Elementary Students’ Perceptions of Mathematics When Multiple Intelligences Are Used in Mathematics Instruction

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ELEMENTARY STUDENTS' PERCEPTIONS OF MATHEMATICS WHEN Multiple INTELLIGENCES ARE USED IN MATHEMATICS INSTRUCTION

THESIS

Submitted to the Graduate Committee of the
Department of Education and Human Development

State University of New York
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Requirement for the Degree of

Master of Science in Elementary Education

By

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Chapter I

INTRODUCTION

Rationale for the Study

For the past 30-50 years, researchers have been exploring the human brain and how it works. Gardner (1991) suggests that all human beings are capable of exhibiting intelligences in seven domains: linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, and intrapersonal. Rather than the traditional intelligence tests that have only linguistic and logical-mathematical skills, Gardner uses all seven areas to measure intelligence.

Intelligence occurs in multiple parts of the body, mind, and the brain. We all have all of these intelligences, but they are not developed equally and therefore we do not know how to use them all. Usually we have a stronger more dominant intelligence we use more often. One can learn, however, to activate these unused intelligences by strengthening and training the intelligences. When these intelligences are awakened, one can learn and understand herself and the world around her. (Lazear, 1991).
Teachers need to learn to incorporate activities that build on each of Gardner’s intelligences in order for all students to achieve their potential. Once a teacher understands their own personal learning styles and how to use them, he/she can use certain techniques to awaken the intelligences in each individual student in the classroom. Multiple Intelligences then must be used in teaching content-based lessons for optimal learning to occur and to keep these skills working. “Anything can be taught and learned through all of these intelligences” (Lazear, 1991, p. xx). The intelligences should be integrated into every day living and problem solving to meet the challenges in every day life (Lazear, 1991).

Statement of the Question

In this study, the researcher focused on teaching math through the use of Multiple Intelligences. The researcher designed lessons for math using two or more intelligences to teach each day. The class was composed of 20 multicultural students: 70% black, 15% white, and 15% hispanic. Their abilities range from average to low average in mathematics. The following research question guided the study: Do students’ perceptions of mathematics change when Multiple Intelligences are used in mathematics instruction?
Definition of Terms

Below are the definitions of terms that will be found throughout the research:

Gardner's Multiple Intelligence Theory - Gardner believed that we should consider seven types of intellectual behavior: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal. Children would therefore be assessed on several different dimensions and should be found gifted in one or more of them. (Gallagher and Gallagher, 1994)

Linguistic Intelligence (Talk smart) - The ability to use language in written and oral expression to help in remembering, solving problems, and seeking new answers to old problems (novelist, lecturer, lawyer, lyricist). (Gallagher and Gallagher, 1994)

Logical - Mathematical Intelligence (Math smart) - The ability to use notation and computation to aid/help in problem solving (mathematician, physicist). (Gallagher and Gallagher, 1994)
**Spatial Intelligence** (Picture smart) - The ability to use spatial configurations and recognize patterns easily (architect, sculptor). (Gallagher and Gallagher, 1994)

**Bodily Kinesthetic Intelligence** (Body smart) - The ability to use different parts of the body to perform a task (dancer, surgeon, athlete). (Gallagher and Gallagher, 1994)

**Musical Intelligence** (Music smart) - The ability to discriminate pitch and to perform or compose sensitive music, while being sensitive to rhythm, texture, and timbre (musician, conductor). (Gallagher and Gallagher, 1994)

**Interpersonal Intelligence** (People smart) - The ability to understand and interact with others (teacher, therapist, politician, salesperson). (Gallagher and Gallagher, 1994)

**Intrapersonal Intelligence** (Self smart) - The ability to understand one’s own feelings (any profession). (Gallagher and Gallagher, 1994)
Limitations of the Study

It is important to understand that the design and findings of this study only apply to 20 fifth grade subjects in one particular classroom. Groupings of students are so diverse; a study using different subjects could result in different outcomes.

All teachers have different philosophies and teaching styles; thus, students' perceptions of a subject could vary depending on the individual teacher.
Chapter II

REVIEW OF THE LITERATURE

Understanding the Brain in Order to Teach Using Multiple Intelligences

Before one can understand Multiple Intelligences it is important to explore the human brain and how it works. Sperry’s research found different ways the brain processes information (Lazear, 1991). The right hemisphere of the brain’s processing tends to be more simultaneous and creative, while the left hemisphere’s processing is more linear and sequential. Another brain researcher, MacLean, suggests that within our brain there are three separate brains that came from our earlier development as species (Lazear, 1991). The three separate brains include: the Neocortex, where thinking, logic, cognition, and reflection take place; the Limbic, where emotions take place; and the Reptilian, where reaction without thinking takes place. All three operate as a unified whole, giving us wisdom and potential (Arnold, 1997).

Brain research shows that learners do not mirror what they are told or what they read. Instead, the brain stores a record of neural activity that takes place in the learner’s sensory and motor systems as they interact with the
environment. Each record is a pattern of connections among brain cells that can be activated again to recreate the experience. When learners place an image in their mind, they store the elements in many different places and construct pathways among the places so that when the learner recalls the experience, all the pathways come together as one image (Restak, 1980). The way that the brain can construct knowledge and behaviors is by taking in data through the sensory perceptions of the body’s five senses (Kotulak, 1996).

When learners want to make further explorations, they link their prior knowledge to understand the new experience (Cowley & Underwood, 1998). “Construction in a student’s brain depends on the interest and prior knowledge of the student and on the richness of the environment” (Lowery, 1998, p. 27).

Diamond, a neurophysiologist, discovered that the brain could change physiologically as a result of learning and experience for better or worse. “Throughout life we can continue to develop enhanced mental abilities in environments that are positive, nurturing, stimulating, and interactive” (Campbell, Campbell, and Dickinson, 1996, p. xxi).

Arnold (1997) explains how the brain processes information in three simple steps:

(1) The brain receives information from the environment through one of the five senses.
(2) Then the brain makes sense from nonsense by using the seven intelligences.

(3) Last, the brain finds a way to communicate what was learned.

Brain research, however, is not something that should be implemented in schools. There is no proof that a particular strategy or method will work. What brain research does do is it helps educators to understand how the brain learns or doesn’t learn, and why. Furthermore, it gives insight on how to structure learning environments and how to appropriately give instruction to students (Wolfe, 1998).

Intelligence – Our Perception of Students Must Change

Almost a century ago, Alfred Binet and his colleagues attempted to find a way to measure intelligence. This was thought to have been a positive scientific development. However, psychologists involved in Binet’s effort came across two very important assumptions: intelligence was a single entity, and intelligence was measured by using only paper and pencil instruments (Lazear, 1991). Traditional intelligence tests only measure linguistic and logical-mathematical intelligences. Therefore, many students do not do well on these tests; they have other many skills and talents. For example, if a student has an extremely high musical intelligence, there is no way to find this out with
a traditional IQ test. Gardner has discovered that intelligence is not a single entity that underlies all problem-solving behavior, but that there are many types of intelligence behavior all produced by their own particular intelligence (Lazear, 1991). If we restrict educational instruction to focusing only on linguistic and mathematical intelligences, the importance on other ways of knowing will be minimized.

An intelligence entails the ability to solve problems or fashion products that are of consequence in a particular cultural setting. The problem solving skill allows one to approach a situation in which a goal is to be obtained and to locate the appropriate route to that goal. The creation of a cultural project is crucial to capturing and transmitting knowledge or expressing one’s views or feelings. The problems to be solved range from creating an end to a story to anticipating a mating move in chess to repairing a quilt. Products range from scientific theories to musical composition to successful political campaigns (cited in Lazear, 1991, p.xi).

Instead of viewing human “smartness” in terms of an IQ score, Gardner’s definition of human intelligence measures the ability to solve real life problems, the ability to come up with new problems to solve, and the ability to offer something valuable to one’s culture (Campbell, & et. al., 1996 p. xv).

