Abstract

Mathematics can be taught in a variety of ways, which corresponds to the reality that children learn in a variety of ways. Howard Gardner confined these different ways down to eight specific intelligences through which children learn. In this study the teaching and learning of mathematics was analyzed according to Gardner's multiple intelligences through observations, interviews and surveys. It was predicted that children would possess one or more of Gardner's multiple intelligences while learning mathematics. Further, if these children do possess forms of MI, the hope is that teachers will begin to identify these forms and teach accordingly. Further research may yield more pertinent information for this study and therefore it will continue to develop.

Introduction

Children learn in many different ways. Which way works best for a certain child depends on many things, such as the child's interests and talents, as well as the subject being studied. Howard Gardner agreed with this assumption and, as a result, developed a theory based on it. His "Theory of Multiple Intelligences" suggests that there are at least eight different ways through which children learn and express their intelligence. He also proposes that these eight intelligences are independent to the extent at which they develop at different degrees in different children. Also, specific multiple intelligences could be geared towards specific subjects studied in schools. This leads to the question of which intelligences affect which subjects. More specifically, how are Gardner's forms of multiple intelligences incorporated into the teaching of elementary subjects such as mathematics? In attempts to examine this idea into more depth, the understanding of the rationale behind Gardner's theory must be presented.

Howard Gardner developed eight intelligences. They are: verbal/linguistic (spoken/written language), logical/mathematical (analyzing and doing maths), musical (performance, composition and appreciation of music), bodily/kinesthetic (potential to use the whole body in learning), visual/spatial (recognizing a multitude of patterns), interpersonal (working with others), intrapersonal (understanding oneself) and naturalistic (being in touch with nature). Gardner's theory is based on the idea that people have a combination of intelligences and that one or more of these is at work at all times.

If the integration of the Multiple Intelligences shows to be beneficial for students within the area of mathematics, the hope is that educators and administrators will lean towards incorporating multiple intelligences into everyday learning. If this becomes a trend in teaching, students will benefit because they will be able to express themselves through many channels and be able to retain information in different ways. To broaden overall knowledge of the multiple intelligences, as well as, to find out if they make a difference in the education of children is important. Further, as discussed by many researchers, ways in which forms of multiple intelligences are implemented within the teaching of elementary mathematics will be determined and analyzed.

Methods

For this research study, literature review, observing, interviewing and surveying were the ways in which I gathered information. First, I reviewed and analyzed pertinent literature. Then I

developed my protocol. After this, I went into the field, which in this case was a classroom, to observe, interview and survey the students and the teacher. When my time in the field was completed, I analyzed my data. I typed out my observational notes and transcribed my interview tape-recordings for easier referral. I prescribed pseudonyms to all individuals who participated in the study. I also created a graph based on the data received from the survey I conducted. Further, I collected copies of assignments from each day's math lesson. The last thing that I did was organize my findings into a coherent manner in order to formulate my conclusions. Following, are the steps I took in a more detailed manner.

Literature

I began my research by reading professional literature about Gardner's Multiple Intelligences (MI). I analyzed several articles, books and movies to learn more about the theory and practice of MI. I looked, specifically, for material geared towards the teaching and learning of mathematics. After investigating these sources, I was able to narrow my research intent to the specific intelligences and their effects on mathematics. The next step was planning for the gathering of information in the field.

Planning

In preparation for entering the classroom, I developed detailed protocol to aid in observation. They consisted of a table to fill out and possible survey and interview questions. The table showed the eight MI in one column, along with brief descriptors. The other column was blank space where I wrote my observations. To view this table, see appendix A. The possible questions for my interviews and surveys were formulated based on my literature research up to that point, as well as my own knowledge of elementary mathematics. For a complete list of possible questions, see appendix B. In addition, I obtained a small tape recorder to use during interviews. This allowed me to record the conversations and transcribe them for further use. After creating and collecting these materials, I chose a classroom in which to observe.

Second grade was the level I decided to observe because it is a stage where basic math skills are developing and being refined. This particular class was composed of 22 students and one teacher. Demographically, the population of the class was Caucasian. I do not, however, feel that the ethnicity of the participants is relevant to the results of the study. This second grade class was very well- behaved and attentive. The classroom climate was warm and welcoming and the students tended to go about their business in a routine manner. The students' desks were arranged in groups of four and five, which left some space in the front of the room for a carpet. Art projects hung from the ceiling tiles and the walls displayed educational and fun posters and banners. As an observer, I felt very comfortable in the atmosphere that the teacher and students had created.

Observation

My observations took place in the morning, which was when the class had their math lesson. Each observation began at 9:00am and ended at 9:45am. I observed a total of six times within a two- week period. While observing, I paid close attention to the lesson and the activities that took place. More specifically, I watched for instances of MI. For example, when I saw that students were going to measure things with their rulers, I noted this next to the bodily/kinesthetic intelligence. To see my complete collection of observational notes, see appendix C. For the

duration of my observations Iremained unobtrusive. However, I did communicate personally with the teacher and students during interviews.

Teacher Interview #1

The first interview was held on my third day in the field. I arrived early to accommodate the teacher's schedule and allow ample time for the interview. Before I began, I explained about the type of research that I was conducting. I offered the teacher a list of Gardner's eight MI to review and inquire about, if needed. The preliminary questions during the survey were to gain general information and background of the teacher. I then moved to the topic of my research and asked, in general, if the teacher knew anything about Gardner's forms of MI. For a complete transcript of interview one, see appendix D. At the conclusion of the interview I informed the teacher that I would like to conduct another interview before my research was done. I also explained that I wanted to interview three students. I discussed some possible questions for such interviews and revealed my proposed survey to hand out to the students.

Student Survey

I created a simple survey to add to my data gathering. This survey was made up of questions about how students felt about certain ideas within mathematics. There were sixteen questions in all; two pertaining to each MI. For example, one question, which was geared towards the interpersonal intelligence, was: How do you feel about working in groups during math? To answer these questions, students had to fill in the smiley-face that corresponded with how they felt. Appropriately, a happy face meant that the student liked it and a sad face meant that the student did not like it. An entire survey can be seen in appendix E. Once all the surveys were filled out, I was able to interview three students about their responses.

Student Interviews

Student interviews were held during my fourth visit to the classroom. The three students that I chose to interview were suggested to me by the teacher. I wanted to interview three students that were at different ability levels within mathematics. Miss Maple geared me towards a girl who was below level, a boy who was on-level and a girl who was above-level. I felt that by having a diverse spectrum of interviewees that I would gain a wider perspective on the questions asked. Consent letters were sent home with each of the three students and returned promptly. I interviewed each student individually. I first explained the process of the interview and the reasoning behind it. I also made sure that each student felt comfortable being tape-recorded. The format of these student interviews was based on the survey that they had each filled out. We discussed in more detail why each student liked or disliked a certain activity named on the survey. I then transcribed these interviews for later use in my analysis. To view student interview transcriptions, see appendix F. With the information from these student interviews, I was ready to move on to interview number two with the teacher.

Teacher Interview #2

The second interview with the teacher took place on the sixth day I went to observe. This interview was formulated based on my observations so far, as well as the information received from the student interviews. Questions were quite specific and focused on issues I had come across while gathering data. For example, one question was: I have noticed that you do a lot of group work in math.

Do you think that this is beneficial for the students? Are there any students that you think would work better on their own? For a full view interview two's transcriptions, see appendix D. With the information gathered from this interview, I felt ready to complete my observations and begin analysis.

Implications of Research Process

All of the steps that were involved in my research project were important to the final outcome. First, reviewing professional literature gave me the background I needed to become more familiar with all of the aspects of Gardner's MI. These articles, books and videos gave me information pertaining to what I needed to look for while in the field. Next, while actually out in the field, the observations I made enabled me to find out if MI was used within the classroom. I was able to connect these observations to much of the literature I had read about MI. Since I remained unobtrusive while observing, my data shows fact, not opinion. This was important because I was not concerned with what I *thought* would take place in the classroom when it came to MI. I feel that my observations were significant in that they told me which MI were used and which MI were not used. In addition, they told me to what extent and how often each MI was used. I then interviewed the teacher to gain an insight as to how she felt about the teaching of mathematics. This was important because I wanted to figure out if the teacher was, in fact, using MI in the classroom and further, whether she was doing so without knowing. It was important to have the view of a professional teacher on the subject of MI, too. This allowed me to find out if teachers think MI is important and beneficial. On the other hand, gaining the perspectives of the students was important as well.

For an anonymous and overall view of how the students felt about MI, I conducted a survey. Although the students were not actually told any information about MI, I still feel that this survey served great purpose. Each question was related to a specific MI. Students merely chose whether they liked or did not like each aspect. From this information I was able to determine which MI seemed to make the students happy. This could have also been seen as which MI the students were comfortable with. I used this collection of data to add to my observations of which MI I detected within the classroom. I felt that this correlation was important in that it could be a reason that a student is not doing well in math. Further, perhaps the methods used in the classroom are not ones that the student enjoys or is comfortable with. To organize my findings, I created a graph which can be viewed in appendix G.

