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TEACHER UTILIZATION OF COGNITIVE INSTRUCTION IN MATH FOR CHILDREN WHO ARE DEAF

A Thesis
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ABSTRACT

The purpose of this observational study was to decide whether or not a teacher trained in cognitive instruction did in fact teach according to cognitive theory. A teacher and four students were observed for nine lessons. Notes from the observations were scrutinized and classified into categories derived from a cognitive instruction checklist (Scheid, 1994). A pre and post test were also administered to the children to measure their individual gain scores. Evaluation of the observation notes support the conclusion that the teacher did, in fact, teach according to cognitive theory.

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CHAPTER I

INTRODUCTION

Review of Literature

Mathematics has evolved into much more than computational skills and rote learning of tables. It is no longer sufficient for children to simply know how to add, subtract, multiply and divide. Mathematics is testing theories, finding patterns, and estimating results (Chester, 1991). "Students need to be encouraged to learn mathematics by processes of mental construction and experience. Elementary school mathematics should access children's natural curiosities about patterns and their world" (Chester, 1991, p. 7).

Mathematics is a symbolic language revolving around abstract concepts. Teachers who teach deaf children realize the problems children who are deaf have with abstract ideas (O'Neill, 1971).

Many children who are deaf do not reach a level of mathematics understanding which is comparable to their hearing peers (Bunch, 1987). There is no research that proves cognitive deficits in deaf children. Therefore the cause for the discrepancy between hearing children's and deaf children's math levels is unclear (Bunch, 1987). Among educators, mathematics is not considered a subject of difficulty for deaf children, but as stated earlier, children who are deaf are behind their hearing peers in their mathematics understanding.

Professionals hypothesize about the reasons for deaf children's low math achievement levels. One factor contributing to deaf children's low math achievement is their often reduced facility with English. Deaf children may not understand mathematical language or terms, and this problem can hinder math reasoning skills (Fridriksson & Stewart, 1988).

According to O'Neill, hearing children grasp many mathematical concepts unconsciously with virtually no effort. Hearing children hear their parents or other people talk about math from a very early age. They hear people computing, counting money, discussing fractions ("you ate 1/2 of the pie"), and relating numbers ("I do not have enough money", "This is more expensive, etc."). Therefore hearing children have more experiences with math simply from an earlier exposure than do children who are deaf. Teachers of deaf children need to supply their students with the numerical cognitive experiences they lack.

Not only are low English language levels cited as contributing to deaf students' problems with mathematics, teachers of the deaf report a lack of confidence in their own abilities to teach math (Bunch, 1987). Deaf education teacher preparation programs focus on teaching communication and literacy. Teachers feel that they leave their college programs ill-prepared to teach mathematics.

This lack of preparation to teach mathematics leads to a prescribed textbook approach. Teachers depend too much on a more traditional method of paper and pencil tasks to teach math concepts (Bunch, 1987; Fridriksson and Stewart, 1988; NCTM, 1989; and O'Neill, 1971). The textbook presents numbers symbolically rather than with concrete objects.

In the discipline of education of students who are deaf, mathematics is not a frequently studied subject. Most of the research within the discipline focuses on the reading, writing, and communication levels of deaf students. Luetke-Stahlman and Luckner (1991) state that "math and science research and intervention have been labeled repeatedly as neglected areas in the education of hearing-impaired students" (p. 317).

Mathematics is a life skill that all children, hearing or deaf, must understand to compete in the future job market. Moreover, with the turn of the century rapidly approaching, deaf and hearing students will have more career opportunities than a century ago. This underscores the need for teachers to reflect on their teaching methods, study their techniques for instruction, and choose a method that assures students will acquire the knowledge and skills necessary to achieve in life after they have finished school. Educators would like to think they are achieving this goal. The sad reality is--they are not. Students are scoring low on tests measuring problem solving skills (Scheid, 1994) and the Educational Testing Service (1989) reports poor achievement in children's math abilities.

The National Council of Teachers of Mathematics (NCTM, 1989) believes that current elementary school math curricula are failing to properly educate students. Underscoring the failure of current curricula is the Educational Testing Service (ETS). The ETS (1989) reports children's math scores on nationally administered tests demonstrate that children fall short of meeting the goal of applying math skills to life experiences, and in the twenty-first century, students in today's math classes will be entering the work force. All children, hearing or deaf, must have a mathematics curriculum that will prepare them for a future which is going to require them to apply mathematics to life experiences.

According to Scheid (1994) the reason for children's poor scores on national tests is teachers' dependence upon traditional drill and practice methods for math instruction. Burns (1993) believes that mathematics instruction is "less about teaching basic computation and more about helping students become flexible thinkers who are comfortable with all areas of mathematics and are able to apply mathematical ideas and skills to a range of problem-solving situations" p. 28). Swart (1985) argues that computational skills may disintegrate with time, but that conceptual learning is more constant.

There are numbers of studies which support the use of conceptual learning in mathematics (Baroody, 1987; Baratta-Lorton, 1976; Bunch, 1987; Chester, 1991; Ross and Kurtz, 1993; Scheid, 1994; & Swart, 1985).

The theoretical basis upon which cognitive learning of mathematics is derived is from Piagetian theory and its 4 stages of child development: sensori-motor, preoperational, concrete-operational, and formal operational (Chester, 1991). According to Piaget, children must pass through each stage consecutively and at their own pace (Biehler & Snowman, 1986). It is possible then for a teacher to have children in his/her class who are operating at different stages of development. To pass through these stages, children must interact with objects, detect their attributes, and compose rules (Chester, 1991). Thus the manipulative approach leads to conceptual learning by manipulating concrete objects.

The manipulative approach (also called the cognitive learning approach) utilizes specifically prepared activities in which the children manipulate objects to gain mathematical concepts. For example, when teaching fractions, children experiment with cooking. They measure the ingredients, make comparisons, and divide and double recipes. This approach allows the children to see mathematics in real life contexts and also permits the children to explore the concepts of fractions through their senses of sight and touch.

In the field of deaf education, the use of the manipulative approach is also advocated (O'Neill, 1971). O'Neill (1971) suggests that deaf children can learn mathematics through activities, "which involve measuring, manipulating and construction" (p. 8). Fridriksson and Stewart (1988) believe that teachers do not use enough manipulative approaches when introducing math concepts. If a teacher presents mathematics in situations that appear real to the child and the child understands the concepts, then mathematics becomes part of the deaf child's thinking (O'Neill, 1971). The NCTM states that the elementary school mathematics curricula should work from the assumption that math is a critical part of real-world situations. Also, activities used in these curricula should be meaningful to the children (1989).

Teachers of deaf children may heed the National Council of Teachers of Mathematics (NCTM, 1989) suggestions. The NCTM advocates that teachers should "de-emphasize paper and pencil activities and focus on the exploration of mathematics through manipulatives, measuring devices, models, calculators and computers" (p. 7). With a manipulative approach, mathematics becomes visual and children do not have to rely upon the symbolic code of English to decode abstract concepts.

Copeland (1984) discussing Piaget's theory explains that children at the concrete operational level should have concrete objects to give them a basis for gaining abstract math ideas. It is not enough to simply lecture, demonstrate, or explain mathematics to children, they must experience it from objects themselves (Copeland, 1984). Baroody (1987) explains that mathematics instruction should start with real experiences for the student and then proceed to instruction at the symbolic level.

Capps and Pickreign (1993) explain that "corrective teaching at the concrete level is preferred to attempting the corrective action once the student has shifted to the symbolic level and is confused by the symbolic manipulations" (p. 9). Manipulating objects at the concrete level is a requirement so that children can learn math skills at all levels of mathematical knowledge (Luetke-Stahlman & Luckner, 1991).

Perry and Grossnickle (1987) cite a study by Baker with three groups of first graders. Instruction for the first group included a three-way sequence of concrete, pictorial, and abstract, while the other groups used a two-way sequence; pictorial to symbolic, and the third group used a symbolic method only. Of the three groups, the groups that received instruction using the three level and two level scored higher than the group that used only the symbolic level (traditional textbook method). Parham (1983) discovered that students using concrete objects scored on achievement tests at nearly the 85th percentile. The group that did not use the manipulatives scored approximately at the 50th percentile.

Chester (1991) states in her study with third grade children that math manipulatives "help students learn from concrete examples and they are then better equipped to deal with abstract concepts" (p. 10). In this study, two groups of third grade hearing children were administered a pre and post tested after instruction of a math unit. The experimental group, the group using manipulatives, received significantly higher post test scores than the control group that only used the textbook.