According to Gardner’s definition of intelligence and his theory of Multiple Intelligences, educators need to change their perceptions of students. Students should no longer be perceived or labeled as dumb, average, or smart,
depending on their IQ scores. Educators can now look at diverse ways children problem solve and learn (Campbell & et. al., 1996). In other words, instead of teachers assessing how smart students are, they need to assess how are kids smart.

Using Multiple Intelligences helps teachers to reach more children and provides students with an experience Gardner calls “many windows looking into one room” and therefore gives students the “feeling of what it is like to be an expert” (Gray, 1996, p. 10). Offering students multiple options gives students an opportunity for academic success. “Gardner’s theory offers an expanded image of what it means to be human” (Campbell & et. al., 1996, p. xvi). The Multiple Intelligences and Gardner’s theory of Multiple Intelligences are defined at the end of Chapter I.

Getting Mind Set

Using Multiple Intelligences in the classroom can be very challenging for some teachers; observing one child seven different ways is an overwhelming thought. Therefore, a teacher who plans on teaching using Multiple Intelligences in the classroom needs to become mind set.
This includes a personal evaluation of a plan for creating a classroom environment appropriate for Multiple Intelligences and an understanding on how to teach and assess students using Multiple Intelligences.

A teacher can evaluate her personal and professional use of Multiple Intelligences by doing a personal inventory. There is a sample of "A Personal Inventory" in Appendix A. Educators must rely on one or more intelligences in their approach to instruction. The instructional approaches are usually determined by the educator's personal preference, the educator's training, and the philosophy of the school (Campbell & et. al., 1996).

After a teacher self-evaluates his professional and personal use of Multiple Intelligences, he needs to reflect on the results, asking questions, such as, "Are there differences between intelligences in your personal and professional life?" Asking such questions may deepen the teacher's awareness for those who may have other expertise (Campbell & et. al., 1996). This inventory also builds a respect for differences in intelligence among students and colleagues. It motivates educators to teach diverse groups of children, giving more adequate ways for children to learn and to succeed (Campbell & et. al., 1996).
Creating an "Intelligent" Environment

Not only do teachers need to recognize intelligence in students; they must also create a "smart" learning environment. The new field of research on "distributed cognitions" suggests that intelligence goes beyond individuals, and is enhanced by interacting with others through the tools we use to think, learn, and problem solve (Campbell & et. al., 1996).

In the article "The Intelligence Friendly Classroom," Fogarty (1998) suggests that if intelligence is nurturable, we need to create a rich environment; if it is constructed, we need to provide tools for the mind; if it is experimental, we need to challenge through doing; if it is multiple, we need to target many dimensions; if it is modifiable, we need to mediate learning; and if it is elusive, we need to vary the way we measure it. If we know all of these things then the intelligence friendly classroom should be a given.

Campbell (1996) suggests that a teacher must ask these four questions in order to find out if a classroom environment is smart:

(1) Are there opportunities for students to work in pairs, small groups or as a whole class?

(2) Are resources readily available in the classroom, such as, books, bulletin boards, art work, posters, and computer?
(3) Are there plenty of tools to use in learning and problem solving?

(4) Do students have their own journals?

Armstrong (1994) believes that the Multiple Intelligence classrooms
should be set up with the “Multiple Intelligence” in mind. Some questions he
feels a teacher should consider when preparing the classroom are:

**Linguistic Intelligence** - Are the words spoken in the classroom age-
appropriate? How are students exposed to print? Is there too much exposure to
dittos?

**Logical-Mathematical Intelligence** - How is time structured in the classroom?
Do the students have certain rules, transitions, and routines they follow
throughout the day?

**Spatial Intelligence** - Is the classroom arranged to meet the different learning
styles in the class? Is the room visually attractive? Do the colors in the room
stimulate the students?

**Bodily-Kinesthetic Intelligence** - Do students have opportunity for movement
around the room throughout the day? Do students receive healthy snacks and
lunches to keep their mind and bodies active? Are there manipulatives in the
room so students can learn using “hands-on?”

**Musical Intelligence** - Do loud noises interfere with learning? Does
background music promote learning?
**Interpersonal Intelligence** - Are there ways to resolve problems between students? Do students have opportunity to interact and work cooperatively with other students?

**Intrapersonal Intelligence** - Do students have the opportunity to work independently? Do students have the opportunity to share their feelings in class?

Teachers must create classrooms that are mind centered instead of content centered. When students work requires “hands on”, the tools become more challenging, lively, and thought provoking; therefore, the students are able to be good decision makers and good problem solvers. The process becomes as important as the product (Chapman and Freeman, 1996).

**Teaching With Multiple Intelligences**

All of the intelligences can be used to become knowledgeable. Vocabulary words can be taught by using body movements, and music can be used to teach math, and so on.

Lazear (1991) states that there are four stages necessary to teach with Multiple Intelligences: Stage I - Awaken Intelligence; Stage II - Amplify Intelligence; Stage III - Teach for/with Intelligence; and Stage IV - Transfer
Intelligence. Stage I is when the intelligences are awakened; students are aware that they possess many ways of knowing. Particular senses can be activated through different activities. Stage II is when the awakened intelligences are nurtured and strengthened on a regular basis. Stage III is when lessons are structured for Multiple Intelligences in order to use, trust, and interpret intelligences. Stage IV is when the intelligences are transferred into our daily living in order to solve problems. The goal of this stage is for the intelligence to become a regular part of everyday thinking and learning (Lazear, 1991).

Once the teacher understands these four stages, they can be used as a model to create lesson plans.

To assess the student’s work, each student should have a portfolio. The work that is put in each student’s portfolio should be work that shows what the student really knows. The students can take part in deciding what should go into their portfolios.

Campbell (1996) translates Gardner’s theory into educational practice: teach to reach all students, perceive and nurture diverse students’ strengths, develop multiple intelligence-based curriculum, and better assess students’ learning.
Further Research

The results of the Third International Math and Science Study (TIMMS) show that United State's students fall behind the other countries in math. The National Council of Teachers of Mathematics (NCTM) supports the use of more projects and open-ended questions where students are guided and encouraged to find meaning in the activities they are doing. Wahl (1997) states this is good, but it's just not enough. This approach by the NCTM only taps in on the Logical-Mathematical Intelligence. Wahl (1997) feels that the other intelligences need to be explored as well. To present his case, he described the process a student can use to solve a math problem in many different ways. The example he used was: "A student is sorting sacks full of food donated by the school for a local food bank. He sorted 1/3 of it before lunch then sorted 3/4 of the remainder before school was out. What part (fraction) of all the food will be left for him to sort after school?" (Wahl, 1997, p. 1)

Using the bodily-kinesthetic intelligence students can visualize the process of food sorting and therefore come up with an estimate of the answer. This process is good to do when problem solving, so when the actual answer is found, the student can check the answer with the estimate to make sure the answer was close to the approximation.
For spatial intelligence, a diagram could be drawn and carefully examined to come up with a correct solution. This insight could lead to the logical-mathematical intelligence; adding the two fractions together shows how much work is left to be done.

A linguistic, interpersonal, and spatial intelligence follow-up would be to have each group re-create the solution by writing out the solution process in complete sentences along with a labeled diagram or flow chart. An intrapersonal intelligence follow-up would be to ask the students what their first reaction to the problem was. If we track what we were thinking and feeling during the process, we will become better problem solvers. Using all of the intelligences to solve problems makes math more relevant to the students and conveys relationships and number sense (Wahl, 1997).

Campbell (1998) did research on his third grade students during the school year of 1989-1990. Each day the students visited seven different learning centers according to the day’s theme. The students learned reading, writing, computing, solving problems cooperatively, moving and building, singing and creating rhythms, and by using different art forms, following an interdisciplinary curriculum. The research was done on the students to explore student’s reactions to a Multiple Intelligence-based instructional model.
Student’s behaviors, attitudes, and abilities to work in non-traditional ways were studied.