I gathered further information pertaining to the surveys by interviewing three students. During these interviews I was able to collect reasons behind the answers that the three students gave on their surveys. The three students gave me enough information to be able to hypothesize that most students chose the smiley face if the activity seemed fun and the sad face if the activity seemed hard. This data correlates with the idea that perhaps using MI in the classroom can lead to a better learning outcome. If the teacher figures out which MI his/her students enjoy and feel comfortable with, the lessons can be geared toward those specific MI. This is where the second interview with the teacher came into play. I wanted to ask specific questions about the teacher's teaching style and incorporation of MI. This gave me a better idea of the goals that the teacher had when teaching mathematics.

Through reviewing literature, observing, interviewing and surveying I was able to gain the information I needed to answer my research question. The triangulation of these data gathering

methods was designed to offer different perspectives on the theory of MI and I feel that I accomplished that goal. I was therefore, able to correlate all of my data together to determine the effectiveness of MI in the teaching of Mathematics. The connections I found between my observations, interviews and surveys will be discussed in detail in the following section.

A Review of Literature

After reading articles and books relevant to the use of multiple intelligences in the classroom as well as viewing a video, the background of this research is beginning to make more sense. Although there are no articles specifically geared towards mathematics and the multiple intelligences, the information that has been gathered will be of great value. First, in an article by Hopper and Hurry (2000), it is revealed that when students learn *how* they are learning, they become more interested in *what* they are learning. Next, in Shepard's (2004) article, evidence shows that when students participate in learning on more than one level they can better express their intelligences. Further, as suggested in an article by Brualdi (1998), the activation of intelligences by allowing students to participate in learning can help to deepen the understanding of the subject at hand. In addition, Nolen (2003), states that the MI teaching style can provide a solution to teaching students with differences or, in other words, reaching a student's individual needs will be easier. In coordination with the previous four articles, Hoerr (1996 & 2004) speaks of a school in which the Theory of Multiple Intelligences is used as a philosophy and incorporated in all that is taught. He is the director of a school based on the philosophy of the Theory of Multiple Intelligences. Howard Gardner (1983 & 1993) developed this theory and in his books he explains the basis of his theory as well as the implications that each intelligence has. Further, in a video which he appeared in, called "How are Kids Smart?" (1995) the idea of a multiple intelligence curriculum is explored in more detail. Expressing a different take on intelligence are the theories of those such as Jean Piaget and Jerome Bruner. Piaget believed that there were four stages in the development of learning and Bruner formed a theory based on three forms of knowledge (Bazik, Dossey, Thornton & Tucker, 1983). Having read these articles and books as well as viewing a video, the implications of Multiple Intelligences within a classroom setting prove to have positive affects.

In their study, Hopper and Hurry (2000) discuss three main points. The first, which has to do with awareness of the learning process, shows that allowing students to explore *how* they are learning deepens their knowledge and interest in *what* they are learning. Especially within mathematics, children want to know why, for example, two numbers when added together equal a larger number. With our adult minds, we find this simple to answer, by thinking of two objects put with three objects to make five objects. Children, however, do not have this mindset. They cannot picture things in their heads as easily as we can. Students who are just learning how to add will need concrete examples in front of them. This can lead students to understand that they are learning through a hands-on method, which basically correlates with the bodily/kinesthetic intelligence because students are manipulating objects.

For many children, school is seen as something that is forced upon them. They must wake up in the morning and go to school everyday because their parents or caretakers say that they have to. What if, once they arrived at school, they were informed of the reasons behind why it is that they have to go to school? This quite possibly could change their attitudes towards school. If students

can see that learning is important for their future, for example getting a job someday, perhaps they will be keen to learn. Further, if they can learn *how* it is that they are learning, perhaps the "force" of going to school can be lessened. If students are taught about the theory of multiple intelligences, they can understand how they are learning. For the younger grades, the explanation can be as simple as connecting the bodily/kinesthetic intelligence with a game of four-square. For upper grade levels, the intelligences can be explained through group work and individual reflection, to introduce inter- and intrapersonal intelligences. According to Hopper and Hurry (2000), this is, essentially, the first step of incorporating multiple intelligences into classrooms.Next, emphasizing individual learning processes allows students to "own" their ways of learning, (Hopper & Hurry, 2000). Once they are aware that they learn in a certain way and they have personalized their way of learning, they are ready be active in their learning process. This will heighten students' understanding of the reasons why different students learn in different ways. At lower grade levels it seems that students are less apt to notice if their classmates learn at a different level than they do. Although this may be true, as they work their way to the upper grades, the separation of learning levels becomes more apparent. If students are allowed to find that one way in which they learn the best, hopefully it can distract them from comparing themselves to other students. Starting this process at lower grade levels can benefit students as they reach the upper grade levels. They will already have it in their minds that there are different ways to learn and that not everyone does well in every way. Also, as was mentioned earlier, the students can "own" their learning process. They can be aware that learning does not only happen through reading, writing and doing math. Moreover, when a particular student has a completely different way of learning when compared to a classmate it will, in the end, not seem to affect either student because they will be enthralled with their own personal way of learning. They will tend not to care if a classmate learns in a different way. This can be good because it can create a balance of learners (Hopper & Hurry, 2000). So, no one is seen to be "smarter" than anyone else. They just learn differently.

In Shepard's (2004) article, he suggests that going beyond the traditional verbal/linguistic approach to teaching allows for a wider understanding by all students. This is due to the fact that not everyone is fluent and/or comfortable with the English language. In many cases, English is the second language for students. Teaching to different intelligences, such as through movement or song, can have a stronger effect on students such as this. Correlating lessons with pictures and objects that have to do with what is being taught can help these students understand things better. Further, what if a child who is not comfortable with the English language is able to show what he learns in math by using manipulatives. This child could explain a number story about a baseball team by using his classmates as the baseball players. He can physically move the students around to show the answer to the number story. This can be an easier way for him to show that he knows how to solve number stories, other than by talking and telling the teacher why and how he knows what to do.

On the other hand, for the students who are fluent in English and do feel comfortable with the language, offering opportunities to learn in other ways can open up new doors that those students may have not had the chance to discover before. Giving students choices seems to be the theme suggested here (Shepard, 2004). Unlike being "forced" to go to school, as was discussed previously, students can feel as if they are choosing to go to school. If children see learning as

interesting, or even fun, perhaps they will unconsciously make it their choice to partake. Within mathematics, sometimes students have trouble understanding why they have to do a certain mathematical operation. Incorporating the interpersonal intelligence by working in groups will allow students to learn from each other. Sometimes, as many adults are aware, hearing people explain things in their own way can help in understanding what is being taught. This is true for students as well. By working in groups, students can help each other and explain things in their own way, which is usually a "kid-friendly" way, since it is coming from a child.

Also, allowing students to express their preferences of learning can enhance the likeliness that they will continue to seek out alternate ways of learning (Shepard, 2004). For example, if a student chooses to give an oral report rather than writing a report, perhaps next time he will venture towards dramatic performance for his assessment. Additionally, he might find that oral reports are not his best way to show what he learned and will turn back to writing. Either way, he is making a choice and learning from that choice. He is figuring out which way best shows off what he has learned and how

he has learned it. Overall, Shepard (2004) is stressing the importance of opportunity for students to learn in any way in which they are willing to participate. Moreover, perhaps students should be given a choice even when it comes to group work. There could be students who would prefer to work on their own, perfecting their intrapersonal intelligence. As long as students are allowed the choice of which way they want to learn things, they will have a large portion of control over their own learning process.

Next, Brualdi (1998) suggests that the allowance of students to learn in multiple ways tends to expand the understanding of the material being taught, which can lead to a sense of control over one's learning. Think about a classroom in which the only method of learning is through reading, writing and speaking. This is, basically, through the verbal/linguistic intelligence. Now picture the students in that class. They are confined to their desks and perhaps the blackboard on which to write. Now, picture a classroom in which music, performance, movement, group work and manipulatives are all included. The students in this classroom are allowed to communicate with one another in group settings, which enables them to learn from each other. These students can use math manipulatives to figure out for themselves why, in fact, ten take away five actually equals five. Further, these manipulatives can help students to compare geometric shapes in order to classify and arrange objects according to appearance.