VanDevander and Rice (1984) studied four groups of children. The instruction for Group 1 relied upon a textbook. Group two worked with manipulatives; Group 3 combined the approaches (textbook and manipulatives), and the last group, Group 4, received no instruction. The highest achievement, according to a test, occurred with the group that received instruction with manipulatives, while the group using the textbook achieved the least gain. Lessons that use math manipulatives are more likely to produce better math achievement than lessons that do not use manipulative materials (Suydam, 1984).

One such curriculum, Math Their Way, (Baratta-Lorton, 1976) is an example of the type of curriculum recommended by the NCTM and O'Neill and Scheid. Baratta-Lorton's curriculum is based upon Piaget's stages of development, and includes goals and objectives requiring the use of interesting and meaningful concrete materials. An urban school in Phoenix, Arizona reorganized their mathematics program based upon Baratta-Lorton's curriculum. The system tested their students and the results showed that "student understanding of math concepts showed an average increase between two and eight months of additional student growth over previous years" (Tankersley, p. 13, 1993).

Statement of Purpose

The purpose of this study was to 1) describe the teaching techniques that a teacher trained in cognitive instruction uses while teaching a math unit, and 2) determine whether or not cognitive instruction did, in fact, occur. Specifically, teachers who employ cognitive teaching methods do the following things:

1. identify and teach underlying concepts and math relationships
2. make connections between old and new information
3. present instruction from a problem-solving perspective
4. teach strategies for problem solving
5. rely on questioning and listening to students during instruction
6. incorporate group learning
7. notice children's attitudes towards mathematics (Scheid, 1994).

For example, if a teacher uses cognitive instruction in math an observer can note that the teacher is identifying and teaching underlying concepts and math relationships (i.e., the concept of 0 + any number is equal to that number). An explanation of relationships is often overlooked by teachers because they assume the children see relationships on their own, when in actuality children need guidance to perceive specific relationships.

By acknowledging that math is present in everyday situations (i.e., sharing candy brought to school) and demonstrating the math properties of sharing equitably, a teacher gives the student experiences necessary for future learning. This also helps students make the connections between old and new information.

Many times word problems do not appear until the end of a math unit and more often than not have no relevance to the children's life experiences. When a teacher gives his/her students word problems that are interesting, and have immediate meaning early on during the instruction, he/she is demonstrating to the class that mathematics is part of everyday life. It is not enough to give the students word problems, the teacher should instruct students on how to solve the problems. Teachers using a conceptual learning approach would use strategies that require the students to draw pictures, estimate, and predict answers (Scheid, 1994).

Teachers must plan instruction that enables children to question what they are doing. Students should be allowed to reflect upon the exercises presented to them. Teachers also should question students as to why, and how math processes happen.

Group learning is also essential to conceptual learning. Through group activities students learn to share thoughts, listen , and present information so that others can understand it. Group learning also allows students to engage in math language in real situations (O'Neill, 1971; Scheid, 1994).

Scheid (1994) asserts that many times students lack confidence in mathematics. This lack of confidence can hinder students from asking questions that they may feel are unintelligent. In addition, the lack of a positive self concept can also hinder success with mathematics.

When these above mentioned principles are incorporated into a manipulative approach, the curriculum encompasses cognitive instruction. Whereas if a teacher allows manipulatives to be used only as tools to aid students when completing drill and practice exercises, cognitive instruction does not take place and the full benefit of a manipulative approach may not be realized. Before the benefits of a manipulative approach can be seen it must be established that the teacher, in fact, uses techniques in applying the manipulative approach to teaching math.

I observed a teacher of deaf students teaching a math unit from <u>Math Their Way</u> (Baratta-Lorton, 1976), a curriculum built on a manipulative approach and based on Piaget's theory and one which promotes the use of cognitive instruction. By scrutinizing my observation notes for specific examples of Scheid's (1994) cognitive teaching method I have provided information about whether or not the teacher used cognitive instruction techniques.

Rationale for Current Research

Children pass through Piagetian stages in order, and according to Copeland (1984), it is a necessary step for children to manipulate objects to pass through Piaget's stages. Without experiences with real objects, children cannot move through the stage of concrete development to abstract development.

Teachers should use manipulatives to engage the students in real reasoning and problem solving activities. Simply exposing children to concrete objects is not enough for conceptual and cognitive learning. Teachers must alter instruction from the traditional method of presenting information and children giving it back to a cognitive framework that begins where children are developmentally and proceeds from there.

Based upon this information, the following research question is posed: Does a teacher trained in a math curriculum, which is based on Piaget's developmental theory and which employs the use of manipulatives, engage students in reasoning and problem solving by using cognitive instruction techniques?

CHAPTER II

METHODS AND PROCEDURES

The purpose of this study was to determine if a teacher used a manipulative approach according to Piagetian based cognitive theory. By examining the instructional methods of a teacher who has been trained to use a manipulative approach it can be determined if a teacher teaches according to cognitive theory. The use of manipulatives according to cognitive theory may affect deaf children's understanding of mathematical concepts.

Setting

I observed nine lessons on the introduction of place value (ones and tens) from the Baratta-Lorton (1976) Math Their Way curriculum. All nine lesson observations took place in one classroom. The lessons were part of the regular school day. The teacher has used this curriculum for two years and had planned to teach this unit using this method regardless of the study. No limits were set on observational time, length of the unit, or choice of the unit. The four children in the class were seated in the middle of the room at a small rectangular table which allowed for easy physical contact between teacher and child (see Appendix A for a floor plan of the classroom). Two children sat on one side of the table, two children on each end, and the teacher on the opposite side. The teacher sat in front of 2 short bookshelves that were arranged in a L. Materials, manipulatives, pencils, and paper stored on the bookshelves, were all within the teacher's reach for every lesson and pulled out only when needed during the lesson. The children could not reach the materials from their seats. The tops of the bookshelves were used to display charts and books.

The classroom remained meticulously neat and tidy. Everything in the room had a proper place and the children were aware of these places. Items stored in boxes were labeled, and on chalkboards and bulletin boards were displayed bright colors and educational information such as the calendar, rules for manners, children's progress reports, etc. The room did not display a traditional atmosphere of desks lined up in rows, instead there were tables for group activities and discussion, and activity centers set up for individual practice.

I remained seated at the table with the children in order to see the children's and teacher's signs, and the use of the manipulatives. I did not participate in instruction, but tried to remain as aloof as possible. At times, the children did sign to me and tell me about what they were doing, but instruction was the teacher's responsibility.

It is important to note that the only time Ms. Sullivan scheduled a exact time for mathematics was when I was scheduled to observe. Otherwise, the teacher interwove her mathematics instruction throughout the school day.

While observing the lessons, my notes consisted of everything the teacher signed (English) and voiced, everything the children signed or voiced, a description of the activity, a description of the materials used, and how the children completed the activity. Any interaction with the teacher was conducted before and after the lessons.

Participants

Teacher

The teacher (white female) who participated in the study teaches at the Residential School for the Deaf (RSD) which has a Total Communication philosophy including a system of manually coded English. She was selected based on the following criteria:

1. She has 18 years teaching experience with deaf students.
2. She has received 30 hours of training in the use of Math Their Way, a cognitive curriculum developed according to Piagetian theory.
3. She agreed to participate in the study.

Ms. Sullivan (the teacher and the students have pseudonyms) previously taught multi-handicapped deaf children for fifteen years. Her experience with this population has forced her to be very structured (without being rigid), organized, and neat. She has a B.S. degree and two teacher certifications (state and Council on Education of the Deaf) in Deaf education. Ms. Sullivan's supervisor describes her teaching abilities as "excellent."

Students

The four children who participated in the study are 8 and 9 years of age, two black females (both are 8 years old), one white female (age 9), and one white male (age 8). Ms. Sullivan described her class as a "low language group" (their language skills are severely delayed when compared to hearing age mates). All four children reside at the Residential School for the Deaf and have regularly scheduled homegoings. The children regularly attend speech and physical therapy classes at the school.

While in Ms. Sullivan's classroom, the children wear an F.M. auditory training unit (Telex). Outside of the classroom, (P.E., cottage, physical therapy, etc.) the children wear individual hearing aids. The aids are regularly checked and fitted by the school's audiologist.

None of the students have deaf relatives in the immediate family.

Victor

Victor, a white male, is 8 years old. He is small for his age and wears glasses. He has no siblings and on homegoing visits, stays with is grandparents. They communicate with Victor by talking; they do not sign.

Although he is not considered multi-disabled, Ms. Sullivan believes he has some attention deficit problems. Victor's average mean length of utterance (MLU) is 3 to 5 morphemes. He smiles frequently and appears to be in good health. Out the four children observed in the study, Victor has the most intelligible speech. He does sign using a pidgin system and many times, while signing to his classmates or other adults, will not use his voice. Communicating with his teacher, Victor uses his voice with sign.