Campbell (1998) came up with ten conclusions from this research:

1. The students displayed increased independence, responsibility, and self-direction throughout the year.

2. Students with behavioral problems made significant improvements in their behaviors.

3. Cooperative skills improved with all of the students.

4. Students became able to use three to five intelligence areas in their classroom reports.

5. Students with dominant bodily-kinesthetic intelligence benefited from the active process of moving from center to center.

6. Leadership skills emerged in most of the students.

7. Parents reported that behavior at home had improved and school attendance increased.

8. Daily work with music and movement in content areas helped students retain information.
9. The role of the teacher changed as the year went on, becoming more facilitative, more diversified, and more of a resource person and guide.

10. Students became skilled in working in this unique and non-traditional classroom.

Although what Campbell found from this research had positive results, he felt a further study should be done to determine if these skills would continue through the students’ schooling (1998).

Campbell (1998) not only found the effects teaching through Multiple Intelligence had on his students, he also found the effects it had on the teacher. He states that he developed a different teaching style other than his original style of standing in front of the class and lecturing all day. He began to observe his students in seven new perspectives. Campbell began to work with his students rather than for them: he explored what they explored, discovered what they discovered, and often learned what they were learning. He became satisfied in the student’s excitement to learn, instead of their scores on tests.

Most importantly, Campbell (1998) learned from planning diverse activities to become more creative in his thinking and learning. He learned to write songs and sing. He became a better drawer and painter. Furthermore, he began to see
self-growth and development that made him wonder who was changing most, his students or himself.

Teaching for Multiple Intelligences is time-consuming and challenging. It can also be a great deal of fun not only for the students, but for the teachers as well. Teaching and planning in seven different ways brings out the creativeness within a teacher. This in turn motives and reaches more students. When students are excited to learn, the opportunity for succeeding is unlimited.
Chapter III

Research Design

**Teaching and Learning Through Multiple Intelligences**

It is very important for teachers to recognize and understand the intelligences each individual student has in her mind and body. Giving the students the opportunity to explore their individual interests and to learn basic skills using different learning tools and resources creates a classroom with a "smart environment." The basic skills the students must know do not need to be taught in the same way to every student. When teachers focus on the students' strengths, they can teach the students how to use their strengths to learn. In diverse classrooms, students that are learning using Multiple Intelligences learn to appreciate and respect the other students' abilities as well. Presenting information to students in many different ways offers many options for success. In this study, the researcher taught mathematics in one, fifth grade classroom, using Multiple Intelligences to find out how students perceive math after being taught in this way.
Classroom Setting

This study was conducted in a large, city school district in Western New York. The study involved 20 multicultural students in a fifth grade math class with two collaborating teachers. For this study the teachers are referred to as Teacher A and Teacher B. Teacher A and Teacher B planned and taught cooperatively the lesson plans using Multiple Intelligences for the unit on Geometry. Teacher A instructed and facilitated the group as a whole, while Teacher B worked with small groups or individual students. The students in this study were taught in a student-centered environment working in cooperative groups. The students had low to average abilities in mathematics.

Teacher Preparation

Before students were taught using Multiple Intelligences the teachers did a Personal Inventory. (See Appendix A) The Personal Inventory helped the teachers to understand what intelligences they relied on to instruct the class. After the teachers reflected on the results of the inventory, the teachers identified their intelligences that were used less often. This process enabled the teachers to be sensitive to their student’s strengths and weaknesses.
Introducing Multiple Intelligences to the Students

In order to teach students math using Multiple Intelligences it is important to find out each student’s dominant and less dominant intelligences. In this study the students were given a survey (See Appendix B) to identify each student’s areas of strongest intelligence. After the students completed the survey, the researcher assessed their answers, and their strong and weak intelligences were identified. (See Appendix C)

Because the theory of Multiple Intelligences was being taught in a fifth grade classroom, the information was simplified for fifth graders to understand. The fifth grade math class was taught a one hour lesson by Teacher A using a creative bulletin board. The bulletin board had a father bunny dressed up as a “gardener” to represent Howard Gardner, and seven smaller bunnies were dressed to represent each of his “Multiple” Intelligences. For example, the Bodily-Kinesthetics (Body-Smart) bunny was dressed like a ballerina.

All seven bunnies were labeled in vocabulary fifth graders could understand, however they were also told the proper name for each intelligence. The Verbal/Linguistic Intelligence bunny was labeled “talk-smart,” the Logical/Mathematical Intelligence bunny was labeled “math-smart,” the Bodily Kinesthetic Intelligence bunny was labeled “body-smart”, the Musical Intelligence bunny was labeled “music-smart,” the Visual Intelligence bunny
was labeled “picture-smart,” the Interpersonal Intelligence bunny was labeled “people-smart,” and the Intrapersonal Intelligence bunny was labeled “self-smart.” Next to each bunny there was a description of each intelligence to portray what a person strong in that intelligence would be like.

The students were told that each and every individual possesses all seven intelligences, but we all have one or two dominant intelligences. This is not how are intelligences have to stay. Each intelligence can be used to gain knowledge and thus be made stronger.

To culminate the lesson, Teacher A did an activity with the students to explain Multiple Intelligences in a simple way. Each student was given an apple and was asked to experience their apple using Howard Gardner’s seven intelligences (NEA Teacher-to-Teacher Books, 1996). For the “talk-smart” intelligence the students were asked to describe how the apple looked. When the students experienced the “self-smart” intelligence, the students reflected in their heads how the apple felt to them. The students were asked to describe the shape of the apples and then sorted the apples by color and shape for the “math-smart” intelligence. For the “people-smart” intelligence, the students compared their apples with their group members. The students sang a song about apples (“Apples and Bananas”) to express the “music-smart” intelligence. To finish
this activity, the students were asked to eat their apples to show the “body-smart” intelligence.

Teacher A explained to the students that they would be taught the next unit on Geometry using the different learning styles they just experienced and these learning styles are called Multiple Intelligences. The students were asked to write a paragraph in their math journals on something they learned from their lesson on Multiple Intelligences and how they felt about learning in this way. (See Appendix D for a sample paragraph)

Notification to the Parents

A letter from Teacher A was sent home explaining the classroom research. Attached to the letter was information explaining the theory of Howard Gardner’s Multiple Intelligences to clarify questions that might arise. (See Appendix E)

Unit Plan

The students were given a pretest to find out their prior knowledge of Geometry. (See Appendix F) The students in this fifth grade math class were
then taught Geometry using lessons with two or more of the seven intelligences for three weeks. By the end of the unit, the students were taught Geometry using all seven intelligences.

The lesson plans were written in a traditional format keeping David Lazear's format in mind from his book "Seven Ways of Teaching." The lesson plan design Lazear used is explained in Chapter II (Stage I – Awakening, Stage II – Amplify, Stage III – Teach, Stage IV – Transfer). (See Appendix G for the lesson plans used in this Unit)

At the end of each lesson students were asked to reflect on certain journal topics in their math journals. (See Appendix H for samples of students' reflections from their math journals)

Teacher A and Teacher B collaboratively identified learning styles, planned the lessons, and assessed instruction to create a student-centered classroom. During student-centered activities, Teacher A facilitated the class while at the same time kept a log of observations of each student called a "Student Intelligence Watch." (See Appendix I for a sample of the behavior log)

At the end of the unit, the students reviewed what they learned by visiting centers in the room with an activity using one intelligence at each center. The students were given a post-test that was used to assess what they learned in
Geometry using Multiple Intelligences. At the end of the test there was a questionnaire for each of the students to answer. The questionnaire asked what intelligences the students preferred using the most. (See Appendix J)

To compare the students' perceptions of themselves in the beginning of the unit to the end of the unit, the original survey was given to them again. This survey gave closure to the unit, but offered a new beginning to their seven ways of learning. It would only be proper now to ask these 20 fifth grade math students, "How are you smart?" instead of "How smart are you?"
Chapter IV

THE FINDINGS

Introduction

The purpose of this study was to find out how students perceive mathematics after Multiple Intelligences are used in mathematics instruction. The following data were collected to interpret the findings:

1. Pre-test scores
2. A survey given to the students
3. Anecdotal records kept on students’ behaviors in the classroom
4. Students’ math journals
5. Post-test scores
6. A questionnaire filled out by the students
7. The original survey was given a second time
The Pre-test

The students were given a pre-test on the Geometry Unit to find out what students already knew about Geometry. The following test results were found: 12% scored in the 90’s, 18% scored in the 80’s, 24% scored in the 70’s, and 48% scored in the 50’s or below. The average test score was 66%. The two students who scored in the 90’s were both retained so they had prior knowledge of Geometry. About half of the class had minimal knowledge of Geometry.