Mainly, this article explains seven of the intelligences and how they can be identified. It further discusses how they can be used within the classroom so that teachers can teach to a wider range of talents within one classroom (Brualdi, 1998). Using this approach can also offer authentic assessment, to include areas other than in the linguistic and mathematical realms. In the end, the different abilities within one classroom can be identified and utilized to the student's benefit. This can be an efficient way to include all types of learners in one classroom. What's more is that these students can feel a sense of accomplishment. This is especially important for those students who struggle with academics. Perhaps there is a student who is exceptional at playing the piano. Maybe an assessment for this student while studying about colonial times, could be to choose a classical piece that was written in that time period to play for the class. Further, since this child will apparently be interested in music, perhaps he could expand this by dressing as the composer and offering a short background of the composer as well. This will, without a doubt,

give the student a sense of pride in showing what he had learned. Another example can be seen within mathematics. Maybe there is a student who cannot answer all of the problems posed on a timed test during the time given. Possibly, it might be a good idea to let this child take the test without being timed and have him work up to being timed. Sometimes the pressure of the clock can disrupt a student's thoughts. Also, maybe there is more than one student who has this same setback. Almost certainly, if these students were allowed to work together, they might have a higher success rate. Eventually they will be comfortable enough to do it on their own, but the support of a group of students who are learning the same way can prove to be an advantage.
Nolen (2003) shows that each of the intelligences has certain characteristics that set it apart from the others. This is a very important factor when incorporating multiple intelligences into the classroom. At first, different techniques must be tried through teaching to find out which students benefit and which students do not. After attempting several methods of teaching through each intelligence, teachers can determine which ones are the best for certain students. Although time consuming and conceivably difficult to manage, perhaps the incorporation of centers can help this to be achieved. Children can move from center to center and work on things that involve all of the intelligences. The theme for a day must remain the same in all centers. Basically, the same thing will be taught at each center in a slightly different manner. This can allow students the opportunity to succeed at one or, hopefully, more of the centers.
After using these centers a couple of times, a teacher can identify the students that learn in specific ways. The teacher can cater his/her teaching style to accommodate these learning styles as well. This is important if a teacher cannot find a way to reach a child. He/she can use implications of one of the intelligences to connect with the child on a different level.
When looking for the characteristics that lead to the different intelligences, teachers must look closely. Students who possess the verbal/linguistic intelligence tend to have a high development of auditory skills and will usually think out loud, rather than to themselves (Nolen, 2003). They can also use words correctly and with ease. Students who have this intelligence will be good persuaders and explainers (Nolen, 2003). Closely related to the verbal/linguistic intelligence is the musical intelligence. Students with this intelligence understand rhythm, tone, and timbre, whether it is within music or simply someone telling a story. Those who hold the musical intelligence can often read music or learn to do so fairly quickly. Also, they tend to have strong opinions when it comes to music. Their willingness and capability to critique music shows this intelligence as well (Nolen, 2003).
Within music, there are patterns of notes and tones that are heard. This is what connects this intelligence to that of the mathematical realm. The logical/mathematical intelligence can be identified in students who can easily detect patterns and think logically (Nolen, 2003). This also leads one to notice the spatial intelligence in a student because within this intelligence, the student can "picture" at pattern and know what it will look like. These students can easily manipulate images in their minds and create new ones to solve problems. An example of this spatial intelligence can be seen in a student who is re-organizing the inside of his desk. He can mentally imagine whether or not certain items will fit in certain ways. This enables him to logically place items into his desk so that they all fit. Once he does this, he is actually manipulating tangible items, rather than images in his mind.

The manipulation of concrete things shows the bodily/kinesthetic intelligence. Students who demonstrate this intelligence have well developed fine motor skills of the fingers and hands, as well as control of their gross motor movements (Nolen, 2003). The ability to manipulate objects with precision shows this intelligence, too. Within mathematics, the manipulation of shapes in geometry, for example, sometimes requires exactness in order for things to fit together. This is also true when a student is doing a puzzle, which correlates with the logical part of the logical/ mathematical intelligence. The ability to use gross motor skills, however, can be shown by gracefulness and accuracy when dancing. This would also connect to the musical intelligence if one was to dance along with music and keep in step with the rhythm during a performance. Many times, students perform in school concerts. This ties in a variety of intelligences, including musical, bodily/kinesthetic and interpersonal. Working in a group can offer new perspectives to students and teach them how to work together. Ultimately, this is what can be seen in a child who expresses the interpersonal intelligence. Students who have this intelligence have the ability to understand people and determine from observation the moods, feelings and motives of others (Nolen, 2003). Closely related to this is the intrapersonal intelligence that can be seen in those who understand themselves and have certain expectations for themselves. Students with this intelligence are usually imaginative, original, patient, disciplined, motivated and have a high amount of self-respect (Nolen, 2003). In order to perfect these two closely related intelligences, a student will observe his own actions and those of the people around him.

Hand in hand with observing people and things around him, a student with the naturalistic intelligence does this within nature. A student with the naturalistic intelligence has a high appreciation for nature and the idea of life as a whole (Nolen, 2003). Overall, taking interest in the environment and the implications that man has upon it, reveals this intelligence in a student. Classification of objects from nature shows this intelligence as well. For example, collecting rocks, insects, shells or other

natural things can demonstrate that a student possesses the naturalistic intelligence. The multiple intelligences are all so closely related that it makes sense to incorporate all of them into a single classroom as much as possible.

Hoerr (1996 & 2004) suggests the idea of having a whole school geared towards the MI approach. New City School, in St. Louis, MO, uses Gardner's Theory of Multiple Intelligences as a philosophy by which to run the school. At this school, teachers offer every student the opportunity to learn in a specialized way so that more students find success within the school setting. This approach creates a child-centered atmosphere in which educators are able to figure out how their students are learning (Hoerr, 2004). They can then cater their teaching styles to their students. The teacher, in turn, transforms from the sole authority of the classroom to the catalyst in the learning process. As Hoerr (1996 & 2004) explains, most teachers go into education because they enjoy working with children and being a prominent part of children's lives. It is a passion that a teacher possesses to reach a certain student on a level that is comfortable for that student. Through using the theory of multiple intelligences within everything that is taught, teachers have the choice and means by which to find that one way that will reach a specific child (Hoerr, 2004).

There are about 41 schools using Gardner's theory of multiple intelligences daily. By making this the philosophy at their schools, there was an effective margin of improvement in the results of

standardized tests (Hoerr, 2004). Specifically, "78% said that their schools had realized gains on standardized achievement tests and that 63% attributed the growth to 'practices inspired by MI theory'," (Hoerr, 2004). Further, 78% also reported improvements of students with learning disabilities (Hoerr, 2004). This goes to show that having a school that incorporates Gardner's theory of multiple intelligences has distinct benefits. This is because it helps educators identify students' strengths and tries to build on those strengths in order to benefit the student in all areas of academics (Hoerr, 1996). Also, Hoerr (1996) offers the idea that the education of parents about the Theory of Multiple Intelligences can help in the overall scheme of things. If parents trust and understand what is going on with their children in school, it is the hope of educators that the parents will continue the implementation of the theory in their homes as well. It is true, however, that some parents will not agree to do this, so in the school is where most of the implementation will take place.

In Fuller Elementary School in Gloucester, Massachusetts, the MI theory has been explored and applied. In a video, it is shown that the shift from how teachers teach to how children learn is very important (Hanson, 1995). A group of teachers decided to use the MI theory in their classrooms. They split the intelligences between three classrooms. Each teacher chose two intelligences that they were interested in or educated about. The linguistic intelligence was spread throughout because it seemed to be the basis for everything that is done in the classroom. These teachers gave the MI approach a try and they concluded that when a child is offered alternative ways to doing things, the child will eventually succeed (Hanson, 1995). Even if the child tries one way and fails, at least he will know what doesn't work and he will stride towards something else that may work better. The same thing works for the teacher. If one teaching style fails, as least the teacher has learned and he/she can alter the style for the next lesson to see what might work better. These teachers put emphasis on the inter- and intrapersonal skills because they felt that these two were very important. It was believed that if a student understood himself and his peers, his learning environment would be strengthened (Hanson, 1995).

In order to strengthen the school as a whole, some different ideas were used. For example, team-teaching, the use of centers, inclusion of learning disabled students, cooperative learning, thematic learning, projects and performance/presentation. In team-teaching, everyone is involved and the collaboration of ideas can result in diverse and exciting learning situations (Hanson, 1995). Centers

offer multiple ways of learning through exploration and self-direction, in which the teacher is the overseer, not the one "teaching" the lessons. Inclusion of learning disabled students can open the eyes of mainstream students so that they can learn to accept and respect those who learn differently. Through cooperative learning, students can learn from the teacher, their peers and themselves. Thematic learning helps to keep a focus of the idea being studied. It also simplifies the idea being studied into specific parts so that students can concentrate on each part and understand it fully. Project, performance and presentation all show how students feel about the preparation for a showing in front of an "audience." If they know that other people will be seeing what they have to offer and possibly critiquing it, they might work harder to perfect if and make it known that they are "experts" on their topic (Hanson, 1995). Overall, through all of these ways of teaching, educators can see *how* their students are smart, not how *smart* they are.