Eve

Eve, a white female, is 9 years old and the oldest of the group. She is average height and weight for her age. She rarely wears her glasses. It is not known if her parents sign or if she has any siblings.

Her average MLU is 5-6 morphemes. She does not display signs of any other disabilities. Eve does not appear as happy as Victor, because she sometimes came to class very glum. At times, Eve appears to be nervous and high strung, because she jumps impulsively from one activity to another. She sometimes must be corrected by Ms. Sullivan for inappropriate behavior but seem to sill enjoy school. She has no intelligible speech and uses a pidgin sign system. Eve appears to be in good health.

Amanda

Amanda, an black female, is 8 years old and the youngest of the group. She is tall for her age. While I was conducting my study, Amanda was fitted for glasses in hopes of correcting the problem with her eye movement. Her parents do not sign. She appears to be in good health.

According to Ms. Sullivan, this is Amanda's first exposure to a signed system. She communicates using sign (pidgin) successfully. She has no intelligible speech. Her average MLU is 4-5 morphemes. Ms. Sullivan describes Amanda as "very smart and alert." She strived to be correct with her answers during the study, and sometimes became upset if she was wrong.

Cindy

A black female, Cindy is 8 years old. She is average height and weight for her age and does not wear glasses. This is her first year at the Residential School for the Deaf. Cindy has 2 brothers. She is the middle child. It is not known if her parents sign. She is in good health.

Cindy is a very inquisitive child. Many times before the observed lesson would begin, Cindy would question Sullivan as to why things were moved in the room, or why something new was displayed. Her average MLU is 7-8 morphemes making her language level the highest of the group. She communicates using a pidgin sign system and has no intelligible speech.

Table 1 displays the children's degree of hearing loss, age of onset, cause of deafness, and thresholds of hearing for the left and right ear.

Table 1

DESCRIPTION OF STUDENTS

Name	Degree of Hearing loss	Age of onset	Cause of deafness	Right ear threshold	Left ear threshold
Amanda	profound, sensori-neural	congenital	unknown	120+ dB	120+ dB
Victor	moderate to severe fluctuating	congenital	possibly hereditary	77 dB	80 dB
Cindy	profound bilateral	congenital	possibly hereditary	110 dB	107 dB
Eve	Permission not obtained for this information				

<u>Procedures</u>

1. Signed parent informed consent forms were obtained for three of the four students which allow descriptions of them to be included in the study (See Appendix B).

2. A signed informed consent was obtained from the teacher (See Appendix C).

3. Selection of a place value unit was made by the Ms. Sullivan (subject). The unit was selected based upon the following criteria:

a. The unit was considered new information for the children

b. Identifying place value is an objective listed in the State Comprehensive Curriculum guide (Tennessee Department of Education, 1992)

c. Identifying place value is a unit in Math Their Way, a curriculum whose design is based on cognitive theory and the use of manipulatives.

The teacher administered a pretest to each of her students (See Appendix D). This pretest measured the student's knowledge of place value. The teacher explained the research project to the children and they consented to participate. The teacher remained naive to the specific focus of the observations. I received permission from her to make observations of her and her students for research purposes. I explained to the teacher and students that my project was to describe how the teacher taught this specific unit.

After the pretest was collected and scored for each child, observations of the teacher teaching the unit began.

When instruction for the place value unit was complete, the teacher administered posttests which were identical to the pretest. The teacher collected the posttests and scored them.

A comparison of each subject's 2 sets of scores on the pre and posttest was made by using individual gain scores and is reported as part of the data.

During the instruction of the unit, I observed all daily math lessons and made notes of all that transpired during the lessons. The unit lasted 2 weeks with a total of 9 observations lasting 30-45 minutes each. Note-taking on site included detailed descriptions of each lesson and how the children proceeded through the unit. After each observation, I entered my hand written notes into my computer, adding comments, noting questions, and organizing (See Appendix E for a sample of the observation notes). After the 9th lesson, I scrutinized my notes and marked examples of categories derived from Scheid's (1994) checklist. Each category was assigned a color (see below) and examples from categories were color coded:

1. Examples of children's readiness to learn place value concepts were circled in purple.
2. Examples of how the teacher identified and taught underlying concepts and math relationships were circled in orange.
3. Examples of problem-solving instruction were circled in red.
4. Examples of how the teacher linked new information to what the students already know were circled in green.

5. Examples of the teacher fostering active learning blue

6. Amount and type of question forms (e.g., why?, how?, etc.) used by the teacher and students, brown.

7. Examples of group learning, yellow

8. Behavior that could be interpreted to represent children's attitudes towards mathematics, black.

A table for six of the eight categories were generated. There were no examples of the category 8, group learning. Category 8 is discussed in Chapter IV. In each table, examples are numbered, the lesson (1-9) in which each example appears is indicated, the example is described in detail and a rationale for categorizing the example is offered.

By scrutinizing and counting the examples found in the observation notes using the checklist as a guide, I was able to determine if the teacher used the manipulative approach according to cognitive theory.

CHAPTER III

RESULTS

A table for each of six of the eight cognitive instruction categories was generated. All tables have identical headings: the example number, a number indicating in which lesson the example appeared, a description of the example, and a rationale for categorizing the example. In the table, materials specific to the Math Their Way (Baratta-Lorton, 1976) curriculum are mentioned. A detailed description of these materials can be found in Appendix F.

Table 2 displays examples of children's readiness to learn place value concepts. There were 6 examples observed during the study. These examples show "readiness" because the children showed an awareness that a specific place has a specific value.

Nine examples of how the teacher identified and taught underlying concepts and math relationships are noted in Table 3. By pointing out equal numbers, examples of more and less than, patterns, etc. the teacher identified and taught underlying concepts and relationships.

Twelve examples of problem solving instruction are described in Table 4. Examples of problem solving instruction during the observational period consisted of the children

Table 2

EXAMPLES OF CHILDREN'S READINESS TO LEARN PLACE VALUE CONCEPTS

EXAMPLE	LESSON	DESCRIPTION	RATIONALE
#1	1	Children play a game with place value board. They know that when they use the place value board, no more than a specific number can be on the white side. If this happens, the children know to group the items and move them to the blue (left) side of the board.	This is an example of the children's knowledge and awareness that a specific place has a specific value.
#2	1	3 of the 4 children can count to 10.	For our base 10 number system, being able to successfully count to 10 is a prerequisite for understanding place value.
#3	1	3 of the 4 children can count by 10s to 100.	Counting by 10s to the next place value, allows the children to see how many groups of 10 are in a higher number.
#4	1	1 of the 4 children can count by 10s to 200.	
#5	1	When asked where 10 candies should be placed, all answer "blue side"	The children have shown an awareness that a specific place has a specific value.
#6	3	1 of the 4 children can not count to 10, but can work on place value of lower bases to help prepare him for place value of our number system (base 10).	By working on lower bases and their place values, this child learns that a specific place has a specific value. Therefore, when he is ready to learn place value for base 10 he is already knowledgeable about place value, he only needs to master the quantity (10) for the place and not the concept of place value.

Table 3

EXAMPLES OF HOW THE TEACHER IDENTIFIES AND TEACHES UNDERLYING CONCEPTS AND MATH RELATIONSHIPS

QUANTITY	LESSON	DESCRIPTION	RATIONALE
#1	1	The children had estimated how much candy was in a bag. When they counted the candy and came to the same number as their guess, the teacher pointed to the paper with their guess written on it (the estimate book) and explained that they still had candy to count and therefore their guess was wrong.	When the teacher showed the children that their guess was wrong, it demonstrated that she had not assumed that the children were already aware of this.
#2-3	1, 8	Shows the children that the amount of candy was more than all of them including herself had guessed. During a later lesson, a child had guessed an amount and had guessed wrong, the teacher went back to the child's guess and showed her that her guess was not enough.	By pointing out to that there was still candy in the bag left to count she demonstrated the concept of "more." This concept may have been overlooked by the children had the teacher not pointed it out.
#4	4	One of the children finished the lessons's activity, walked to the chalkboard and wrote on the chalkboard: 5 5 5 1. The student then showed the teacher what she had written.	Rather than simply praising the child for her work, The teacher demonstrated to the group on the place value board what the student had written by using Unifix cubes and making 3 groups of 5 cubes on the blue side and 1 cube on the white side. The teacher made the relationship clear to the other children, who may have not interpreted the girl's chalkboard work in the same way.