The Survey

The teacher used one class period to teach the students about Gardner’s Multiple Intelligences. After the lesson, the students were given a survey to identify their areas of strongest intelligence. There is a graph at the end of the chapter to compare the survey taken before Multiple Intelligences were used to teach mathematics to an identical survey taken after Multiple Intelligences were used to teach mathematics.
Student Intelligence Watch

When students were engaged in student-centered activities the teacher made observations and kept anecdotal records of each student using a behavior log checklist. The Student Intelligience Watch shows ways students are trying to enhance their learning. (See Appendix I for a sample of a Student Intelligence Watch)

Math Journals

For the whole unit on Geometry, the students kept math journals. This was something very different for most of them. The only other time the students kept journals was in Language Arts. Although math journals were a new concept, the majority of them enjoyed using them. It was very important to the students that the teacher read what they wrote each day. Some of the students would ask the teacher what the journal topic was for the day before the teacher could write it on the board.

Math journals were used mainly for the students’ reflections. They were also used for the students to write down the process of a certain task. For example, students would list the steps in measuring an angle.
All the vocabulary and diagrams used to teach Geometry were stored in the back of the math journals. When the students studied for their Geometry test at the end of the unit, all they needed to take home were their math journals.

Using math journals gave the teacher a good idea on how the students perceived mathematics when Multiple Intelligences were used in mathematics instruction.

The following are eleven of the journal topics given to the students to write and reflect about:

Day 1 – How did you like learning math in this way?

Day 2 – Write a story, song, or poem using all of the vocabulary words you have learned so far.

Day 3 – Write about your favorite part of Geometry so far.

Day 4 – Write about your favorite part of today’s lesson.

Day 5 – Make a list of everything needed to make a shape a polygon.

Day 6 – What is your favorite subject in school?

Day 7 – Does math come easy to you? Explain your answer.

Day 8 – What did you like best about math today?

Day 9 – Do geoboards help you to learn Geometry?

Day 10 – Would you like to learn other subjects using the seven Multiple Intelligences?
Day 11 – Did you like or dislike learning Geometry using Multiple Intelligences? Look back at the whole unit. What was your favorite lesson?

Post-test Scores

To review for the post-test students worked in centers. They spent about 10 minutes at each center. There were seven centers with activities using one intelligence at each center.

The post-test was given on the next day. The following test results were found: 15% scored 100%, 40% scored 90%-99%, 25% scored 80%-89%, 15% scored 70%-79%, and 5% scored 60%-69%. The average test score was 89%.

The test scores showed that students did very well learning math using Multiple Intelligences.

Questionnaire

At the end of the post-test the students were asked to fill out a questionnaire. The questionnaire asked the students to circle the intelligences
that were helpful for them to learn math, and to put an “X” by the intelligences that were harder for them to use.

The following are the percentages of the students that circled each intelligence:

94% body-smart  83% people-smart  78% talk-smart  72% body-smart
72% math-smart  72% music-smart  44% self-smart

The questionnaire also asked the question: Do you like learning math using Multiple Intelligences? Explain your answer.

<table>
<thead>
<tr>
<th>95% of the class said yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5% of class said no</td>
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</table>

The following are some of the students’ explanations:

“I think it helped me a lot.”

“Using Multiple Intelligences is very easy and I can learn better.”

“They help you learn and remember things easier.”

“I like it because it is fun and easy.”

“When learning using Multiple Intelligences, the strategies are easier to learn from.”

“It is a fun way to learn, plus you can learn more that way.”
“It tells you what you are stronger at.”

“We did projects and played games.”

“Because it is not boring; it’s fun!”

“We were learning math in a different way.”

The Original Survey Given a Second Time

The original survey was given again at the end of the Geometry Unit.

The chart below can be used to compare students’ dominant intelligences at the beginning of the unit to students’ dominant intelligences at the end of the unit.

Chart to Compare Surveys Taken Before and After the Unit:

| Key: |
| X - signifies the assessment of the students’ intelligences from the survey given at the beginning of the unit |
| O - signifies the assessment of the students’ intelligences from the survey given at the end of the unit |

<table>
<thead>
<tr>
<th>Student</th>
<th>Talk smart</th>
<th>Body smart</th>
<th>People smart</th>
<th>Self smart</th>
<th>Picture smart</th>
<th>Music smart</th>
<th>Math smart</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>X</td>
<td>O</td>
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<td>5</td>
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### Table

<table>
<thead>
<tr>
<th>Student</th>
<th>Talk smart</th>
<th>Body smart</th>
<th>People smart</th>
<th>Self smart</th>
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<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<td>19</td>
<td>X</td>
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<td>X</td>
<td>X</td>
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<td>X</td>
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</tbody>
</table>

Some findings from the surveys were:

- Students’ perceptions of themselves changed after being taught a unit in math using Multiple Intelligences.

- Some of the students used their dominant intelligences to strengthen their weaker intelligences.

- Some of the students were able to awaken all of their intelligences.

- Two of the students’ intelligences stayed the same.

**Summary of the Findings**

The findings show that the majority of students in this math classroom liked learning math using Multiple Intelligences. Only one student did not like learning math using Multiple Intelligences, but had no explanation for his answer. The results from the survey, tests, and questionnaire support the findings.
Chapter V

IMPLICATIONS OF THE RESEARCH

Discussion

The purpose of this study was to see what students’ perceptions of mathematics are after Multiple Intelligences are used for mathematics instruction. The study involved a fifth grade, low to average math class.

In order to find out students’ perceptions of math using Multiple Intelligences, it was important for students to understand each of the intelligences and Howard Gardner’s theory of Multiple Intelligences.

Once students understand the concept of Multiple Intelligences, they can determine their dominant intelligences. Students can use their dominant intelligences to learn in many different ways and to strengthen their weaker intelligences.

When the teacher taught from the teacher’s edition, the students were unmotivated and bored. Teaching the students mathematics in many different ways motivated the students and made learning fun.
Not only did the students enjoy learning math this way they also got a chance to see the many ways that they are smart. The students were able to achieve and have a sense of self-worth.

The teacher of this study believes that all students are gifted and talented, and that it is the teacher’s responsibility to find out how all children are smart. The teacher will find that teaching in many different ways gives the students the opportunity to find their gifts and to learn how to use them.

Conclusions

The research conclusion is that the majority of students found that learning mathematics using Multiple Intelligences in mathematics instruction made mathematics fun and helped them to improve their math skills. Some of the students said they liked learning math in this way so much that they would like to learn their other subjects in this way as well.

The researcher draws these conclusions from many sources; however, three of them were of major importance: responses in the students’ math journals, the post-test scores, and the questionnaire at the end of the unit.

The responses in the students’ journals were generated from the journal topics given at the end of each math class by the teacher. The students reflected in their math journals using the self-smart skills they acquired from the study.
The math journals were read only by the teacher which made this time of reflection for the students less restrictive.

The post-test scores assessed what the children learned and what they retained throughout the unit. The teacher was very pleased with the test scores.

The questionnaire at the end of the unit reinforced the students’ perceptions of math after learning in this way. The students also identified the intelligences that they liked using and the intelligences that were harder for them to use.