How does one determine what the word “smart” actually means? How smart someone is can be inferred as how intelligent they are. Intelligence has many definitions. Bazik et al. (1983) shared four psychologists’ ideas of intelligence and knowledge. Two of these, Jean Piaget and Jerome Bruner, prove to be relevant especially within the area of mathematics. Piaget developed four stages of development through which children learn. They are: the sensorimotor stage, pre-operational thought, concrete operations and formal operations. The sensorimotor stage, which is from birth to one and a half years, is the development of motor skills from the gross level to finely coordinated actions (Bazik et al., 1983). Hand-eye coordination, which is part of this stage, is essential for the manipulation of mathematical models. On a larger scale, there is growth in seeing spatial relationships between the self and the objects in the immediate environment (Bazik et al., 1983). The next stage is called Pre- operational thought, which covers ages one and a half to seven. This is a stage of intellectual development. Mathematically, an important feature of this stage is that a child will develop concepts into larger realms (Bazik et al., 1983). For example, a child will realize what a ball is and eventually realize that many things in his/her environment are ball-shaped. This also the stage at which children begin to identify numbers and what they mean (Bazik et al., 1983). After figuring out the meaning of numbers, most children move to the next stage, which is called the stage of concrete operations. In this stage, children ages seven to twelve gain the knowledge that mathematics is a concrete idea and they can see that through manipulation of objects in their environments (Bazik et al., 1983). Lastly, Piaget’s fourth stage, which is the stage of formal operations, develops in children ages twelve and older. Basically, this stage is the development of the ability to problem solve and think critically within mathematics (Bazik et al., 1983). As Piaget developed these stages he discovered that different methods are necessary as one deals with students of differing ages from early childhood through collegiate and adult levels. Further, “the needs and capabilities of learners at all levels differ appreciably and require different materials and methods for effective learning,” (Bazik et al., 1983). This shows how the use of Multiple Intelligences can benefit a classroom because it allows teaching to different learning levels, so that children can gain as much knowledge as possible.

Bruner’s theories share an idea that there are different forms of knowledge. He developed these three forms of enactive, iconic, and symbolic to, “serve as models for the storage and retrieval of information.” (Bazik et al., 1983). Beginning with enactive knowledge, which is the first level, Bruner sees this as a representation of action without verbalizing. Some examples of this would be: learning to touch keys on a calculator or how to bundle groups of straws in to tens. The second level is iconic knowledge. This level deals with visual and perceptual organization, usually communicated through pictures (Bazik et al., 1983). An example of this might be seen when a child looks at a picture and counts how many animals are present. The third level, symbolic knowledge is the type of knowledge that shows concrete representation. Using calculation symbols in an arithmetic problem is an example

of this level of knowledge. Bruner sees knowledge as developing in a sequence. He believes that each learner goes through these levels of development and eventually, within the realm of mathematics, reaches a thorough level of understanding (Bazik et al., 1983). With a basis for where knowledge comes from it is easier to understand how the multiple intelligences come into

play. Piaget and Bruner both offer quality theories which enhance the importance of teaching to different levels of learners, which is really what the Theory of Multiple Intelligences has in mind.

Implications of MI Literature

Through careful analyzing of these articles, books and videos, it is apparent that the use of multiple intelligences is advantageous to students and teachers. There is much evidence that teaching with an incorporation of the multiple intelligences can benefit the students greatly. Whether this is because it allows students choices in learning or reaches students on different levels, it is valuable. Further, teachers can benefit because they will feel a sense of accomplishment in reaching children on different levels.

Mathematics is an area of academics that is crucial for success on many levels. In the real world, from buying groceries to following directions, students will eventually encounter things that will require a basis of mathematical skills. Children learn about math at an early age. Babies encounter a form of mathematics when they try to put different shaped blocks through their corresponding holes in a plastic box. As they become toddlers they might begin to work with large- pieced jigsaw puzzles. Further, when they begin kindergarten, children will usually learn to count and learn when their birthdays are and how that connects to the days of the week and the months in a year. All of these things are part of mathematics. Specifically, they are parts of the logical/mathematical intelligence, as define by Gardner (1983) as the ability to analyze, problem solve, and perform mathematical functions.

While teaching mathematics in an elementary classroom, teachers should be aware of the ways that students learn. As mentioned by Hooper and Hurry (2000), children can benefit from learning *how* they learn. It is fitting then to assume that teachers can benefit from this as well. It is the teacher who has to identify how the student is learning before he/she can adequately teach the student what is going on. Multiple intelligences can offer the teacher the means through which to teach a student how he/she is learning. Within mathematics, this is important because math itself is a rather realistic subject. There is proof as to why one plus one equals two when you show a student one apple and another apple and that together they are two. Now, to go even further than this proof, a teacher can show students how they are learning, whether it be through use of manipulatives or group work. These two things happen to coordinate nicely with the bodily/kinesthetic intelligence and the interpersonal intelligence.

There are some people who may think that mathematics can only be taught through the logical/ mathematical intelligence. This shows to be a false assumption because math is taught using objects and concrete things to get the points across. Just as Shepard (2004) suggests that going beyond the traditional verbal/linguistic methods of teaching, going beyond the logical/ mathematical method while teaching mathematics can be academically stimulating for students. It is also evident that teaching to multiple intelligences can expand the understanding of the subject at hand (Brualdi, 1998). Learning mathematics starts out as memorization, within the basic math facts, such as 5+6=11. Beyond that, however, comes problem solving and critical thinking. If students can use the bodily/kinesthetic intelligence and perhaps act out a math fact, they might remember and understand things on a deeper level.

Recognizing that students learn in different ways is the first step in organizing such activities as acting out math equations. Teachers must be aware that each intelligence has specific implications and

that some, if not all, of the intelligences are connected in some way (Nolen, 2003). When teaching mathematics, teachers can look to see how children perform within math workbooks or on worksheets after having learned through certain intelligences. Once the teacher has found the ways that work best for each child, the assessments for the class can be made according to how they best learn.

As Bazik et al. (1983) revealed, through study of Piaget's theory behind intellectual development, children learn in different ways at different levels. His study dealt with ages in particular, but the same idea is present within classrooms. There are usually a diverse group of students in one classroom who learn at different levels. If the use of the Theory of Multiple Intelligences is used in a classroom such as this, different levels of learners can be reached more sufficiently. Also, as shown by Bruner's theory on intellectual development, each learner goes through a series of levels of knowledge before reaching full potential (Bazik et al., 1983). In these stages, a learner may need to be offered a variety of ways of learning. Using the multiple intelligence theory, teachers can identify and teach to different levels of knowledge. Knowing background behind the concepts of intelligence and knowledge, it is more evident what the Theory of Multiple Intelligences is based on. This is because intelligence is sometimes seen as an effect of knowledge and the two seem to go hand in hand.

How much someone knows can show how intelligent he/she is. How intelligent someone is can only be shown to its full potential if the opportunities are there. That is, if the Theory of Multiple Intelligences is incorporated into the classroom, these opportunities to learn in different ways are present and ready to support a child's intelligence at all levels. In the following section, the process through which I went in order to determine if MI are incorporated into the classroom will be revealed.

Results

While trying to determine the usefulness of Gardner's Multiple Intelligences (MI) within mathematics, I found that, as I had speculated, MI *are* incorporated into the teaching and learning of mathematics. From the information I received through interviews and surveys, as well as my observations, I realized that teachers use MI, yet they are not aware they are doing so. This is note worthy as my teacher interviewee, Miss Maple said:

"Well, I think it's interesting, because like I told you, I had not looked at anything like this since I was in college and it's neat that you tell me that I did all of these things...I guess I was kind of curious to actually find out how many I did use. Now, knowing that I do use them makes me kind of excited and proud of myself. The thing is, after you've taught for so long, you forget about those things that you learned back in college...but I think that with experience, you realize...they just come naturally and you just do them anyway." (Miss Maple, 4.8.05)

Learning this from Miss Maple, I was able to assume that this was probably true for more teachers with her amount of experience. Gardner's MI is something that teacher education students learn about in their college courses and, as Miss Maple said, is forgotten when they become professional teachers. It seems appropriate to say, then, that MI are important and used regularly in elementary classrooms, even if they are not defined as "multiple intelligences." Further, while looking for incidents of MI in the classroom I came across many, but not all, of the intelligences.

Bodily/Kinesthetic

It became apparent that Miss Maple used seven of the eight intelligences outlined by Howard Gardner (1983 & 1993). She was, as mentioned earlier, not aware she was using MI in the classroom at all. I had assumed that since I was observing mathematics, that the most prevalent intelligence would be logical/mathematical (to view all intelligences, see Appendix H). This, however, proved not to be the case. Although seven of the eight intelligences were detected, there was one which prevailed. This intelligence, being bodily/kinesthetic, was somewhat of a surprise. If one thinks of the words 'bodily' and "kinesthetic,' I am quite sure that thoughts would veer towards 'movement of the body.' Now, think of mathematics. Do you see any connections? At first, I did not realize the great connection that the two actually had. If you refer to Gardner's definition of bodily/kinesthetic, as highlighted by Dee Dickinson (2002), the link between bodily/kinesthetic and mathematics begins to take form:

"[It] Involves physical coordination and dexterity, using fine and gross motor skills, and expressing oneself or learning through physical activities. It may be exercised by playing with blocks and other construction materials, dancing, playing various active sports and games, participating in plays or make-believe, and using various kinds of manipulatives to solve problems or to learn." (Dickinson, 2002)

The portions of this definition that show the most relevance are: "...using fine and gross motor skills...," and "...using various kinds of manipulatives to solve problems or to learn." (Dickinson, 2002) Throughout my observation hours I noticed many uses of this intelligence. Mainly, through useof rulers, fine motor skills were utilized to manipulate a mathematical tool. It was obvious, through listening to conversations between students, that the use of rulers was "fun" and "sometimes hard." I think that the fun comes from being able to do something other than adding and subtracting while learning math. The fact that it was sometimes hard for students to use the rulers can be attributed to the development of their fine motor skills. This is an acquired skill that second graders are still building. I did see, however, that the use of rulers was beneficial to students. After working with a ruler, students had formed an understanding of 'one foot' and the reasons for which standards are needed within measurement. Being able to move the ruler around and feel how long it actually was, helped students perform tasks such as walking around the room to find objects that they thought would be equal in length to one foot, or one ruler. Students had to do this without having a ruler with them to measure the objects.