Table 3 (continued)

QUANTITY	LESSON	DESCRIPTION	RATIONALE
#5-7	6	When working with a lower base, the teacher introduced written numbers that coordinated with the items on the children's place value boards. Each time the children added a block to their board, the teacher recorded the "number" on a strip of paper. Ex. 0, 4 would be written when there were 0 items on the blue side and 4 items on the white. A pattern of 0,0; 0,1; 0,2; 0,3; 1,0; 1,1; 1,2; 1,3; 2,0, 2,1; etc. . . emerges.	Again, the teacher did not rely upon the children to see the pattern themselves. She pointed the pattern out to the children several times.
#8	7	The children guess how many Unifix cubes it takes to go around a design. After they guess and have written their guess on a paper, they count the cubes and write the actual amount on the same paper next to their guess. Then, the students were instructed to compare the two numbers. One time, the actual number of cubes that went around the design was equal to the number of cubes for the previous design. The teacher showed the children on the paper that the numbers were the same.	The teacher points out to the children when numbers are the same. She does not depend upon the children to make these connections themselves.
#9	7	The teacher and students guessed how many cubes it would take to measure an electric cord. They wrote their guesses and the actual amount on paper. The teacher guessed 46, the actual number was 96. She showed the children that the 10s column for her guess and the real amount were different, but the 1's column were the same number.	The teacher demonstrates when the 1s for 2 2-digit numbers are the same and that the 10s for the 2 numbers were different. She does not depend upon the children seeing this relationship theirselves.

Table 3 (continued)

QUANTITY	LESSON	DESCRIPTION	RATIONALE
#10	8	One of the children had guessed that 10 beans were in her bag. She counted 46 beans. The teacher asked her if her guess was correct, and then explained to her that 46 is more than 10.	The teacher made a direct point to show the girl that her answer was incorrect and to show the relationship of "more" between the two numbers.

Table 4

EXAMPLES OF PROBLEM SOLVING INSTRUCTION

EXAMPLE	LESSON	EXAMPLE	RATIONALE
#1	1	To solve how many candies are in the bag, the teacher demonstrates how to count the candy using the place value board. The children were to count out 9 pieces of candy on the white side (right side). When the 10th piece of candy is added, all 10 pieces of candy must be grouped together and moved to the blue side (left). *When the children worked with lower bases, the number allowed on the white side was 1 less than the base (ex. base 3, only 2 items are allowed on the white side, base 5 only 4 items are allowed on the white side etc.)	The teacher models for the children how to count the candies on the place value board. By modeling this, she has shown the students a strategy for solving the problem of "how many?"
#2	2	The teacher tells the children to look for groups of 3.	This is another example of teaching a problem solving strategy.
#3-6,	3-6	The teacher leads the children into an activity to see how many of a specific item (ex. beans, candy, pennies, etc.) are in each child's container.	During this activity, the teacher has given the children a real life problem to solve which helps the children to see that math is present in many situations. She has also in previous lessons demonstrated how to solve the problem.
#8-10	7	The teacher leads an activity in which she creates a design with a Geo-board and a rubberband. She places Unifix cubes around the rubberband and the children are to figure out how many cubes are around the design. This is done 3 times during 1 lesson with a different design each time.	For examples 8-12 The teacher has given the children "real life" problems to solve, and she models the strategies to help the children solve the problem.

Table 4 (continued)

EXAMPLE	LESSON	EXAMPLE	RATIONALE
#11	7	The teacher leads an activity to solve how many Unifix cubes lying next to an electrical cord will measure the cord.	
#12	8	The teacher leads an activity to see how many items are in a bag.	

answering a question; How many items are in the bag? or How long is the electrical cord?

Table 5 lists how the teacher links new information to what the students already know. Nine examples are described in Table 5. These examples show the teacher linking new information to what the students already know by building her lessons daily. She started with lower bases and when the children were comfortable with the lower base, she proceeded to a higher base.

Table 6, examples of the teacher fostering active learning, details 12 examples. All lessons but one were considered to be active because the children did not sit and absorb information, but actively participated.

One hundred and eighteen teacher questions were categorized according to question type and are displayed in Table 7. The majority of question types asked by the teacher were "How many?"

There were no examples observed of the teacher utilizing group learning. Specific examples of behaviors that could be interpreted to represent children's attitudes towards mathematics are not in a table. This category required more discussion than a table allows and such discussion can be found in Chapter IV. Table 8 displays a quantity summary of examples in each category.

Table 5

EXAMPLES OF HOW THE TEACHER LINKS NEW INFORMATION TO WHAT THE STUDENTS ALREADY KNOW

EXAMPLE	LESSON	DESCRIPTION	RATIONALE
#1	1	The students and the teacher earlier in the year made a large estimation book. For the lesson, the children estimated by looking at a bag how many candies were inside. This question and their answers were written on a page and added to their estimation book. The children were very familiar with estimating and counting while using the place value board.	The teacher began the place value unit with an activity that was familiar to the children and they were comfortable doing. The children have been practicing estimation throughout the year. The addition of grouping items by 10 was new information added to the already established knowledge of estimation.
#2-5	2, 4, 5, 6	The children were familiar with counting objects on the place value board up to 10. They knew that when the teacher assigned a specific amount, that the amount could not be on the white side. For example, if the teacher assigned the number 10, then when 10 items were placed on the white side the children should group the items and move them to the blue side. The teacher used this knowledge to teach smaller bases. When the children were competent in the lower bases, the teacher introduced base 10.	The children had been "playing" with their place value boards since the early part of the school year. They were familiar with the procedure of grouping items and moving them to the blue side. The teacher had never introduced this game as being "place value." It was only seen as a game or a way to count items. The teacher began with the lower bases first. The children mastered place value for the lower bases and then moved on to base 10. This way, the concept of place value was already established, and all the children had to master were the different bases.

Table 5 (continued)

EXAMPLE	LESSON	DESCRIPTION	RATIONALE
#6	2	When the children placed 3, 5, 7, or 10 items on the blue side, the teacher first instructed them that this was called a group.	The concept and sign of group is one the children were familiar with. They were not familiar with referencing sets of numbers as a group. Later as they mastered the connection of "group" and numbers, the teacher replaces the sign "group" with the new signs "tens, and ones."
#7	6	The teacher waits until she feels the children have mastered the concept of the place value board and knowing how to "read" the amounts on it, before she introduces how to write the number on the place value strip. They already knew how to sign the number (ex. 3,1 means 3 groups of 10 and 1 left over = 31) but they were not knowledgeable about the written symbol.	The teacher allows the children to master the concrete information first. Then, she introduces the new information of written symbols (symbols).
#8-9	7	The teacher introduces the words "tens" and "ones." She explains that the groups on the blue side of the place value board are now named "tens" and the single items on the white side are now named "ones."	Earlier, the teacher instructed the children that the sides of the place value board are named "tens and ones." When the children have mastered this new concept, she introduces the children to the written forms of the words.

Table 6

EXAMPLES OF THE TEACHER FOSTERING ACTIVE LEARNING

EXAMPLE	LESSON	DESCRIPTION
#1- 8	2-9	The children are involved in these lessons by counting and manipulating items on their place value boards.
#9-11	7	The children manipulated geo-boards, Unifix cubes, and place value boards to determine how many cubes will go around designs the children make.
#12	7	All the children help to place Unifix cubes next to an electrical cord to measure the length of the cord.

Table 7

AMOUNT AND TYPE OF QUESTION FORMS USED BY THE TEACHER

LESSON	*WHAT? (short answer)	HOW MANY?	WHO?	*WHAT? (long answer)	YES/NO	HOW?	CHOOSE 1 OF 2 ANSWERS GIVEN	WHERE?	TOTAL
1	1	2	1	1	9	0	0	1	15
2	1	6	0	2	1	0	0	0	12
3	5	4	0	3	2	1	1	1	17
4	1	4	0	6	0	0	1	0	12
5	3	2	0	0	6	0	0	0	11
6	5	1	0	2	1	0	0	0	9
7	1	12	0	2	5	2	0	1	23
8	4	6	0	2	3	0	1	0	16
9	0	2	0	0	0	0	0	1	3
TOTALS	21	39	1	18	27	3	3	4	118

*What? (short answer) = a What question that requires only a 1-3 word response. For example, What do you think I have in the bag?

**What? (long answer) = a What question that requires a more lengthy response such as a sentence or two. For example, What do we do now?