**Recommendations for Further Study**

This study focused on eleven days worth of math lessons. To be more effective, a study could be designed to cover more than one unit. It takes a long time for the students to be trained to learn in seven different ways.

The study could also compare students’ perceptions from two different classrooms at the same grade level: one class using Multiple Intelligences to teach and the other class learning in a more traditional way.

Another study could focus on how the role of the teacher changes when teaching using Multiple Intelligences. Because of the more student-centered activities, the teacher spent more time working with the students, rather than working for them.
A study could be done on how much time is spent planning for lessons in a Multiple Intelligences classroom compared to how much time is spent planning lessons for a more traditional classroom. The teacher spent more time planning lessons when Multiple Intelligences were used to teach than the teacher did when more traditional lessons were taught.

A final recommendation would be to include instruction in all content areas using Multiple Intelligences. "If all students are to learn the curriculum, then all need the opportunity to be taught in ways that enrich their learning" (Bellanca, 1998, p. 659). Without the opportunity to learn and practice the seven ways of knowing, students will not be capable to perform more complex, higher order intelligence tasks later (Lazear, 1991).
Appendices
Appendix A

The Personal Inventory
Teacher A

Personal Inventory

The Inventory has the seven Multiple Intelligences and boxes to assess your current professional and personal use. Put a 3 next to any intelligence used extensively, a 2 for moderate use, a 1 for infrequent use, and a 0 if never used. The total for each intelligence can range from a low zero to a high six.

<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Professional Use</th>
<th>Personal Use</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logical/Mathematical</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Verbal/Linguistic</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Visual/Spatial</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Bodily/Kinesthetic</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Musical</td>
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<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Interpersonal</td>
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<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>3</td>
<td>2</td>
<td>5</td>
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</tbody>
</table>

Teaching and Learning Through Multiple Intelligences by Linda Campbell, Bruce Campbell, and Dee Dickinson
Teacher B

Personal Inventory

The Inventory has the seven Multiple Intelligences and boxes to assess your current professional and personal use. Put a 3 next to any intelligence used extensively, a 2 for moderate use, a 1 for infrequent use, and a 0 if never used. The total for each intelligence can range from a low zero to a high six.

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<td>3</td>
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<td>6</td>
</tr>
</tbody>
</table>

Teaching and Learning Through Multiple Intelligences by Linda Campbell, Bruce Campbell, and Dee Dickinson
Appendix B

Survey
Survey

This survey will help you identify your areas of strongest intelligence. Read each statement. If it expresses some characteristics of you and sounds true for the most part, jot down a "T." If it doesn’t, mark an "F." If the statement is sometimes true, sometimes false, leave it blank.

1. _____ I’d rather draw a map than give verbal directions.
2. _____ If I am angry or happy, I usually know exactly why.
3. _____ I can play (or used to play) a musical instrument.
4. _____ I can associate music with my moods.
5. _____ I can add or multiply quickly in my head.
6. _____ I can help a friend sort out strong feelings because I successfully dealt with similar feelings myself.
7. _____ I like to work with calculators and computers.
8. _____ I pick up new dance steps fast.
9. _____ It’s easy for me to say what I think in an argument or debate.
10. _____ I enjoy a good lecture, speech, or sermon.
11. _____ I always know north from south no matter where I am.
12. _____ I like to gather together groups of people for parties or social events.
13. _____ Life seems empty without music.
14. _____ I always understand drawings that come with new gadgets.
15. _____ I like to work with puzzles and play games.
16. _____ Learning to ride a bike (or skates) was easy.
17. _____ I am irritated when I hear an argument or statement that doesn’t make sense to me.
18. _____ I can convince other people to follow my plans.
19. _____ My sense of balance and coordination is good.
20. _____ I often see patterns and relationships between numbers faster and easier than others.

21. _____ I enjoy building models (or sculpting).

22. _____ I'm good at finding the fine points of word meanings.

23. _____ I can look at an object one way and see it turned sideways or backwards just as easily.

24. _____ I often connect a piece of music with some event in my life.

25. _____ I like to work with numbers and figures.

26. _____ I like to sit quietly and reflect on my inner feelings.

27. _____ Just looking at shapes or buildings and structures is pleasurable to me.

28. _____ I like to hum, whistle, and sing in the shower or when I'm alone.

29. _____ I'm good at athletics.

30. _____ I enjoy writing detailed letters to friends.

31. _____ I'm usually aware of the expression on my face.

32. _____ I'm sensitive to the expressions on other people's faces.

33. _____ I stay "in touch" with my moods. I have no trouble identifying them.

34. _____ I am sensitive to the moods of others.

35. _____ I have a good sense of what others think of me.

(Multiple Intelligences – NEA Teacher-to-Teacher Books, 1996)
Appendix C

Scoring the Multiple Intelligence Assessment
Scoring the Multiple Intelligence Assessment

Put an "X" in the box for each item you marked with a "T". Add up the number of "X's" in each row. A total of four "X's" in any category indicates a strong ability in that intelligence.

A  9  10  17  22  30 =  

B  5  7  15  20  25 =  

C  1  11  14  23  27 =  

D  8  16  19  21  29 =  

E  3  4  13  24  28 =  

F  2  6  26  31  33 =  

G  12  18  32  34  35 =  

Key:
A: word smart
B: math/logic smart
C: picture smart
D: body smart
E: music smart
F: self smart
G: people smart
Appendix D

Sample of First Math Journal Entry
How do I like learning this way? I like learning this way because if you write, you don't learn anything, but if you do activities, you can learn something out of that.

I learn that you can measure sure in different ways by using a protractor and making a circle and using arrows to learn how to do a protractor. I learn that you can have more fun doing activities.
Appendix E

Notification to the Parents.
Statement of Informed Consent to Parents or Guardians

This form describes a research study that I will be doing in your child’s math class. I will be doing this research to find out if your child’s perceptions of math change when I teach them math using Multiple Intelligences. (Multiple Intelligences are seven different learning styles that a person can use to learn).

First, I will give them a survey, so that they can see what kind of learning styles they like to use. When I give them a post-test at the end of a chapter, there will be a questionnaire asking what learning styles they prefer to use and which learning styles are not useful for them to learn math. I will teach every math lesson for six weeks using at least two of the seven Multiple Intelligences. By the end of the chapter, we will have used all seven Multiple Intelligences. At the end of this research, I will repeat the original survey to see if they have changed their mind about the learning styles they chose in the beginning of the research.

I believe that they will benefit participating in this research. It will help them to identify their own personal learning styles that they can use not only in math, but in their other subjects as well.

Any of the data or test scores I collect will be confidential.

Their participation in this study is completely voluntary. They are being asked to make a decision about whether or not to participate in this study. If they wish to participate and you agree with the statement below, please sign in the space provided. They may change their mind at any time to withdraw from the study.

I, ________________________, having read and understand the information provided in this form, agree to have my child participate as a subject in this project.

______________________________  ________________________
Parent or Guardian's signature  Date
The Multiple Intelligence Theory: Dr. Howard Gardner believes that there are many forms of intelligence (many ways by which we know, understand, and learn about our world). We all possess all of the intelligences, but not all of them are developed equally; however, within ourselves we have the capability of activating all of our intelligences (Lazear, 1991).

Learning using Multiple Intelligences is very motivating and fun for children. The students will learn their individual gifts and talents. This way of learning gives the students self worth and the confidence to succeed.

The following is an explanation of the seven different intelligences:

Students who are strong in...

Linguistics like to read, write, tell stories, and play word games.

Logical Mathematical like to experiment, question, figure out logical puzzles, and calculate.

Spatial like to design, draw, visualize, and doodle.

Bodily-Kinesthetics like to dance, run, jump, build, touch, and gesture.

Musical like to sing, whistle, hum, tap feet and hands, and listen.

Interpersonal like to lead, organize, relate, manipulate, mediate, and go to parties.

Intrapersonal like to set goals, meditate, dream, be quiet, and plan.
Choose the correct answer for each.

Use the drawing below to answer 1–4.