Visual/Spatial

This previous activity took my attention to the visual/spatial intelligence, which Dickinson (2001) described as:

"[It] Involves visual perception of the environment, the ability to create and manipulate mental images, and the orientation of the body in space. It may be developed through experiences in the graphic and plastic arts, sharpening observation skills, solving mazes and other spatial tasks, and exercises in imagery and active imagination." Dickinson (2002)

I felt that it was a spatial task to estimate lengths of objects throughout the classroom. The result of this activity was that students were able to realize how important it is to have a standard of measurement. The teacher explained how different students thought that different objects were equal in length to one foot. This illustrated that without a standard of measurement, it would be a free-for-all and everyone could claim that their object was one foot long without complication.

This, accordingly, would become a hindrance in a real-life situation, such as the one offered by the teacher. She suggested the fact that when someone wants to build a house, they have to pay for the house depending on how many feet (although it is really square feet) are in the house.

Verbal/Linguistic

To bring this to the level of the rest of the class, Miss Maple read a story, which demonstrated the verbal/linguistic aspect of mathematics.

In a story called, "How Long is a Foot?" a king wanted to give his queen a new bed. The king told the carpenter to make the bed seven feet long. The carpenter, not wanting to make any mistakes, was careful to measure seven feet for the bed. When he gave the bed to the king, both parties were pleased. The kind offered the bed to his queen only to find out that it was too short for her. He did not understand how this could have happened. He measured the bed and, low and behold, it was not seven feet long. He was very angry with the carpenter and demanded a new bed that was, in fact, seven feet long. The carpenter, knowing how careful he had been, measured the bed in the king's presence to show that it really was seven feet long. The king, still not convinced, measured it again himself. When he reached seven feet, he was well beyond the frame of the bed. It was at that moment that the carpenter and the king realized what was wrong. The king's "feet" were larger than the carpenter's "feet" so, naturally, their measurements were different.

The verbal/linguistic intelligence is defined by Dickinson as:

"[It] Involves reading, writing, speaking, and conversing in one's own or foreign languages. It may be exercised through reading interesting books, playing word board or card games, listening to recordings, using various kinds of computer technology, and participating in conversation and discussions." (Dickinson, 2002)

By using this story, the teacher was able bring the importance of standards of measurement to life. From then on, the teacher referred to this story while reviewing facts about measurement. This shows that the use of the verbal/linguistic intelligence is beneficial within the teaching and learning of mathematics. Further, it illustrates the importance of the relationship between two members of the classroom; the teacher and the student. The students have to listen and interact with the teacher in order to gain all of the information being offered.

Interpersonal

Cooperating with the teacher is important in all areas of education, even in mathematics. It was seen while observing that there were many occurrences of this interpersonal intelligence, clinically described by Dickinson (2002) as:

"[It] Involves understanding how to communicate with and understand other people and how to work collaboratively. It may be exercised through cooperative games, group projects and discussions, multicultural books and materials, and dramatic activities or role-playing." (Dickinson, 2002)

The interpersonal intelligence was exemplified through things such as communication between teacher and student, as well as between students and other students. Communication between teacher and student has been identified previously in the reading of the story, "How Long is a Foot." Between students, however, group work showed to be the most abundant way to demonstrate interpersonal intelligences. While observing, I noticed that the students' desks were arranged into groups of four and five. This is a common way to organize a classroom in order to

save space, and ultimately, foster group work situations. Every incident of group work within math, centered on these pre-formed groups. Students had to share materials and check each other's work during group activities. I saw this to be beneficial in that the teacher was no longer the sole authority in the classroom. The students were now learning form each other and working out their mistakes as a group. For example, one activity involved measuring the perimeter of different sized squares. All of the groups received one copy of each square. Each member measured the perimeter of a square and wrote the result on the square itself. Then, the squares were rotated throughout the group for each member to measure and check to make sure the original measurement was correct. If someone found a problem, he or she had to confront the original measurer and contend that his or her measurement was incorrect. This made the groups work together to be certain that all of their measurements were correct. Being able to work in a group stems
from the ability to control oneself individually. Without self-control, group control would be hard to maintain.

Intrapersonal

Possessing the ability have self-control is important when working in a group. This can be identified by the intrapersonal intelligence, which I also observed while in the field. As conceptualized by Dickinson (2002), this intelligence can be identified as:

"[It] Involves understanding one's inner world of emotions and thoughts, and growing in the ability to control them and work with them consciously. It may be exercised through participating in independent projects, reading illuminating books, journal-writing, imaginative activities and games, and finding quiet places for reflection." (Dickinson, 2002)

While in the classroom I noticed that many students had good self-control. This is a large component of the intrapersonal intelligence. During the times that students were given assignments to do individually is when this intelligence emerged. Those students who held qualities of the intrapersonal intelligence were always on task and well behaved. I feel that having this intelligence is important because students need to learn to do things for themselves just as much as they need to learn to work together. Within math, doing worksheets and math journal pages are examples of the teacher fostering the intrapersonal intelligences. This also leads to the logical/mathematical realm of MI.

Logical/Mathematical Intelligence

Worksheets, such as timed tests, are used to assess knowledge of basic mathematical operations. This activity is very relevant within the logical/mathematical intelligence, which can be explained by Dickinson (2002) as:

"[It] Involves number and computing skills, recognizing patterns and relationships, timeliness and order, and the ability to solve different kinds of problems through logic. It may be exercised through classifying and sequencing activities, playing number and logic games, and solving various kinds of puzzles." (Dickinson, 2002)

The logical/mathematical intelligence, as stated earlier, was, to my surprise, not the most prevalent intelligence observed in the classroom. It was, however, noticed during activities such as doing worksheets and math journal pages. It was while doing these things that students utilized what most people think of when they hear the word: math. When students used basic math operations, such at addition, they were showing their logical/mathematical intelligence. In

order to distinguish whether this intelligence was beneficial, I referred to my interview transcriptions. Miss Maple (4.8.05) said that, "...I do think they need to do pencil and paper things...it can't all be hands on..." With this information from the teacher I was further able to deduce the importance of the logical/mathematical intelligence. Students benefit from this because in real life situations they need to know, for example, that $2.00 plus $2.00 equals $4.00. Also, by performing basic mathematical operations students gain the background that they need in order to complete tasks such as counting objects to classify and study.

Naturalistic Intelligence

This leads me to the naturalistic intelligence, which I did not observe to be very common in the classroom. This intelligence can be expressed by Dickinson (2002), as:

"[It] Involves understanding the natural world of plants and animals, noticing their characteristics, and categorizing them; it generally involves keen observation and the ability to classify other things as well. It may be exercised by exploring nature, making collections of objects, studying them, and grouping them." (Dickinson, 2002)

The one instance of this intelligence was during the activity in which students walked about the room and wrote down objects that they thought were equal in length to one foot. Students were to list these objects on their notebook paper. Then, when they were told to go around the room and check each item with a ruler, they had to put a star next to the items that were almost exactly one foot long. This showed how the students organized and classified the objects that they had chosen to write down. This intelligence, although rare, seemed to be beneficial in that it offered students a coherent manner in which to write their data. The intelligence that was even rarer than this, however, was the musical intelligence.

Musical Intelligence

The musical intelligence, which I did not see any implications of while observing, can be described by Dickinson (2002) as:

"[It] Involves understanding and expressing oneself through music and rhythmic movements or dance, or composing, playing, or conducting music. It may be exercised by listening to a variety of recordings, engaging in rhythmic games and activities, and singing, dancing, or playing various instruments." (Dickinson, 2002)

Although I did not see any use of this intelligence in the classroom, I do believe that it can be beneficial to the students. While interviewing a student I came across the question of, "Would you like to sing math songs if you knew any?" The answer given by the student was, "Yeah...sometimes I can remember songs better than other things...maybe the song would help me remember math things." I took this as an implication that this could help students who, for example, could not remember the order or operations, or the method in which to solve equations with partial sums. Speaking of the latter example, I had developed a song that I used while working in the field. I was teaching partial sums to second graders and some of them could not remember the steps in using this method. The song I created, to the tune of "Mary Had a Little Lamb," went like this:

"I can add double digit Numbers Numbers I can add double digit numbers with partial sums.
First I add the ones column The ones column The ones column
Then I write the answer in the tens and ones columns..."