Table 8

TOTALS OF EXAMPLES

EXAMPLES	QUANTITY
1. Children's readiness to learn place value concepts	6
2. How the teacher identifies and teaches underlying concepts and math relationships	10
3. Problem-solving instruction	12
4. How the teacher links new information to what the students already know	9
5. Teacher fostering active learning	12
6. Amount and type of question forms used by the teacher	118
7. Group learning	0
8. Behavior that could be interpreted to represent children's attitudes toward mathematics	Specific examples not in a table, see Chapter 4 for detailed discussion.

Results from the pre and post test are shown in Table 9. The children completed the tests individually. Many times the children wrote the correct answer but the numeral was written incorrectly (backwards). When this happened, the teacher asked the children what numeral was written, and the teacher wrote the children's response under their written response. Figure 1 shows the number of children who answered each item correctly.

Table 9

GAIN SCORES

STUDENT	PRETEST SCORE	POST TEST SCORE	GAIN
Eve	0	9	+9
Cindy	0	8	+8
Amanda	0	8	+8
Victor	0	7	+7

Perfect score = 9.

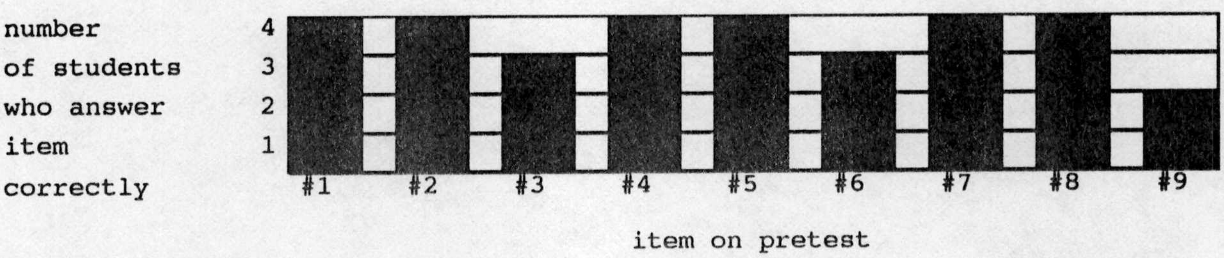

Figure 1

FREQUENCY OF CORRECTLY ANSWERED ITEMS ON POST TEST

CHAPTER IV

DISCUSSION

Limitations

There are several limitations of this study. These include: (a) the limitations inherent in the use of a checklist-category system and (b) the data collection by one observer.

The use of any checklist-category system shapes a researcher's view of the data. Such a system has a specific focus and it includes as well as excludes certain content. The focus of Scheid's list is to examine teaching techniques to determine if the techniques can be classified as cognitive instruction (Scheid, 1994). While Scheid's list takes into account instructional techniques it excludes information about setting, incidental teaching, and information about the influence of students' backgrounds. To "fill in the blanks" and to mitigate against the inevitable reduction of data when they are presented in tabular form, the following discussion of each category is offered.

Finally, another limitation in this study was that data were generated from the notes of only one observer. Observer bias in interpreting observation notes and recollections is an issue. Also, the descriptions of the observed lessons may be incomplete because one observer has no recourse to others' notes or recollections. In summary, a possible result was that observer bias colored the data examination, and the data may be incomplete.

Examples of children's readiness to learn place value concepts. Before instruction began, Ms. Sullivan (teacher) and I discussed what unit would be observed. She explained to me that place value was appropriate to teach at that time. According to Ms. Sullivan, 3 of the 4 children in her class had the prerequisite skill of successfully counting to 10. Victor was not able to count to 10 successfully every attempt, but in Ms. Sullivan's opinion, he could still participate in the lessons. By working in the lower bases, Victor could gain understanding of the concept of place value, and with time apply that understanding to the base 10 number system.

The children during the observational period completed their lesson on a "place value board" (see Appendix F). Using this board, allowed the children to visualize the ones and tens place, and to physically move items from the "ones" to the "tens." This activity was presented from the beginning as if it were a game. The rules of the "game" were that Ms. Sullivan would decide upon a number and she would count up to that number. If the number was 5, as Ms. Sullivan counted up to 5 the children would place 4 items on the white side (ones). On the fifth item, the children were to group the items together in a cup and move the cup to the blue side (blue). Physically moving the items as they were counted, enabled the children to understand that a particular place has a particular value.

Examples of how the teacher identifies and teaches underlying concepts and math relationships. Often the children were to estimate how many items were in a container. Sometimes, they were instructed to write their guess down on paper. After counting the items on the place value board, the children were to look back at their guess and see if they were correct. Ms. Sullivan would explain to them that their guess was more or less than the actual amount. She did not rely on the children to make this connection.

By pointing out the relationships of numbers, children begin to look for relationships on their own. During lesson 1, Ms. Sullivan showed the children a bag full of different colored candy. Victor signed "Can make pattern!" Ms. Sullivan later explained to me that throughout the year, the children work on patterning by making and finding patterns in everything; candy, the calendar, numbers, etc. When Victor explained that a pattern could be made from the candy, that was a direct result of Ms. Sullivan demonstrating earlier and consistently that patterns existed.

One event that happened during the observations excited Ms. Sullivan very much. Eve had completed her activity, and was permitted to go the chalkboard and write. Ms. Sullivan continued to assist the other children in completing their activity. That particular day, the children had worked with base 5. Eve excitedly demanded Ms. Sullivan's attention by vocalizing. She had written on the chalkboard: 5 5 5 1. Ms. Sullivan asked "3 groups of 5 and 1?" Eve shook her head yes. The other children had become distracted by Eve. Ms. Sullivan showed the children what Eve had written and then demonstrated on the place value board using Unifix cubes (See Appendix F) 3 groups of 5 on the blue side and 1 cube on the white side. Ms. Sullivan offered an explanation to the class because she did not assume that the children would interpret Eve's chalkboard work in the same way.

Examples of problem solving instruction. In the majority of the lessons, the children were to solve the problem of how many items were in a container. For adults, this may not seem like a genuine problem, but to young children it is. For young children, it is also a chance to see mathematics as a useful tool to answer a question. Solving the question of how many beans are in the jar is much more meaningful than a worksheet asking how many tens and ones in the number 54. Using the place value board, gave the children a strategy to solve their problems.

The children were instructed to solve how many cubes went around a design and how many cubes measured the length of an electrical cord. This was an excellent example of problem solving instruction and real life mathematics. It also showed the children that perimeter and measurement are a number concept.

Examples of how the teacher links the new information to what the students already know. For the first lesson, the children worked with estimation; a concept they already understood. Also during the first lesson, the children grouped items by 10 which was new information for the children. By working with an already familiar concept (estimation) it allowed for a less stressful lesson which introduced new information (grouping items by 10).

By the end of the observational period, the children were successfully grouping items by tens. This was due to the fact that Ms. Sullivan began with lower bases first. The concept of place value was easier to establish without trying to manipulate 10 items. Manipulating 3, 5, and 7 items permitted the children to group more frequently than if they had started with 10 items. Also, this allowed Victor to gain an understanding of place value when he could not successfully count to 10.

Ms. Sullivan described her class as "low language." Knowing this, Ms. Sullivan began her unit using vocabulary that was familiar to the children. The words "tens" and "ones" were not introduced until very late in the unit. The children began calling the blue side of their place value board (tens) a group. This sign and concept was a familiar one. If Ms. Sullivan had introduced place value and new vocabulary at the same time, it would have been too much information at once. Signing "group" was a concept the children already understood. Later, when place value became an understood concept, Sullivan introduced the vocabulary of "tens and ones." When the children were comfortable with the new term, she introduced the written words. Ms. Sullivan also waited until the end of the unit to put written symbols with the activities. This is a principle that the Baratta-Lorton curriculum endorses. Master the concrete first, and later apply the written symbol (words or numerals).

Examples of the teacher fostering active learning. Every lesson but the first was an active lesson. In eight out of nine lessons, the children were actively involved. They manipulated materials, completed papers, and were permitted to estimate, and measure.

Amount and type of question forms used by the teacher. During nine lessons, Ms. Sullivan asked 118 questions to the class. Some of the questions were very basic requiring a simple 1-2 word answer, but many of the questions required a more extensive answer. Many times the children did not answer Ms. Sullivan, but the children were exposed to higher level thinking questions. According to language development theory, the more a child is exposed to specific types of linguistic structures, such as the structure for higher order questions, the more likely a child will be able to answer such questions and/or ask them in the future.

Due to the children's low language level, they rarely asked questions or offered comment. That they displayed an understanding of the unit is shown by their successfully completing activities and by their post test scores. It is probable that by continuing math instruction in this way the children's math language will improve and in the future they can offer comments or ask questions.

