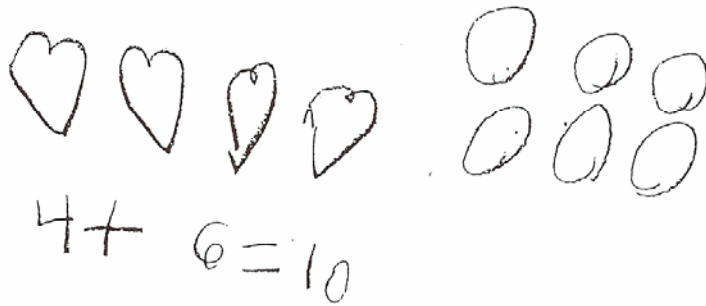
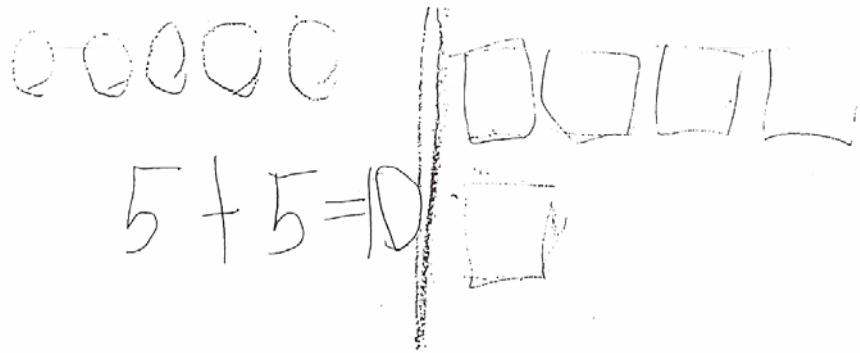
**Examples of Student Work**  
*Figure 9: Samples of How Many*



$$\underline{2} + \underline{6} = 8$$



*Figure 9:* These are two more examples of how students drew pictures to solve a number sentence for the number 8.

**Examples of Student Work***Figure 10: More samples of How Many.*

*Figure 10: These students used shapes to write number sentences for the number 10.*

Examples of Student Work  
Figure 11: Samples of How Many

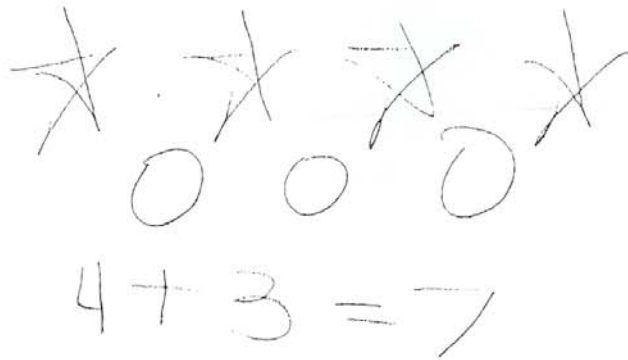


Figure 11: These students used houses and shapes to show how to solve a number sentence for the numbers ten and seven.

**Examples of Student Work**  
*Figure 12: Samples of Counters in a Cup*

12 and 0 is 12  
8 and 4 is 12  
5 and 6 is 12

4 and 5 is 9  
 3 and 6 is 9  
 7 and 2 is 9  
 1 and 8 is 9

*Figure 12: These are examples of the student recording sheet for the game Counters in a Cup. The students recorded how many red and yellow counters they had for the numbers twelve and nine*

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## Appendix A: HSIRB Approval Letter



August 30, 2005

Cathy Steely  
450 Arlington St.  
Easton, PA 18045

Dear Cathy Steely:

The Moravian College Human Subjects Internal Review Board has reviewed your proposal: Using a Constructivist Approach to Teaching Math to Low Ability Levels. Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note that if you intend on venturing into other topics than the ones indicated in your proposal, you must inform the HSIRB about what those topics will be.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

A hard copy of this letter will be sent to you through U.S. mail shortly. If you do not receive the letter by the time you need to begin gathering data, please do not hesitate to contact me. Also, please retain at least one copy of the approval letter for your files. Good luck with the rest of your research.

Debra Wetcher-Henricks  
Chair, Human Subjects Internal Review Board  
Moravian College  
610-861-1415 (voice)  
medwh02@moravian.edu

## **Appendix B – Principal Consent Form**

September 6, 2005

Dear Ms. Piazza,

During the 2005-2006 school year, I will be completing courses towards a Master's Degree in Curriculum and Instruction at Moravian College. The courses I am taking will help me stay in touch with the current teaching practices and methods that will help me provide the most effective learning experiences for the children in my classroom.