The full song can be seen in Appendix I. I taught this song to my students and as a result, some of them did better with using partial sums. I even observed times when students sang the song to themselves while working out a double digit addition problem. This further exemplifies that the musical intelligence can be beneficial when used within mathematics, even though I did not find any use during my research observation.

In Conclusion

I was very pleased with the results of my observations of MI within elementary mathematics. I was able to see seven of the eight MI being used in the teaching and learning of math. It proved to be true that all of the MI are apparent in the classroom, as well as beneficial to the students. In regards to being beneficial to the teacher, I feel that MI in the classroom can enhance teaching on more than one level. First of all, teachers can identify which students hold which intelligences and therefore teach to those intelligences. One idea, as shown by Bruce Campbell (1989) is to offer centers in the classroom that use all of the different intelligences to teach on topic. Next, students can be exposed to different teaching styles, which open their minds to abstract things. It enables them to think "outside the box." Further, administrators might see this as an opportunity to bring out the best qualities in the students and the teachers. Once students find a way of doing something that they are comfortable with and "good" at, perhaps they will be confident enough to try more new things. Using MI in the classroom is an overall goal that schools should have in order to offer a well-rounded educational experience.

There were strict limitations in my research. I confined my literature sources to those containing information about MI, MI in the classroom or MI and mathematics. Observations, therefore took place only during the mathematics lesson in my chosen classroom. I only observed in one second grade classroom, consisting of 22 students and one teacher. While making these observations I particularly looked for instances of MI and thus those were the only kinds of notes that I took. Further, I chose to do only three interviews with students because I wanted to be able to confine my data to specific situations. I therefore chose three students were at different learning levels to get a wider perspective from minimal information.

In triangulating all of the data that I received from my literature review, observations and interviews I did reach the conclusion, as stated previously, that MI are incorporated into mathematics and are beneficial to students. However, I feel that further research, perhaps in more grade levels and more subjects, could yield pertinent information on the benefits of an MI teaching style. While reviewing my collected information I became curious as to why, in fact, the Logical/Mathematical intelligence was not prevalent in the teaching and learning of mathematics. It would be interesting to limit research even further to concentrate fully on that specific intelligence within mathematics. Also, in compliance with this issue, finding out further information about why and how the Bodily/Kinesthetic intelligence is beneficial to students while learning mathematics would be fascinating. This is because when one thinks of the Bodily/Kinesthetic intelligence, mathematics certainly does not come to mind right away. Overall, I feel that more research should be conducted about MI being incorporated into the classroom. Since MI showed to be beneficial within mathematics, perhaps the benefits can stretch across the whole curriculum.

Patricia Setchell EDUC 401
Friday April 1, 2005
Mrs. Lenz
2nd Grade
Time: 9:00am-9:45am
Subject: Math

Verbal/Linguistic Reading, Writing, Speaking, Conversation, Discussion	Students had to write the word, perimeter, on their white boards with a definition. Students learn a new word, Area. Teacher writes this word on the board. Students write it on their white boards. Teachers asks students for a sentence using the word area. Teacher gave verbal directions and students listened well.
Logical/Mathematical Numbers, Computing Skills, Patterns, Orders, Logic, Puzzles	Students had to list objects from a worksheet from that with the smallest are to the with the largest area.
Visual/Spatial Manipulation of Ideas, Imagination, Spatial Tasks	Students use marker boards. Students were asked to think about what things they could use to measure area. Connection to the real world: a house is detailed by saying it is so man "square feet".
Bodily/Kinesthetic Fine/Gross Motor Skills, Physical Activity, Using Manipulatives to Solve Problems	Students used rulers to measure the size of the cubes they were using to find areas of shapes. Students used small cubes to find the area of shapes by setting them on the shapes and counting how many fit in each shape. Students got up out of their seats to go work with their fifth grade buddies. Students raise hands if they have an answer to a question.
Musical Expression through Music, Rhythm	None
Interpersonal Group Work	Students worked with fifth grade buddies to do a math assignment. Students had to explain to their buddies what the assignment was and how to do it. Then, second graders do it and

Verbal/Linguistic Reading, Writing, Speaking, Conversation, Discussion	Writing in "green writing book"- list of things that they thought might be one foot long. Talked about a story they read previously called, "How Long is a Foot?"- About a Kind and Queen and the King wanted to give his Queen a new mattress…the measurements got messed up because the King's "feet" were larger than the carpenter's "feet", so the bed was too small. Lesson is that there needs to be a uniform way to measure things- the ruler. Teacher guided the discussion, students raised hands to answer various questions that she asked. Other than that the students did not talk very much.
Logical/Mathematical Numbers, Computing Skills, Patterns, Orders, Logic, Puzzles	The concept that 12 inches = one foot. Counting things in the room. Math boxes: p. 217 Counting the "people" for one of the math boxes.
Visual/Spatial Manipulation of Ideas, Imagination, Spatial Tasks	The idea in the story about building a bed…connects classroom activities to real world ideas. Looking around the room and seeing things that might = one foot. Students had to estimate. Then used a ruler to actually measure these things. They could touch and manipulate the objects. Using "people" for a math box question. Actually moving the people into groups and counting them. The Math Boxes themselves show a spatial organizational method for doing math questions. Working on "scroll", which is a really long hundreds chard rolled up on a paper towel roll. Using marker boards to check work and draw pictures.
Bodily/Kinesthetic Fine/Gross Motor Skills, Physical Activity, Using Manipulatives to Solve Problems	Walked around room for 5 minutes to estimate objects that would be one foot. Walked around again for 5 mins to check their estimates with a ruler.
Musical Expression through Music, Rhythm	none
Interpersonal Group Work	none
Intrapersonal Self-Control	At one point there were 7 students of 21 playing with their rulers while the teacher was talking. Most students had quite good self control. Students worked on math boxes alone and only a few asked questions. When they walked around to measure things they
Naturalistic Classification, Collection and Organizations of Objects to Study	In their "green writing books" they made a list of estimated one-foot-long items and then checked them and wrote the ones that were close to one foot in another column. Then starred the ones that were exactly one foot. Showed categorization and organization.

Student Interview #1
Susan
April 1, 2005

Interviewer: So, you must be Susan. My name is Tricia. Is it okay if I ask you some questions about the survey you took this week?

Susan: Sure.

Interviewer: I'm going to tape-record us so I can listen to it later, are you okay with that.

Susan: Yeah, that's fine.

Interviewer: Okay, so, you said you didn't like to do math worksheets, can you tell me why you don't like that?

***Susan*:** Um, well, they take a really long time to do.

Interviewer: Do you think that doing puzzles is more fun?

Susan: Yeah.

Interviewer: Is that why you said you liked doing that?

Susan: Yeah.

Interviewer: Okay, how about solving number stories? You said you didn't like that. Can you tell me why?

Susan: They're kind of hard sometimes.

Interviewer: You think they're hard sometimes? Well what if you're allowed to use objects to help you? Is that easier?

Susan: Yeah, that's a little easier.

Interviewer: So, lets move on to the next question. The hundreds grid, did you use that a lot this year?

Susan: Yeah.

Interviewer: Would you say it was kind of like your best friend in math?

Susan: (laughs) Yeah.

Interviewer: Alright, how about math boxes?

Susan: They were fun.

Interviewer: Okay, what about your white board. It looks like you have fun using that. What do you think that helps you with?

Susan: It helps me when I'm doing my number stories because I can write down problems and draw pictures.

Interviewer: How about singing about math? Have you ever sung a song about math?

Susan: Nope.

Interviewer: Would you like to sing math songs if you knew any?

Susan: (laughs) Yeah.

Interviewer: How could that help you?

Susan: Well, sometimes I can remember songs better than other things. So maybe the song would help me remember math things.

Interviewer: Let's see, using rulers. You've been doing that a lot this week. Do you like that?

Susan: Uh huh.

Interviewer: Do you think you're pretty good at it?

Susan: Yeah, it isn't that hard to do.

Interviewer: Okay, tracing shapes. What about that? You circled the frowning face for that one. Can you tell me why?

Susan: Well, because some of the shapes have corners and edges and I think it is kind of hard to trace those shapes.

Interviewer: Oh, I see. Okay, how about asking questions. If you need help, are you afraid to ask for it?

Susan: No.

Interviewer: Okay, what about listening to music while you do math work? Do you think that would distract you?

Susan: Nope. I like it.

Interviewer: What kind of music would you listen to?

Susan: Well, we usually listen to Tarzan in class.

Interviewer: Oh, that sounds fun. Alright, how about collecting things?

Susan: I like that, but I don't do it very much.

Interviewer: So you wouldn't do that in your free time?

Susan: No.

Interviewer: Okay, well, pattern counting. You said you didn't really like that. How come?