No examples of group learning were observed during the study. The children's low language level seems to discourage them from being able to work in a group and to discuss an activity among themselves. There were two instances (measuring the electrical cord and the outlining designs with Unifix cubes to see how many went around the design) when the children worked together to complete a task that Ms. Sullivan directed. Completing a task together such as those mentioned earlier is good practice for working together successfully which will aid the students later when they are capable of engaging in group learning.

Behavior that could be interpreted to represent children's attitudes towards mathematics. It is important to mention that at no time during the study did Ms. Sullivan refer to the lessons as "math." When it was time to go to the table and begin the lessons, Ms. Sullivan showed them the containers with items inside and asked "How many beans do you think are inside?" The children did not have to be coaxed to begin the activities and none of the children ever expressed that they did not want to participate in the activities. As mentioned in Chapter III, normally Ms. Sullivan did not have a regularly scheduled time for mathematics. A prescribed time for math was established only because I was there to observe. Interweaving mathematics throughout the day whenever necessary allowed for the children to see how math occurs through the day and use it. One example of this, is one day before the lesson began Cindy was eating her snack of Skittles candy. She graphed her candy on her napkin according to color and explained to Ms. Sullivan which column in her graph had more candy and which column had less.

During the lessons, the children were asked many times to estimate how many items were in a bag or cup. Young children are often times not comfortable with guessing. Children have to have confidence in themselves to make a guess. The fear of being incorrect is very strong at the children's ages. All of the children would guess and on only one occasion did anyone display any upset about being incorrect.

When Eve independently transferred her math knowledge to the chalkboard she displayed an interest in mathematics. She was excited with what she had done and this is evidence that she possesses a positive attitude toward mathematics.

One might assume that Victor would have a bad attitude toward math because in terms of skill level, he functions lower than the other children. Ms. Sullivan helped Victor whenever he needed it, and made special concessions for him so that he could complete the activities as independently as possible. One such example was when the children began working with base 10. Victor needed help counting to 10. Ms. Sullivan gave him a piece of paper with outlines of 10 beans drawn on it. Victor was to place 10 beans on the paper and when all the outlines had a bean placed on them, he was to group the beans in a cup. The other children never teased Victor and he did not display any behavior during math lessons that could be interpreted as negative.

It is critical to emphasize the dramatic increase of scores from the pre test to the post test. Ms. Sullivan and myself were pleasantly surprised at the children's performance on the post test. The pre and post test were the children only experiences with a paper and pencil task without using manipulatives. The Math Their Way curriculum (Baratta-Lorton, 1976) promotes mastering the concrete before attempting the abstract. Ms. Sullivan's class obviously mastered the concrete concept of place value and transferred their knowledge to a abstract task (post test).

Overall, based upon the observations made, one can conclude that the children in Ms. Sullivan's class displayed a positive attitude toward mathematics and were comfortable with completing activities in math lessons.

Future Research

Based upon the findings in this study some suggestions for future research can be made. The checklist-category system could be used to identify teachers who use cognitive instruction and those who use other instructional techniques. Teachers could be assigned math groups of comparable ability, and employ various teaching techniques. Based on student outcomes it might be possible to recommend one teaching technique as better for students who share characteristics with the experimental groups.

A crucial element of all educational research that I feel would benefit teachers, would be to include the practitioner in the research project. A researcher enters a classroom, observes, and reports findings without ever conferring with the teacher. Many times research goes unnoticed by teachers. When teachers do notice research, they often feel as if the research findings or suggestions have unrealistic applications in an actual classroom. For research to be beneficial to teachers, it must be a shared project between the researcher and the practitioner. Also it is imperative for teachers to do research themselves and learn to document, observe objectively, and use their findings to enhance their instruction and their students' academic and affective growth.

Cognitive instruction has been recommended as a teaching technique. It was not possible to determine from this study if cognitive instruction is better than other teaching techniques. Thus, the efficacy of cognitive instruction remains to be studied.

LIST OF REFERENCES

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Baratta-Lorton, M. (1976). Math their way. Ontario: Addison-Wesley.

Baroody, A. (1989). Children's mathematical thinking: A developmental framework for preschool, primary, and special education teachers. New York: Teachers College Press.

Biehler, R. F. & Snowman, J. (1986). Psychology applied to teaching. (5th ed.). Boston: Houghton Mifflin.

Bunch, G. O. (1987). The curriculum and the hearing-impaired student: Theoretical and practical considerations. York University: Little, Brown and Co.

Burns, M. (1993, April). The 12 most important things you can do to be a better math teacher. Instructor, p.28-31.

Capps, L. R. & Pickreign, J. (1993). Language connections in mathematics: A critical part of mathematics instruction. Arithmetic Teacher. 41(1), 8-12.

Chester, J. & Others. (1991). Math manipulatives use and math achievement of third-grade students. (Report No. SE 052 315). (ERIC Document Reproduction Service No. Ed339 591)

Copeland, R. W. (1984). How children learn mathematics: Teaching implications of Piaget's research. (4th ed.). New York: Macmillan.

Educational Testing Service. (1989). A world of differences: An international assessment of mathematics and science. Princeton, NJ: Educational Testing Service.

Fridriksson, T. & Stewart, D. A. (1988). From the concrete to abstract: Mathematics for deaf children. American Annals for the Deaf, 133(1), 51-55.

Heath Mathematics. (1987). Canada: D.C. Heath and Co.

Luetke-Stahlman, B. & Luckner, J. (1991). Effectively educating students with hearing impairments. New York: Longman.

National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, Va.: The Council.

O'Neill, V. (1961). Teaching arithmetic to deaf children. Washington, DC: Alexander Graham Bell Association.

Parham, J. L. (1983). A meta-analysis of the use of manipulative materials and student achievement in elementary school mathematics. Dissertation Abstracts International, 44, 96A.

Perry, L. M. & Grossnickle, F. E. (1987) Using selected manipulative materials in teaching mathematics in the primary grades. (Report No. Se 047 844). (ERIC Document Reproduction Service No. ED 280-684)

Ross, R. & Kurtz, R. (1993). Making manipulatives work: A strategy for success. Arithmetic Teacher. 40(5), 254-257.

Scheid, K. (1994). Cognitive-Based methods for teaching mathematics. Teaching Exceptional Children. 26(3), 6-10.

Suydam, M. N. (1984). Manipulative materials. Arithmetic Teacher. 31(5), 27.

Swart, W. L. (1985). Some findings on conceptual development of computational skills. Arithmetic Teacher. 32(5), 36-38.

Tankersley, K. (1993). Teaching math their way. Educational Leadership. 50(8), 12-13.

Tennessee Department of Education. (1992). Comprehensive Curriculum Guide. Nashville: Author.

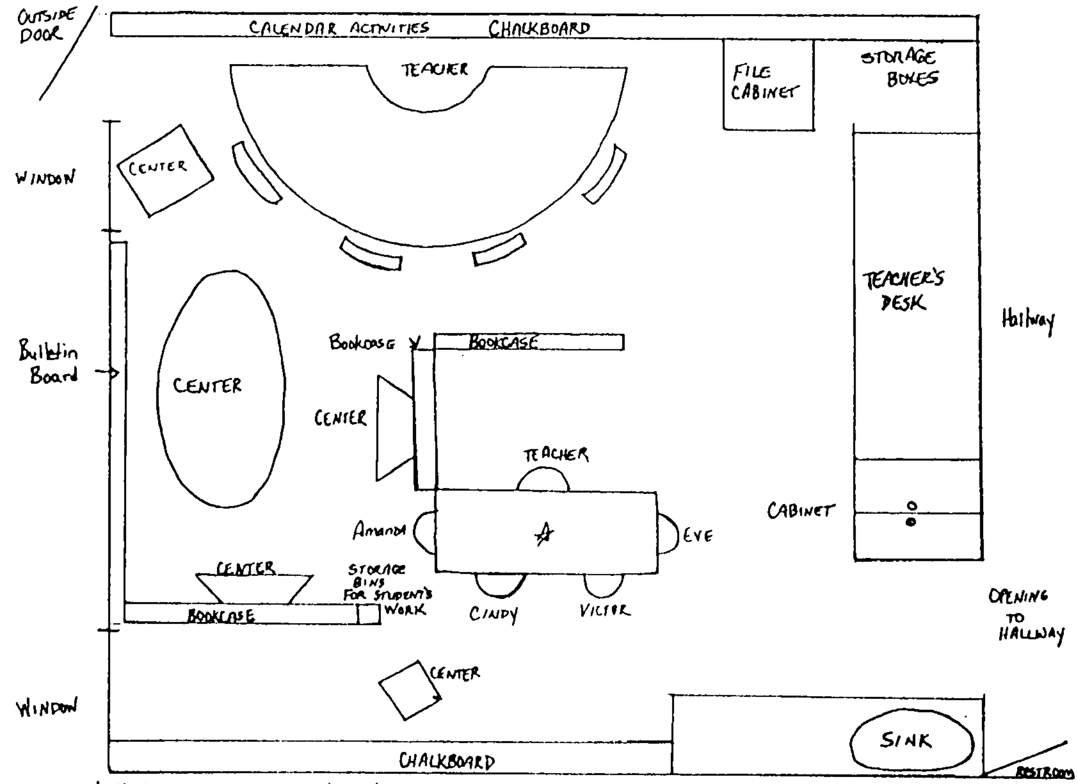
VanDevander, E. M. & Rice, D. R. The effect of three types of brain-based instruction on the mathematics achievement and attitudes of second grade students. (Reports No. Se 045 128). (ERIC Document Reproduction Service No. Ed 250-155)

APPENDICES

APPENDIX A

CLASSROOM DIAGRAM

CLASSROOM DIAGRAM



★ Math was taught at this table

APPENDIX B

PARENT CONSENT FORMS

CONSENT FORM FOR PARENTS

Dear Parent(s),

The purpose of this letter is describe to you a research project, which will be conducted by a graduate student at the University of Tennessee, and to request your permission to allow ____________________ to participate in this project.