Moravian's program requires that I do a systematic study of my own teaching practices. The focus of my research study this year is the impact of using a constructivist approach to teaching math. We will be using the Investigations math series, which supports the constructivist approach to learning math. In doing this, I hope to learn whether this approach allows all students to succeed in their mathematic understanding and if they are able to apply the learned skills in their pencil and paper tasks. This study will take place from September 6, 2005 to December 30, 2005.

As part of my study on the constructivist approach, I will be observing the students during independent center activities and reflecting on how the learning of their math concepts is progressing. I will be collecting students' work in a math folder and analyzing their progress. I will also be interviewing interested students about their thoughts and feelings about their experiences learning mathematics in our classroom. Finally, the students will be asked to complete a survey before and after the study to express their feelings about the math we are doing.

All of the children in my classroom will be participating in the Investigations math activities as part of our math program. However, participation in this study is entirely voluntary. The students may withdraw at any time during the study by verbally telling me that they do not wish to participate in the activities surrounding my study. The parents of my students may choose not to allow them to participate in my study. They will need to sign a consent form allowing me to use the information gathered on their child. The students' grades will not be affected in any way if the parent chooses not to have them participate. Parents may also withdraw their student at any given time during the course of the study. They will need to contact me through a written note indicating the reason for withdrawal. However, information collected prior to the withdrawal may still be used when reporting the findings of this study.

All of the children's names will be kept confidential. All students will be given a pseudonym to protect their identity. I will be the only one with the pseudonym key. This will not change the content of my study in any way. Neither the child's name, nor the name of any other student, faculty member, cooperating teacher or cooperating

institution will appear in any written report or publication of the study or its findings. Only my name and the names of my sponsoring professors will appear in this study. All materials will be kept in a secure location.

My faculty sponsor is Dr. Joseph Shosh. He can be contacted at Moravian College by phone at (610) 861-1482 or email at [jshosh@moravian.edu](mailto:jshosh@moravian.edu).

If you have any questions or concerns about my project, please feel free to contact me at school or email me at [steelyc@eastonsd.org](mailto:steelyc@eastonsd.org) . If not please sign and return the bottom portion of this letter. Thank you for your cooperation.

Sincerely,  
Miss Steely

I attest that I am the principal of the teacher conducting this research study, that I have read and understand this consent form, and received a copy. Cathy Steely has my permission to conduct this study at Cheston Elementary School.

Principal's signature: \_\_\_\_\_

Date : \_\_\_\_\_

## **Appendix C – Parent/Guardian Consent Form**

September 6, 2005

Dear Parents/Guardians,

During the 2005-2006 school year, I will be completing courses towards a Master's Degree in Curriculum and Instruction at Moravian College. The courses I am taking will help me stay in touch with the current teaching practices and methods that will help me provide the most effective learning experiences for your child.

Moravian's program requires that I do a systematic study of my own teaching practices. The focus of my research study this year is the impact of using a constructivist approach to teaching math. We will be using the Investigations math series, which supports the constructivist approach to learning math. In doing this, I hope to learn whether this approach allows all students to succeed in their mathematic understanding and if they are able to apply the learned skills in their pencil and paper tasks. This study will take place from September 6, 2005 to December 30, 2005.

As part of my study on the constructivist approach, I will be observing the students during independent center activities and reflecting on how the learning of their math concepts is progressing. I will be collecting students' work in a math folder and analyzing their progress. I will also be interviewing interested students about their thoughts and feelings about their experiences learning mathematics in our classroom. Finally, the students will be asked to complete a survey before and after the study to express their feelings about the math we are doing.

All of the children in my classroom will be participating in the Investigations math activities as part of our math program. However, participation in this study is entirely voluntary. Their grade will not be affected in any way. I will lead a class discussion prior to starting my data collection that explains that they all will be participating in the activities and that I will be collecting data based on the work they are doing. I will also explain and demonstrate how to withdraw from this study. The students may withdraw themselves from the study by verbally telling me that they do not wish to participate in the activities surrounding my study or that they do not want their work included in my data. A conference will then take place between the student and myself to discuss the reason for their withdrawal. You may also choose to withdraw a student at any time during the course of the study. Please contact me through a written note indicating your reason for withdrawal. However, information collected prior to withdrawing may still be used in the study when reporting my findings. I will also be sending home a survey that you may choose to complete. This survey will be used as data in my

study. You are not obligated to complete the survey. If you choose to complete and return the survey, this will indicate to me your consent to participate in my study.

All of the children's names will be kept confidential. Their names will be changed to protect their identity. They will all be given a pseudonym. I will be the only one with the pseudonym key. These changes will not change the study in any way. Neither your child's name, nor the name of any student, faculty member, cooperating teacher or cooperating institution will appear in any written report or publication of the study or its findings. Only my name and the names of my sponsoring professors will appear in this study. All materials will be kept in a secure location.