Susan: Well, I know how to do it, but I just don't like to do it.

Interviewer: Well, how about writing about math?

Susan: I kind of like that.

Interviewer: What kinds of things would you write about?

Susan: Uh, what I did.

Interviewer: What about graphs? Could you write about graphs?

Susan: I could write which thing won, like which was the most on the graph.

Interviewer: Okay, what about adding?

Susan: No, I don't really like that.

Interviewer: You don't? Why not? Do you think that maybe its too easy?

Susan: Well, maybe, but then the more numbers you add, the harder it is.

Interviewer: Okay, I see. Well, what about subtracting? You said you didn't like that too much.

Susan: Yeah, that's even more hard.

Interviewer: Okay, how about using money or count money?

Susan: No, not really.

Interviewer: Why is that?

Susan: Well, I really only like to use money when we go shopping.

Interviewer: So do you think that it is something that is important to learn?

Susan: Yeah.

Interviewer: Okay, doing graphs, how do you think about that?

Susan: Yeah, I like graphs. I like to color in the things on graphs.

Interviewer: Okay, good. What about fractions?

Susan: No. They're a little hard. Well, they're okay.

Interviewer: Alright, do you think that you are good at telling time?

Susan: Yes.

Interviewer: Okay, so do you think if I showed you my watch you could tell me what time it is?

Susan: Yep. It's…about 10:00.

Interviewer: Yep, very good! 10:01, to be exact. Nice job. Okay, timed tests.

Susan: I LOVE timed tests!

Interviewer: Why do you love them?

Susan: Because we get to, um, we get to get things for ice cream. At the end of the year we have a sundae party. We have different levels that you have to get to and I'm almost done.

Interviewer: Oh, that's great! So, do you like math?

Susan: Well, kind of.

Interviewer: So do you feel like you are good at math?

Susan: Kind of.

Interviewer: So, what is your favorite thing about math?

Susan: Graphs.

Interviewer: Do you think that using the hundreds grid helps you when you're trying to figure out how to add and subtract?

Susan: Adding. It helps me with that a lot, and subtracting too, I guess.

Interviewer: So what do you mostly use the hundreds grid for?

Susan: I mostly use it for things like, helping me add.

Interviewer: Okay, good. Well, I think that is all I have to ask you. Thanks for helping me out.

Susan: You're welcome. Bye.

Laura: Yeah.

Interviewer: Do you think you do okay with that? Are you good at measuring things?

Laura: Yeah, it's not that hard.

Interviewer: Okay, tracing shapes. What do you think about that? Do you think it's pretty easy?

Laura: Yeah.

Interviewer: Alright, what about working in groups?

Laura: I like to work in groups because I don't like to be by myself working.

Interviewer: Okay, so what do you do when you work in groups?

Laura: We, like, help each other out if we don't know what an answer is.

Interviewer: Okay, good. So what about asking questions when you need help with something in math? Do you feel okay doing that?

Laura: Yeah.

Interviewer: So you're not afraid to ask the teacher for help?

Laura: No.

Interviewer: Alright, that's good. What about listening to music while you work on math things? Do you think that would distract you at all?

Laura: Hmm. Sometimes it would and sometimes it wouldn't.

Interviewer: What kind of music would you listen to so that it wouldn't distract you?

Laura: The music she (teacher) has. It's Tarzan. We get to listen to it sometimes.

Interviewer: Okay, how about collecting things in nature? Have you ever collected rocks or bugs or anything like that?
Laura: Well, I have so much rocks by my house that sometimes I make a collection and then when I've taken them all I have to put them back.

Interviewer: Okay, what about pattern counting? Do you think you're okay at doing that?

Laura: Yeah.

Interviewer: So can you count by 5s, 10s and 2s?

Laura: Yeah.

Interviewer: Which one do you think is easiest?

Laura: Tens.

Interviewer: Why not twos?

Laura: Well, sometimes if I count to fast I get mixed up.

Interviewer: Okay, what about writing about math? If you made a graph about everyone's favorite colors, what could you write about that?

Laura: Umm…that one color had more people than another color, or something like that.

Interviewer: Do you like adding?

Student Interview #2
Laura
April 1, 2005

Interviewer: Hi, you're Brad, right? It's nice to meet you, my name is Tricia. I'm going to ask you some questions about the survey you took this week, okay?

Laura: Okay.

Interviewer: I'm also going to tape-record us so I can listen to it later if I need to. Are you okay with that?

Laura: Yep.

Interviewer: So, doing math worksheets. You sad you liked that. Can you tell me why?

Laura: Umm…I don't really know why. They're just not so hard most of the time.

Interviewer: Okay, well what about doing puzzles?

Laura: I don't know. I said I liked it, but I don't know why.

Interviewer: Do you think that puzzles have anything to do with math?

Laura: Kind of, but I think of like, the puzzles you put together.

Interviewer: How about solving number stories. You said you kind of liked doing that.

Laura: Yeah, because I like to use the people to figure them out.

Interviewer: Okay, what about using the hundreds grid? Does that help you?

Laura: Yeah.

Interviewer: Okay, good. Well, you said that you don't like to do math boxes. Why not?

Laura: Because they're, like, kinda too hard sometimes.

Interviewer: Do you think that is because there are so many different things to do on one page?

Laura: Yeah, kind of. And sometimes it takes me a long time.

Interviewer: So, what about using your white board? Do you like to do that?

Laura: Yeah.

Interviewer: What does it help you with?

Laura: Well, when I need to draw pictures to figure out my number stories.

Interviewer: Okay, do you like to sing about math? Have you ever done that?

Laura: Well, no, but last year we sang about stuff all the time, so I might like to sing about math.

Interviewer: So you would like to sing about math if you could, right?

Laura: Yeah, I'd do that.

Interviewer: Do you think it would help you remember things?

Laura: Yeah, it might.

Interviewer: Okay, well what about using rulers? Do you like to do that?

Laura: Yes.

Interviewer: Do you like subtracting?

Laura: Yes.

Interviewer: Well, why don't you like using money?

Laura: Well, I'm just not very good at it so I don't like it that much.

Interviewer: Okay, well what about graphs? Do you like making graphs?

Laura: Yep.

Interviewer: Okay, good. What about fractions?

Laura: I kind of like them…I think they're kind of hard sometimes.

Interviewer: Okay, how about telling time? Do you think you're good at that?

Laura: Yeah.

Interviewer: Did you learn a lot about telling time this year?

Laura: Yeah, because on all the math boxes there is usually a time question.

Interviewer: Okay, how about timed tests?

Laura: I love timed tests. We do them usually on Friday and Tuesday.

Interviewer: So, I heard that you get rewards for these timed tests.

Laura: Yeah, we get a banana split. Well, we have to earn it by reaching different levels of timed tests.

Interviewer: Okay, so do you like math, overall?

Laura: Well, kinda.

Interviewer: What is your favorite thing about math?

Laura: Telling time, probably.

Interviewer: Why do you like telling time?

Laura: Because I don't really get it wrong a lot.

Interviewer: Do you think you're good at math?

Laura: No, because I have to have a tutor.

Interviewer: Do you really think that having a tutor means you're bad at math?

Laura: Well, I guess I just need help a lot.

Interviewer: Okay, so do you think that math got harder when you got to second grade?

Laura: Yes, because we have to do more tests, its seems like. And we do math everyday.

Interviewer: Okay, I see, well thanks for answering questions for me.

Student Interview # 3
Brad
April 1, 2005

Interviewer: Hi, my name is Tricia. You're Brad, right?

Brad: Yeah.

Interviewer: Okay, well, I'm going to ask you some questions about the survey you took this week. Is that okay?

Brad: Sure.

Interviewer: Alright, good, and I'm going to tape-record us talking so I can listen to it later, too. Is that okay with you?

Brad: Sure.

Interviewer: Okay, so doing math worksheets. You said you kind of liked doing that. Can you tell me why you like it?

Brad: Well, because I like math, it's my favorite subject and like the sheets we do.

Interviewer: How about doing puzzles? You said you don't really like doing that.

Brad: They get me bored sometimes.

Interviewer: Okay, well, solving number stories? You don't really like that?

Brad: Nope. But I like the hundreds grid. It helps me with math stuff a lot.

Interviewer: Very good. Well how about doing math boxes?

Brad: Math boxes are easier than doing other stuff like science.

Interviewer: Do you think that the way math boxes are split up into sections helps you concentrate?

Brad: Yep, because I don't get confused and I can finish one problem at a time.

Interviewer: What about using your white board?

Brad: I like using it because I can help me when I'm doing math things, like number stories.

Interviewer: Okay, what about singing?

Brad: Singing. I don't really like it.

Interviewer: What if the song helped you remember things about math?

Brad: Well, I guess that I would like that it might help me learn.

Interviewer: Okay, how about using rulers. You've been doing that all week, do you like it?

Brad: Yes, I love using rulers. I think that I'm pretty good at it.