The purpose of this study is to describe how a teacher teaches math using manipulative approach (using objects to count). Your child will be involved with the study for a 1 to 2 week period. During this time, your child will participate in his/her regular math class. Two tests will be given to your child. A pre-test will be given before the math unit is taught by your child's teacher. Upon completion of the unit another test will be given and the scores from the two tests will be compared. Observations of your child during this time period will also be made. There are no known risks to your child if he/she participates in the study.

Your child's identity will remain confidential. Only the investigator and the chairperson of her thesis committee will have access to your child's scores, and personal information such as degree of hearing loss, age of onset of deafness and cause of deafness. This information will remain on computer disk which will be locked in the investigator's office during the study. After completion all personal information will be destroyed. Any reference to your child will be disguised to protect your child's identity.

Your child's participation in this study is voluntary, and you may refuse to have your child participate. If you have any questions about the research, please call Dr. Kathleen Warden, University of Tennessee, (615) 974-2321.

(over please)

I have read and understood the explanation of the study and my child's role in it. I agree to allow my child to participate.

Name	Child's name
Signature	Date

I will allow Tennessee School for the Deaf to allow Dana Pickard access to my child's personal information: degree of hearing loss, age of onset, cause of deafness, and age.

Name	Child's name
Signature	Date

Dana Pickard Principal Investigator	Kathleen Warden, Ph.D. Chairperson of Thesis Committee
Date	Date

APPENDIX C

TEACHER CONSENT FORM

CONSENT FORM FOR THE TEACHER

Dear Participant,

The purpose of this letter is to describe to you a research project, which will be conducted by a graduate student at the University of Tennessee, and to request your permission for you to participate.

The purpose of this project is to describe the techniques you use as you teach a math unit of place value. The unit is from your math curriculum, Math Their Way (Baratta-Lorton, 1976), a curriculum built on the manipulative approach. The data source will be Dana Pickard's observational notes and the unit pre and posttest scores of your students. The expected duration of this project is two weeks (10 class days for observations).

At no time will you or your students be identified. I foresee no risk to you because you will remain anonymous and the data gathering is not substantially different from usual classroom practices. It is uncertain what benefits if any will result for you (the teacher) as a result of this project. It is possible that a description of the math classes may be of interest to you. You will be given a copy of the completed thesis. All information will remain on computer disk and will be locked in my home.

Your participation in this study is voluntary. Refusal to participate will involve no penalty or loss of benefits. You may discontinue participation at any time. If you have any questions about the research you can contact Dr. Kathleen Warden, University of Tennessee, (615) 974-2321.

(over please)

I have read and understood the explanation of the study and my role in it. I agree to participate.

name date

signature

Dana Pickard Dr. Kathleen Warden,
Ph.D.
Principal Investigator Chairperson of Thesis
Committee

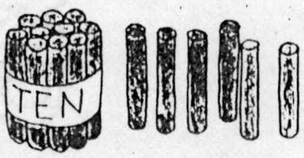
date date

APPENDIX D

PRE-POST TEST

Chapter Review

How many?



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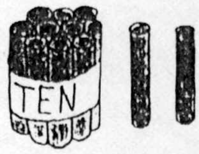

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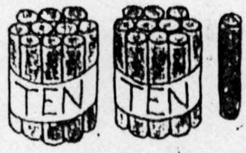

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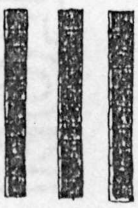

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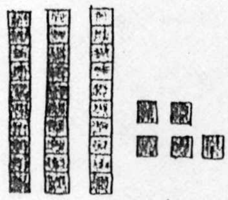

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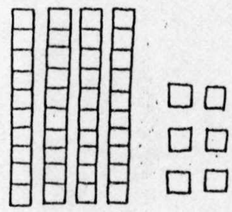

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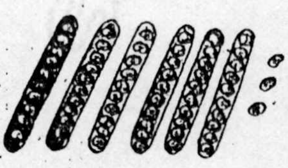

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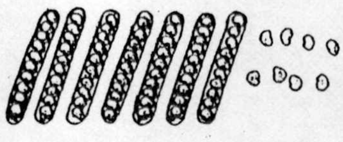

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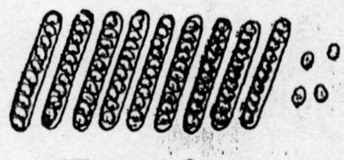

Tens	Ones

*Copied from Heath Mathematics (1987).

APPENDIX E

SAMPLE OF OBSERVATION NOTES

Note: Each category was color coded. Notations on the sample indicate color.

G = green
P = purple
B = blue
R = red
O = orange
BR = brown

SAMPLE OF OBSERVATION NOTES

LESSON 4

Gi

SULLIVAN-we worked on 3 yesterday, What # today? What do you think? ✓ ← BR → ✓
EVE-9
SULLIVAN-lets try 5 NO
SULLIVAN-let's see how many pennies? ✓-BR
How many do you think? ✓-BR
kids guess
SULLIVAN-count to 5 and stop
SULLIVAN-1-5 stop and make group place in cup
SULLIVAN-now what? ✓-BR
CINDY-move to blue side
again 1-5
SULLIVAN-What do now? ✓-BR
all sign stop
AMANDA-group and move
SULLIVAN-how many groups? ✓-BR
kids all sign 2
SULLIVAN-again 1-3 What do you do now, move or stay? ✓-BR
EVE-stays
SULLIVAN- read the board 2,3
SULLIVAN-shows jars of pennies
How many do you think inside? ✓-BR
shows each jar and lets the children guess R
SULLIVAN- you have to find out
SULLIVAN-What do you do to find out? ✓-BR
SULLIVAN- need to count 1-5
kids-stop
SULLIVAN-make a group
SULLIVAN-passes out all the all jars
K-pour them out, each has own jar and place value board
all the children begin
EVE-stops on 5 and places on blue side
AMANDA-finishes and reads correctly
CINDY-does same
VICTOR-gets help from Barbara
VICTOR-counts to 5
SULLIVAN-What do you do now? ✓-BR

EVE: stopped finished her work wrote on chalkboard 5,5,5 1 Eve very excited!
showed SULLIVAN,
SULLIVAN- showed her with place value board on blue3, 1 on white 0
~~VICTOR by counting to the third group he had caught on~~

APPENDIX F

DESCRIPTION OF MATERIALS FROM THE BARATTA-LORTON CURRICULUM

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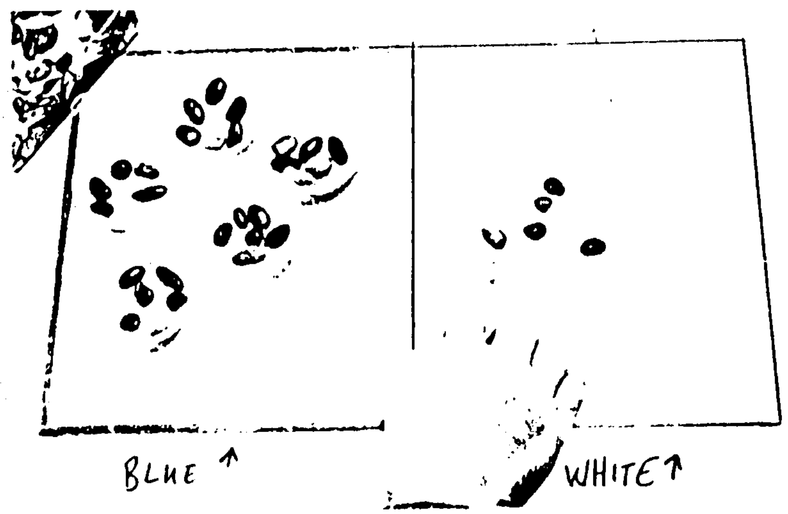
BARATTA-LORTON CURRICULUM

Estimation book: teacher-made book used periodically for estimation lessons. e.g.: Teacher will hold up a jar of marbles and ask "How many do you think are inside?" The children answer and the teacher records their guesses on a page in the book.

place value board (p.v. board): teacher made large mat placed flat on a table, blue side always is on student's left, no words or numbers are on the board, the white side equals ones, the blue side equals tens.