My faculty sponsor is Dr. Joseph Shosh. He can be contacted at Moravian College by phone at (610) 861-1482 or email at [jshosh@moravian.edu](mailto:jshosh@moravian.edu). Ms. Piazza, the principal, has approved my study and can be reached by phone at (610) 250-2542.

If you have any questions or concerns about my project, please feel free to contact me at school or email me at [steelyc@eastonsd.org](mailto:steelyc@eastonsd.org). If not, please sign and return the back page of this letter. Thank you for your cooperation.

Sincerely,  
Miss Steely

I attest that I am the student's legally authorized representative and that I read and understand this consent form, and received a copy.

Legal representative signature: \_\_\_\_\_

Child's Name: \_\_\_\_\_

Date: \_\_\_\_\_

Appendix D – Parent Survey

Dear Parents/Guardians,

Please take a few minutes and complete this survey. All of the information will be kept confidential. Please answer all of the questions honestly and to the best of your ability. I am asking that you return the survey back to me by the end of next week. Please do not feel obligated to complete and return the survey. It is entirely voluntary. Completion of the survey indicates your agreement to participate in my study. Thank you for all of your cooperation.

1. Describe your personal feelings about mathematics.

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2. How important was learning math for you throughout your schooling?

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3. How enjoyable was learning math for you?

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4. How important is learning math for your child?

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5. Describe your child's confidence in their math skills

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6. How enjoyable is learning math for your child?

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7. Do you support the current math curriculum at our school? Why/why not?

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8. Do you feel playing games and using math centers are acceptable ways to learn new math skills? Why/ why not?

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9. Do you help your child at home with their math skills?

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10. What ways, if any, do you think our math curriculum could be changed?

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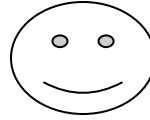
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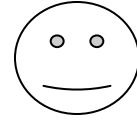
## Student Survey



no

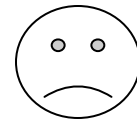
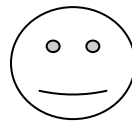


yes

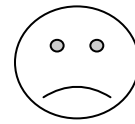
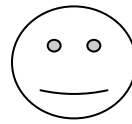
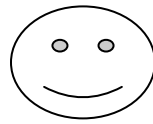


sometimes

1. Do you like math?



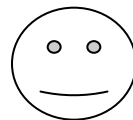
2. Do you like when we play games in math?



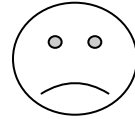
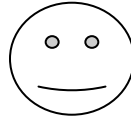
3. Do you like to do workbook pages in math?



4. Do you like when we use manipulatives during math time?



5. Do you like to do choice time activities during math centers?



## Appendix F – Weekly Survey

### Weekly Attitude Survey

Name \_\_\_\_\_

1. This week math was \_\_\_\_\_.

2. I liked when we

\_\_\_\_\_  
\_\_\_\_\_.

3. I didn't like when we

\_\_\_\_\_  
\_\_\_\_\_.

4. I liked \_\_\_\_\_ because it

\_\_\_\_\_  
\_\_\_\_\_.

5. One thing I learned this week was

\_\_\_\_\_  
\_\_\_\_\_.

## Appendix G - Student Interview Questions

1. Math is \_\_\_\_\_

2. The best thing about math is

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3. The worst thing about math is

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4. One way that I use math with my friends is

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5. My favorite part of math class is

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6. When I come to a math problem that I don't know how to solve,

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7. My math journal helps me to

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8. When I am doing math, I am really proud of the way I

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9. One thing I wish I knew more about in math is

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10. In math class, I like to work alone/ in groups because

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## Appendix H – Interview Questions

### One-on-one Interview Questions

The following is a list of potential interview questions that I used for my one-on-one student interviews.

1. Do you like learning math?
2. What do you like/dislike about learning math?
3. Do you think you are a good math student?
4. Why do you think you are/aren't good at math?
5. How do you feel when you are doing math?
6. Do you like playing games in math?
7. Do you like working in your center group?
8. If you could change anything about our math time, what would you change?
9. Has playing math games made you feel more comfortable about working in math?

## Appendix I: Observational Checklist

### Observation Checklist

Name \_\_\_\_\_ Date \_\_\_\_\_

Activity/ Group observed \_\_\_\_\_

Scale: 1 = observed      2= not observed      3 = not applicable

Solve problems and reasons		Teacher's Comments
Knows and applies problem solving process		_____
Knows and uses strategies effectively		_____
Calculates results accurately		_____
Explains results and reaches reasonable conclusions		_____
Contributes to cooperative group tasks		_____
Uses manipulatives properly		_____
Uses and links pictures and diagrams to numeric symbols and words		_____
Discusses questions, explains, justifies math thinking either orally or in writing		_____
Draws conclusions, organizes, records data using tables, graphs, number lines, scales, grids and geometric shapes		_____

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_