1. Which is a line segment?
   a) \( \overrightarrow{BJ} \)
   b) \( \overrightarrow{DM} \)
   c) \( \overrightarrow{PN} \)
   d) \( J \)

2. Which is a ray?
   a) \( \overrightarrow{CK} \)
   b) \( \overrightarrow{DH} \)
   c) \( \overrightarrow{DL} \)
   d) \( P \)

3. Which lines are perpendicular?
   a) \( \overrightarrow{EM} \perp \overrightarrow{CK} \)
   b) \( \overrightarrow{AH} \perp \overrightarrow{PN} \)
   c) \( \overrightarrow{AH} \perp \overrightarrow{EM} \)
   d) not given

4. Which lines are parallel?
   a) \( \overrightarrow{AH} \parallel \overrightarrow{EM} \)
   b) \( \overrightarrow{CK} \parallel \overrightarrow{PN} \)
   c) \( \overrightarrow{AH} \parallel \overrightarrow{PN} \)
   d) \( \overrightarrow{EM} \parallel \overrightarrow{PN} \)

5. What type of angle is shown?
   a) acute
   b) right
   c) obtuse
   d) not given

6. What type of angle is shown?
   a) acute
   b) right
   c) obtuse
   d) not given

7. Estimate the measure of the angle shown.
   a) 45°
   b) 120°
   c) 15°
   d) 80°

8. Estimate the measure of the angle shown.
   a) 25°
   b) 190°
   c) 75°
   d) 105°

9. What is the name of this polygon?
   a) octagon
   b) hexagon
   c) quadrilateral
   d) pentagon

10. What type of triangle is shown?
    a) scalene
    b) isosceles
    c) equilateral
    d) not given
Choose the correct answer for each.

11. What is a name for this polygon?
   - a) square
   - b) trapezoid
   - c) rhombus
   - d) parallelogram

12. Which is a chord?
   - a) \(HG\)
   - b) \(AC\)
   - c) \(EF\)
   - d) not given

13. Which figure below is similar to this polygon?
   - a)
   - b)
   - c)
   - d)

14. Which figure below is congruent to this polygon?
   - a)
   - b)
   - c)
   - d)

15. Which shows a line of symmetry?
   - a)
   - b)
   - c)
   - d)

16. Which figure below is a flip image of this polygon?
   - a)
   - b)
   - c)
   - d)

17. Choose the next two numbers in the pattern.
   - a) 5, 15, 30, 50, ___, ___,
     - b) 75, 105
     - c) 75, 100
     - d) 80, 115

   - b) 11, 21, 30, 38, ___, ___,
     - a) 47, 55
     - b) 46, 55
     - c) 46, 53
     - d) 45, 51

   - b) 2, 3, 5, 9, 17, 33, ___, ___,
     - a) 40, 48
     - b) 56, 59
     - c) 65, 129
     - d) 66, 130

18. Maria looks at the cover of her jewelry box. She draws the cover on a piece of paper. What type of polygon has Maria drawn?
   - a) pentagon
   - b) octagon
   - c) hexagon
   - d) quadrilateral

Obj. 6.3; 9–12; 3/4; /4
Obj. 6.4; 13–16; 3/4; /4
Obj. 6.5; 17–20; 3/4; /4
Appendix G

Lesson Plans
Day 1
Lesson Plan: Multiple Intelligences
Objective: Getting students ready for Geometry Unit by teaching them how to learn math using Multiple Intelligences.

Display bulletin board on Multiple Intelligences and explain.

*We all possess all seven intelligences, but individually we all have one or more intelligences that are stronger than the others do.
*Explain each intelligence and give examples. (Students that are strong in talk-smart like to...)
*We can strengthen our weaker intelligences.
*We are all talented and gifted in some way.
*It is important to ask people, "How are you smart?" not "How smart are you?"
*It is important to understand the process as well as the product.

"Let's find out what your strong intelligence(s) are."

Give students a survey. (Take home each survey and assess. Bring back results to the class.)

Do activity with apples to help students understand the Multiple Intelligences:

1. Give each student an apple.
2. Talk-smart: Describe how the apple looks.
3. Body-smart: How does the apple feel?
4. Math-smart: What shape is the apple?
5. People-smart: Compare and talk about your apple to the person sitting next to you.
6. Math-smart: Sort apples by color and size with group members.
8. Music-Smart: Sing a song about apples.
10. Self-smart: Write about your apple: What colors were on your apple? How did your apple taste?

**Journals:**

*Pass math journals out. Tell the students that they will be writing in them every day at the end of the math period. Tell students that I will collect journals at the end of the unit.*

*Write in journal (5-11-99). “Write about something you learned today. Do you think you are going to like learning in this way?”*

**Pretest:**

*If there is time give the pretest for the Geometry Unit.*
Day 2 - Teaching Geometry Using Multiple Intelligences

Lesson - Geometric Ideas:

Materials: poster board (one for each group), markers, notebooks, pencils

Objective: To understand Geometric terms: point, line, line segment, ray, and plane.

1. Explain each term on the board and have students write them down in their notes.
2. Give each group a term and a piece of poster board.
3. Assign jobs: #1 draw rough draft on a piece of paper, #2 and #3 transfer drawing onto poster board, and #4 present to the class
4. Explain to the students that their posters must include: the term (use large enough letters so we can read), the definition, the symbol, and how to read the symbol.
5. Have each group present their posters (group member #4).

(people-smart, talk-smart, picture-smart)

Practice:
*Hold up big flash cards and have students name the term.
*Draw a diagram and have students come up to the board and trace with their finger these parts:
1. \( \overrightarrow{BA} \) and \( BC \)
2. \( \overrightarrow{AF} \) and \( GL \)
3. \( \overrightarrow{DF} \) and \( CI \)
4. \( \overrightarrow{HF} \) and \( JB \)
5. \( BH \) and \( EF \)
6. \( JL \) and \( JK \)

(body-smart)

Journal Entry - Write a story, song, or poem, using all the vocabulary words you have learned so far. (self-smart)

Homework: R67 (worksheet)

Day 4 - Teaching Geometry Using Multiple Intelligences

Lesson - Pairs of Lines
Day 3 - Teaching Geometry Using Multiple Intelligences:
Lesson - Measuring, Estimating, and Identifying Angles
Materials: Geoboards, pencils, index cards, rubberbands
Objective: To identify right, acute, obtuse, and congruent angles.

1. Go over homework.
2. Finish posters (5 minutes) and have the rest of the students present their posters.

Input: Have students work in pairs with geoboards. Partner #1 will make an angle on the geoboard. Partner #2 will use an index card (90 degree angle) to estimate if the angle is greater than, less than, or equal to the angle of the index card. Switch jobs. (body-smart, picture-smart)

Vocabulary - Pass out sheet with vocabulary words on it (protractor, degrees, vertex, right angle, acute angle, obtuse angle, and congruent angle). (talk-smart)

- Show the students a protractor, and tell them it is used to measure angles in degrees (What else do we measure in degrees?)

- Draw a circle on the board using large protractor. Draw the diameter so students can see that half of the circle is the size of the protractor. Draw examples of all four angles. (picture-smart)

- Show the students the steps to measure an angle and how you can estimate the measure of an angle (if the angle is smaller than a right angle we know the angle will be less than 90). Also explain that the degrees on the protractor counts by tens.
Practice:

Give students worksheet with angles to measure. On the back of the sheet have the students draw their own.

1. 30°  
2. 130°  
3. 90°  
4. 180°

Closure: Have students make up a song or story using vocabulary.

Homework: page 40 in the workbook

Journal Topic: Write the directions on how to measure an angle. Write about something that you liked or disliked about math today.
To Measure an Angle:
1. place the center of the protractor at the vertex
2. place the ray at zero
3. read the scale that begins at the zero mark

To Draw an Angle:
1. draw points at the center of the protractor at 0 and at the desired measure
2. draw rays to connect the outer points with the vertex
Identifying Angles:

An angle is formed by 2 rays with a common endpoint called the vertex. (The vertex is always named in the middle.)