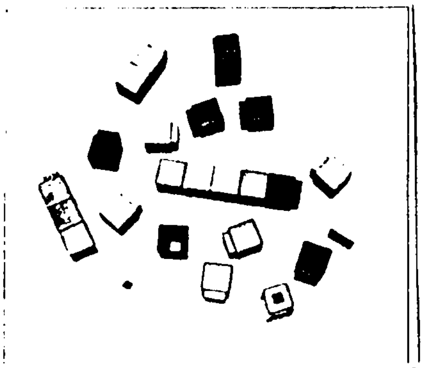
items for counting: jelly beans, beans, pennies, cubes

number chart: chart used each day during calendar time to count the number of days in school, e.g., "We've been in school how many days?" Numerals that are multiples of 10 are written in red.

1, 2, 3, . . 10, 11, 12, ...

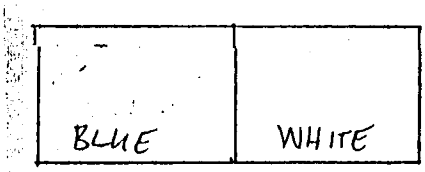
counting cups: cups used for holding items that are placed on the blue side of the place value board.

Unifix cubes: 3/4" interlocking plastic cubes. Available from Educational Teaching Aids, Creative Publications, and others.*



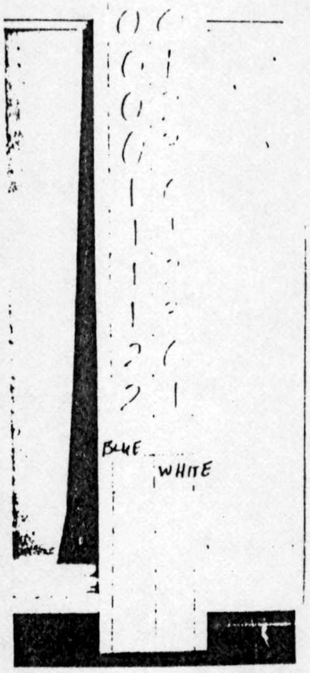
bowls, bags, plastic eggs, paper bags: containers to hold items to be counted on place value board.

blue and white card: card, left side blue, right side white.

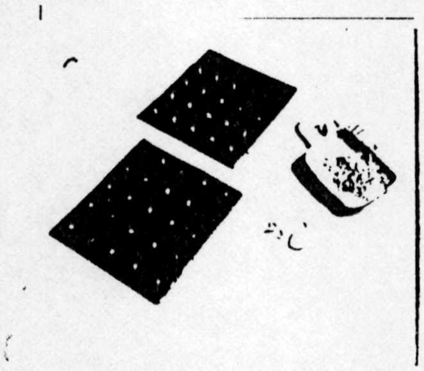


tens card, ones card: flash cards

place value strip: strip of paper, blue on left side, white on right side, used for recording amounts of items on place value board.

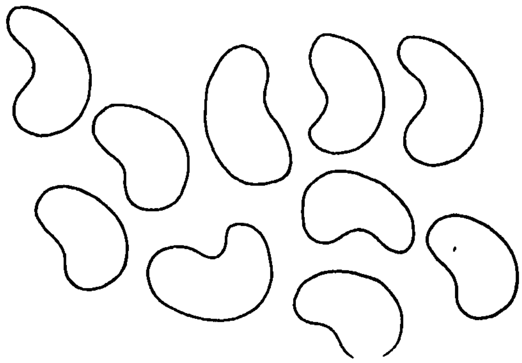


Geoboards: boards, 20cm or " square (size can be larger or smaller) with 25 nails in a 5 x 5 array.*

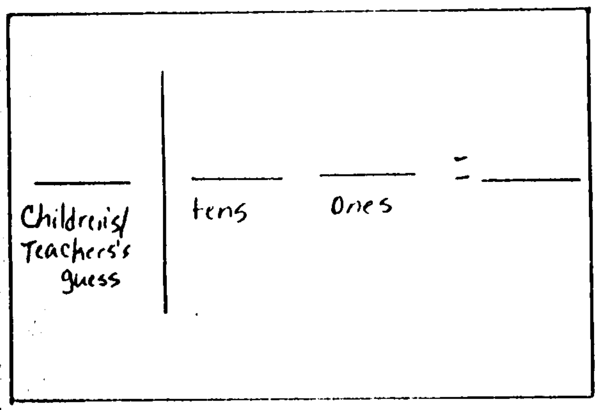


electric cord: cord from equipment in classroom, used for measurement

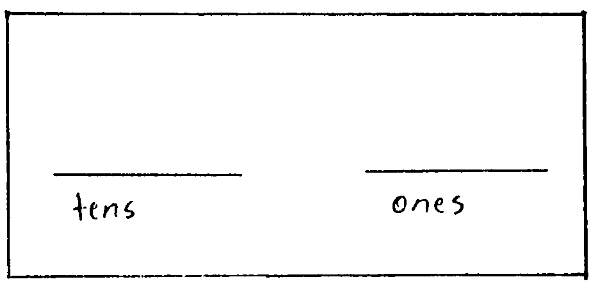
<u>bean outline picture</u>: outline picture of beans used for children who need help counting 10 beans. Child places a bean on each drawn bean and when the paper is full the child knows he/she has 10 beans on the paper.



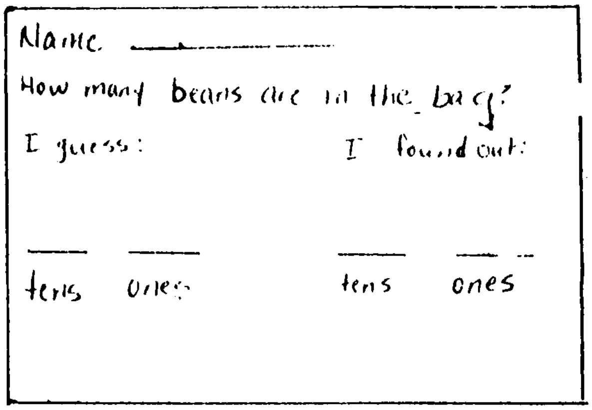
<u>paper #1</u>:



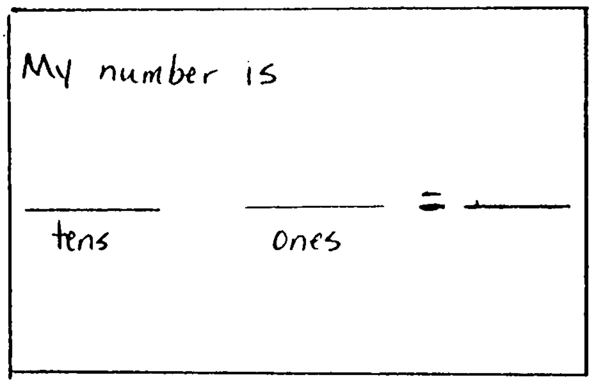
<u>paper #2</u>:



paper #3:


Name ____________
How many beans are in the bag?
I guess: ___ tens ___ ones
I found out: ___ tens ___ ones

paper #4:


My number is
___ tens ___ ones = ___

*Copied verbatim from Mathematics Their Way (Baratta-Lorton, 1976) p. 361 and 365.

Photos of materials copied from Mathematics Their Way (Baratta-Lorton, 1976)

VITA

Dana E. Pickard graduated from Middle Tennessee State University in May, 1992. She received a Bachelor of Science degree in Special Education and received Tennessee teacher certification in elementary education and special education.

After graduation, Dana moved to Knoxville, Tennessee to begin work on her Master of Science degree in special education with an emphasis in education of the hearing impaired. The degree was conferred in August 1994.

Presently she lives in Clarksville, Tennessee with her husband and will teach deaf children beginning Fall, 1994.