A protractor is used to measure or draw angles in degrees.

A right angle measures 90°.

An acute angle measures less than 90°.

An obtuse angle measures more than 90°, but less than 180°.

Congruent angles are 2 angles that have the same measure.
Day 4 - Teaching Geometry Using Multiple Intelligences

Lesson - Pairs of Lines
Objective: To name intersecting, parallel, and perpendicular lines.

Input: Have a student read the definition for intersecting lines (already written for them on dot paper). Have the students work in pairs and make what they think intersecting lines are on a geoboard from listening to the definition. Then have the students draw intersecting lines on dot paper. (Use the overhead to demonstrate.) Do the same with perpendicular lines and parallel lines. (talk-smart, people-smart, picture-smart)

Practice: Have students come up to bulletin board with a diagram of different pairs of lines. Have cards made for students to pick. Students will pick a card that will tell them to show different pairs of lines (for example, show lines that are vertical parallel lines). (body-smart, picture-smart)

More Practice: Play "Simon Says" using arms to demonstrate pairs of lines.

Closure: Turn to your partner and describe perpendicular lines, parallel lines, and intersecting lines.
Journal Topic: Write about your favorite part of today's lesson.

Homework: R and P 70.
Pairs of Lines:

* Intersecting lines are lines that meet at a point.

* Perpendicular lines are lines that intersect and form right angles.

* Parallel lines are lines in the same plane that never intersect.
Day 5 - Teaching Geometry Using Multiple Intelligences:

Lesson - Classifying Polygons

Objective: To be able to identify polygons (triangle, quadrilateral, pentagon, hexagon, and octagon).

Input: Have students listen to definition of a polygon and on a scrap piece of paper have them draw a picture of what they think a polygon looks like. Tell the students that vertices is plural for vertex. On a graphic organizer, have the students write the definition for polygons and label each polygon (how many sides, angles, and vertices does each have?). (talk-smart, picture smart)

Have students make a chart: (picture-smart)

<table>
<thead>
<tr>
<th>Polygons</th>
<th>Sides</th>
<th>Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangle</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Quadrilateral</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Pentagon</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Hexagon</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Octagon</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Practice: Show pictures of real life objects (put on a bulletin board) and have students stick a label on each object. (body-smart)

More Practice: Give each group a basket full of cut out shapes. Have students make an animal with the shapes by gluing them on to a piece of construction paper. All five shapes must be used and labeled.

Journal Topic: Make a list of everything needed for a shape to be a polygon.

Homework: R and P 71
POLYGONS
Day 6 - Teaching Geometry Using Multiple Intelligences
Lesson - Similar and Congruent Figures
Objective: To identify and draw similar and congruent figures.

Materials: Dot paper, pencil

Input: Pass out vocabulary to explain what a figure needs to be similar. Use overhead to demonstrate how to draw similar figures. Have students draw an original figure (rectangle). Then show how if you multiply the same number by each side you will create a similar figure (same shape, but not the same size). Have students practice making more similar shapes to the original figure.

Have a student read the definition for a congruent figure: Model how to draw a congruent figure by drawing a figure and then draw the same exact figure but in a different position on the overhead (same shape, same size).

Practice: Students will draw a figure and then trade papers with their partners. The partner will then draw a congruent figure to match their partner's figure. (picture-smart, people-smart)

Journal Topic: What is your favorite subject in school?

Homework: R 73
Day 7 - Teaching Geometry Using Multiple Intelligences
Lesson - Exploring Symmetry
Objective - To investigate and construct congruent figures.
Materials: construction paper, scissors, ABC paper, rulers

Input: Have students refer back to vocabulary sheet and have a student read the definition for symmetrical figures and lines of symmetry.
1. Have students fold a piece of construction paper in half.
2. Have the students cut out a design with the paper folded (remind students not to cut on the fold).
3. When students are done cutting have them open their paper to see that each side of the fold is congruent.
4. Have the students draw a dotted line on the fold and tell them that the dotted line is the line of symmetry.

Practice: Pass out sheets with the alphabet on it. Have students find letters that are symmetrical by drawing lines of symmetry through the letters. Which letters are symmetrical? Which letters have more than one line of symmetry? Have the students decode words that are missing half of the letters to make the words symmetrical.

Journal Topic: Write about if you think math comes easy to you or not. Explain your answer.

Homework: Workbook page 45.
Day 8 - Teaching Geometry Using Multiple Intelligences
Lesson - Classifying Triangles
Materials: rulers, pencils, protractors, graph paper
Objective: To classify different types of triangles: equilateral, isosceles, scalene, and right triangles.

Input: Pass out graphic organizer with the four different triangles. Tell the students that the important thing about identifying triangles is by looking at their angles and their sides. Have students right the definition for each triangle on the graphic organizer. Then pass out a piece of graph paper to each student. Model to the students how to draw the different triangles and have them draw and label each. Explain to the students that if you add up all the angles of a triangle they will always add up to 180 degrees. Show how a right angle can be scalene and isosceles also.

Practice: Have students find missing angles on different types of triangles (add given angles together then subtract from 180 and that will give you the missing angle). Ask students if they can think of any other ways to find the missing angle. (math-smart)

Explore: Have the students explore triangles to answer Always, Never, or Sometimes to the following:

An isosceles triangle is a right triangle.

A right triangle is a scalene triangle.

An isosceles triangle is an equilateral triangle.

A right triangle has more than one right angle.

More Practice: Sing the song “The Triangle Hokie Pokie”

Journal Topic: What did you like best about today's lesson?

Homework: Workbook page 46
"The Triangle Hokie Pokie"

Put your triangle in, put your triangle out. Put your triangle in and you shake it all about. It has 3 sides and it has 3 angles. That's how we know our triangles.

Put your equilateral in, put your equilateral out. Put your equilateral in and you shake it all about. It has all congruent sides. It has all congruent angles. That's how we know our triangles.

Put your isosceles in. Put your isosceles out. Put your isosceles in and you shake it all about. It has two congruent sides. It has two congruent angles. That's how we know our triangles.

Put your scalene in. Put your scalene out. Put your scalene in and you shake it all about. It has no congruent sides. It has no congruent angles. That's how we know our triangles.
Put your right triangle in. Put your right triangle out. Put your right triangle in and you shake it all about. It has 90° on only one of it's angles. That's how we know our triangles.
isosceles triangle - a triangle with two congruent sides and two congruent angles.

equilateral triangle - all congruent sides and all congruent angles.

right triangle - a triangle with one 90° angle.

scalene - no congruent sides and no congruent angles.
Day 9 - Teaching Geometry Using Multiple Intelligences
Lesson - Quadrilaterals
Materials - Geoboards, rubber bands, pencils, dot paper
Objective - To classify quadrilaterals as rectangles, squares, trapezoids, parallelograms, or rhombuses.

Warm Up - Fold dot paper so that there are 4 sections. With a partner students will take turns making 4 different 4 sided shapes. Then the students will draw each of the shapes they created on the four sections of the dot paper. Students will then make a "T" chart and identify differences and similarities of all four shapes they have made. Have students share their comparisons with the class. (talk-smart, people-smart, body-smart, picture-smart)

Input - Show and explain the definitions of different quadrilaterals (square, rectangle, trapezoid, parallelogram, and rhombuses) on chart. Have students compare the different quadrilaterals and list all that apply to each polygon on their own charts.

<table>
<thead>
<tr>
<th>Quadrilateral</th>
<th>Trapezoid</th>
<th>Parallelogram</th>
<th>Rectangle</th>
<th>Square</th>
<th>Rhombus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Yes</td>
<td>yes</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>yes</td>
<td>yes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Journal Topic: Does using geoboards help you to learn quadrilaterals better?

Homework R and P 79
Day 10 - Teaching Geometry Using Multiple Intelligences
Lesson - Circles
Materials - Compasses, rulers, pencils
Objective - To name the parts of a circle to construct a circle using a compass.

Warm Up - What is a circle? Identify three things in everyday life that are in the shape of a circle.

Input - Pass sheet to all students with vocabulary of all parts of a circle on it. Model how to draw a circle using a compass. On the other half of the vocabulary sheet, have students draw a circle using a compass. (picture smart)

Guided Practice - Have students name the following:
1. Name 3 radii in circle “O”.
2. Name 2 chords.
(talk-smart)

Practice - Have students draw and label a circle with:
1. Center P
2. Diameter QR
3. Radius PS
4. Chord ST

- Show students how to find a diameter by multiplying the radius by two.

Journal Topic: Would you like to learn other subjects using Multiple Intelligences?

Homework - Work book page 47
Circles:

All the points on a circle are the same distance from the point called the center.

**Diameter**: A line segment that passes through the center of a circle and has both endpoints on the circle. (The width of a circle.)

**Radius**: A line segment with one endpoint on the circle and the other endpoint at the center. (The length of a radius is one-half the length of a diameter.) *Radius \times 2 = Diameter* \[ \text{(Radii)} \]

**Chord**: A line segment with both endpoints on the circle.

**Semicircle**: A half of a circle.

Use a compass to construct a circle:

1. Put the metal tip at the point to be the center.
2. Open the compass to the length of the radius.
3. Rotate the pencil around the center.
Day 11 - Teaching Geometry Using Multiple Intelligences
Lesson - Review Geometry by setting up seven centers in the
room that has one of the seven intelligences at each center.
Objective - To review for the final test in Geometry.

Center #1 - Talk-smart: Students will sit in cooperative groups
and discuss similarities and differences of Quadrilaterals on a
bulletin board. Then they will write the similarities and
differences down on a “T” chart.

Center #2 - People-smart: Students will play a board game
together called “The Polygon Game.”

Center #3 - Music-smart: Students will practice singing “The
Triangle Hokie Pokie.” Then together they will sing it on the tape
recorder and play it back so they can listen to themselves sing
the song.

Center #4 - Picture-smart: Students will use dot paper to draw
similar and congruent figures. When they are done drawing the
figures they will draw the lines of symmetry through each figure.
Then students will draw a figure and exchange it with someone in
their group. Students will draw a congruent figure of the drawing
they received from someone in their group.

Center #5 - Body-smart: Students will play a game using
flashcards and a bulletin board. The flashcards will ask students
to come up to the bulletin board to trace a line, line segment, ray,
parallel lines, perpendicular lines, and intersecting lines

Center #6 - Math-smart: Students will do a math activity sheet
that will ask them to measure angles, to find the missing angle on
a triangle, and to find the diameters and radii of circles.
Center # 7 Self-smart: Students will all go back to their seats to reflect on one last journal topic: Did you like or dislike learning Geometry using Multiple Intelligences? Explain your answer. Now look back at the whole unit. What was your favorite lesson?

*Students will spend about 10 minutes in each center. When students hear music they will go clock-wise to switch centers.

Home work: Take home your journal and use it to study for the Geometry Test tomorrow.
Appendix H

Samples of Students’ Reflections from Their Math Journals
Journal Topic: start a story or a song with vocabulary words.

One day I saw an endless line that went on and on. Then I saw the sun and the rays were shining on me and they were pretty bright rays. Then I saw a line segment. There was an accident and they had to put the yellow plastic stuff that usually says caution. Then I saw a point and I tripped over it. Then last I saw a plane and it was really neat. Then when I woke up I found out it was a dream about... Geometry.
write about your favorite part of Geometry so far.

My favorite part of Geometry is when we used the Geo boards. It was really fun. Also easy to put on the rubber bands.

5-17-99

I liked learning all ways. They were all fun to me. They were also easy lessons to learn from the quiz.

5-18-99

Journal - write everything needed for a shape to be a polygon. It has to have sides. It needs to have vertices. Also it needs to be closed.

Journal Topic - what is your favorite subject and why?

My favorite subject is math in Geometry because we are working with fun stuff.
Journal Question: Write about what you like about learning math today.

Answer: I like learning in math today because we got to learn in a fun way. Also, we learned in a way that you won't forget what you learned about.

Journal Question: Write everything needed for a shape to be a polygon.

Answer: Everything needed to be a polygon is that all the sides have to be closed to be a polygon.
Write about what you liked about learning math today.  5-17-99

What I liked about learning in math today was the Geo boards. I also liked playing Simon says.
5/17 Math Class

write about what you like about math

The thing I liked about geometry was about the angles. My favorite angle was the obtuse. The reason why I liked it because it is always open wide like my mouth. Another reason why I liked geometry was because I learned new words like right angle, obtuse angle, and acute angle. Another reason why it is fun is because I will need it for life.
5/17/99  Write about what you liked about learning math today.

I liked the part of math when we used the Geo boards. I also liked making the shapes on the Geo boards.
Journal - write everything

5-18-99 needed for a shape to be a polygon.

There are three parts of a shape to be a polygon. First it has to be closed and have line segments. Second the shape has to have a vertice.
What is your favorite subject in school?

My favorite subject is math because math is fun, and the other favorite subject is science because in science we get to do experiments and watch a tape. We also get to play games like jeopardy, the why we play games it will help us study our notes.
Journal what is your favorite subject in school and why?

My favorite subject in school is math. I like math because we are working in groups. I also like math because we are working with polygons. I like working with polygons. I like making the creatures on the paper. That is my favorite subject.
Journal: Do geoboards help you to learn geometry?

Yes, because we get to practice making the shape.

1. The center of the circle is at point B.
2. The diameter of circle "B" is AC.
3. Three chords of circle "B" are BD, BC, BA.
4. Two chords of circle "B" are ED, AC.
5. A semicircle of circle "B" is AC.
6-4-99  Journal - Write about if you would like to learn other subjects using the seven intelligences.

Yes, I would because I like doing it this way. I think it is fun.

6-7-99  Journal - Did you like or dislike learning geometry using MI's. Look back at the whole unit. What was your favorite lesson?

I liked using geometry with MI's. It is fun. My favorite lesson was the Polygons. It was fun.
Appendix I

Student Intelligence Watch.
STUDENT INTELLIGENCE WATCH
Behavior Patterns Log

How many of these behaviors can you find in your students?

☐ “Doodling” during a lecture or discussion
☐ Irresistible urge to discuss work with friends
☐ Humming quietly to self while working or while walking down the hall
☐ Precision in language and thought
☐ Difficulty sitting still or staying in seat
☐ Recognition of and delight in abstract patterns
☐ Very quiet, very self-reflective
☐ Quick problem solving
☐ Creative ideas, suggestions, and answers
☐ Body gestures and physical movement in expressing self
☐ Tapping pencil, foot, or finger while working
☐ Can remember thinking formulas and problem-solving strategies
☐ Relentless question-asking, avid curiosity
☐ Good at listening to and communicating with others
☐ Is helped by “visuals”; likes drawing, coloring, or painting
☐ Likes “hands-on” (manipulative) assignments
☐ Highly intuitive (“flies by the seat of their pants”)
☐ Good in sports, well-coordinated physically
Appendix J

Questionnaire
Questionnaire:

Circle the intelligences you used that were helpful for you to learn math.

Put a "X" next to the intelligences that were harder for you to use.

Intelligences (learning styles):
1. body smart - "using your body to learn math"
2. music smart - "using music to learn math"
3. people smart - "working cooperatively in groups to learn math"
4. self smart - "working independently to learn math"
5. picture smart - "looking at pictures or diagrams to learn math"
6. word smart - "speaking, reading, and writing to learn math"
7. number smart - "using problem solving to learn math"

Do you like learning math using multiple intelligences? YES or NO (circle one)

Why? __________________________________________________________
 __________________________________________________________
References
References

Arnold, E. (1997). The brain and how to help students use the one they have. Rochester, New York: Ellen Arnold.