Interviewer: Okay, good. What about working in groups? You said you don't really like to do that. Can you tell me why?

Brad: Everybody yells at me and it's hard to work together.

Interviewer: So you think you would rather do things alone?

Brad: Yeah.

Interviewer: Why is that?

Brad: Because I have more time to think.

Interviewer: Okay, what about tracing shapes? You said you liked that.

Brad: I like tracing shapes because it can make me like shapes better and better. I can draw them better every time I try.

Interviewer: What about asking questions? Are you afraid to ask for help?

Brad: Nope.

Interviewer: Listening to music while you work on math things. You said you wouldn't like that. Why?

Brad: Because it would distract me and stuff.

Interviewer: Can you think of any kind of music that wouldn't distract you?

Brad: Yeah.

Interviewer: Like what?

Brad: Umm, I don't know. Music that doesn't have a lot of talking on it.

Interviewer: How about collecting things in nature, like rocks?

Brad: I like doing that.

Interviewer: Pattern counting? You said you liked doing that.

Brad: Yep.

Interviewer: What do you think is easiest: fives, tens or twos?

Brad: Umm…I don't know, tens probably.

Interviewer: Alright, writing about math. You said you liked that.

Brad: Yeah, I like to write about things in math.

Interviewer: If you were writing about a graph of favorite colors, what could you tell me?

Brad: Like the title of the graph.

Interviewer: Okay, adding. Do you like adding?

Brad: Yeah.

Interviewer: Why don't you like subtracting?

Brad: Because adding makes it the higher number and I have trouble with subtracting.

Interviewer: Okay, what about counting money. You said you liked doing that. Why?

Brad: I like counting money because I like the smell of money.

Interviewer: What if it's the fake money you count in class?

Brad: Well, I still like it. I'd count with it anyway.

Interviewer: Okay, graphs. Why don't you like graphs?

Brad: I don't know, I just don't like it as much as other math things.

Interviewer: Okay, what about fractions?

Brad: Well, they're kind of hard sometimes.

Interviewer: Okay, well what about telling time? Do you think you're good at that?

Brad: Yeah, it's good to know how to do that.

Interviewer: Okay, good. Well, what about timed tests?

Brad: I like those because I can do them faster than when I know I'm being timed.

Interviewer: So it kind of pushes you along?

Brad: Yeah, it gets me in a rush and I know that I have to finish on time.

Interviewer: Okay, well, do you like math overall?

Brad: Kind of.

Interviewer: Do you think you are good at it?

Brad: No.

Interviewer: You don't? Why not?

Brad: Well, sometimes I have trouble and I need help.

Interviewer: Well that's alright. Even I need help with math sometimes! Well, thanks for helping me by answering my questions.

Transcription
Interview #1
Miss Maple, Second Grade Teacher

March 30, 2005

Interviewer: So, How long have you been teaching?

Miss Maple: Nine years.

Interviewer: Nine years. So how long at this school?

Miss Maple: This school, I've been here, let's see, 6 years.

Interviewer: And where were you before that?

Miss Maple: I was in Madina. One year in second grade and then, uh, two years out at Hudson.

Interviewer: Okay.

Miss Maple: First grade.

Interviewer: So were you always in second grade here?

Miss Maple: Always in second grade here, yes. I was hired in second grade and here I am.

Interviewer: In your own education, how far did you go? Where did you go to school?

Miss Maple: I went to Western Illinois University, in Macomb. I don't have my masters, I just have my regular teaching degree.

Interviewer: And you had said that you still attend classes.

Miss Maple: Yes, we still have to attend classes. That's part of our requirements that we have to do.

Interviewer: So, do you have a personal favorite subject to teach?

Miss Maple: I do, and it's math. I do enjoy teaching math. I do also enjoy reading. I mean, reading at the beginning of the year is a lot different than reading at the end of the year. But, um, Mostly math though. I concentrated on math at WIU.

Interviewer: So that was your favorite subject to learn, too?

Miss Maple: Yes, yes it was.

Interviewer: I was wondering if you knew much about the Multiple Intellegences.
Miss Maple: Yes, yes its coming back to me. I haven't touched it for quite awhile, but.

Interviewer: Of the list I just gave you, do you see any intelligences that stand out and are recognizable in your teaching?

Miss Maple: Um, I would say we do a lot of, you know, the hands on in math. I believe in them, you know, experimenting. We don't just do worksheets. We use a lot of manipulatives, working with partners, grouping. That kind of thing.

Interviewer: Do you think that benefits the students?

Miss Maple: I do. I definitely think it does. I think they then, get a hands on idea of what math is all about. Not just a worksheet and being able to answer questions.

Interviewer: Okay, well, thank you very much for sitting down to do this with me. I

think that in a couple days I will interview
you again with some questions about what
I've seen since I've been observing in here.

Miss Maple: Okay, great.

Transcription
Interview #2
Miss Maple, Second Grade Teacher

April 8, 2005

Interviewer: Alright, so, how many of the eight multiple intelligences do you think that I found in your classroom?

Miss Maple: Um…out of the eight? Four.

Interviewer: Try again.

Miss Maple: Five?

Interviewer: Nope.

Miss Maple: Three.

Interviewer: Nope.

Miss Maple: Two?

Interviewer: Nope.

Miss Maple: One.

Interviewer: No.

Miss Maple: Okay, six.

Interviewer: Nope.

Miss Maple: Seven?

Interviewer: Yep, that's it.

Miss Maple: Really?

Interviewer: Yeah, did you know you're using that many and you didn't even know it?

Miss Maple: No, that's pretty cool. Here's me, with one, two, three…haha.

Interviewer: Haha…okay, so which one of the eight do you think I did *not* see?

Miss Maple: Definitely the musical one.

Interviewer: Yes, that's the only one I didn't find.

Miss Maple: Yes, we rarely sing about music…I mean sing about math, sorry.

Interviewer: Do you think that there is any way that you could sing about math?

Miss Maple: Oh, sure, I mean we've definitely sung about other things, but I guess there just aren't many songs about math that I know. I mean, it's not something I've really thought about that much. Maybe now that I know about it, though, I can start to bring it in more.

Interviewer: Okay, good. I'm glad to know that. Alright, with the naturalistic intelligence I didn't really see any use of nature, although I did notice some classification action when you had the students go around the room and list things that might be close to one foot, then star the ones that were exactly one foot.

Miss Maple: Yeah, okay.

Interviewer: Can you think of any ways you can incorporate that intelligence more?

Miss Maple: I guess, you know, when I think of that, we do things outside…um, we did shadows, which was actually science, but we did measure the shadows, which would be math related. But I definitely think that when you teach anything, making it fit into their world, making it fit in as a whole, like outside of the classroom, maybe in nature, is really important.

Interviewer: Yeah, okay, that's great. So now that you know you use the multiple intelligences in your classroom, do you think you might be more aware now and notice when you use certain intelligences?

Miss Maple: Well, I think it's interesting, because like I told you, I had not looked at anything like this since I was in college and it's neat that you tell me that I did all of these things, well almost. I could have told you in the beginning that there wouldn't be any music…haha. But, um, I guess I was kind of curious to actually find out how many I did use. Now, knowing that I do use them makes me kind of excited and proud of myself. The thing is, after you've taught for so long, you forget about those things that you learned back in college. You know, you need to make sure you *this* in your lesson, and incorporate *that*…and now it's just something that I do and I don't even realize it. But I think that with experience, you realize that you don't need to be worrying about incorporating all those things because they just come naturally and you just do them anyway.

Interviewer: Yeah, that's interesting. I hope that's how things will be when I have my own classroom!

Miss Maple: Oh, I'm sure it will be just like that.

Interviewer: Okay, well, on the graph that I made of the surveys, does anything surprise you?

Miss Maple: Um, not really. I mean, the verbal doesn't surprise me as far as worksheets, I mean, who doesn't like to do them and who does. But I do think they need to do pencil and paper things as well. It can't all be hands on, you know, very up and about kind of thing. I think that they do need to be able to focus and be able to read something quietly to themselves.

Interviewer: When I was interviewing those three students I came across the fact that two of them didn't like group work very much and only one did, which surprised me, because I always had the notion that everyone liked group work.

Miss Maple: Really?

Interviewer: Yes, and some of the reasons were that they don't always agree on things within their groups.

Miss Maple: Okay, yes.

Interviewer: Can you think of any ways that you can make group work more appealing to everyone involved?

Miss Maple: Yeah, I mean, when I think of group work I always remind my students that just because their working in groups doesn't meant that they have to think that same way that everyone else in their group is thinking. The reason why we work in groups to help each other so that when someone gets to a point where they don't know how to do something, they can ask a group member for help. I mean, each student has a certain way to solving a math problem. Either they do it in their head, use the hundreds chart, write it down…but they need to do it they way that is best for them, not the way that the rest of the people in their group are doing it. I mean, just because Sally does it one way, doesn't mean that Sari has to do it that way, too. It's hard at second grade, I think, because they see their friends doing it a certain way and they think that they should be able to do it that way, too. So this is something I try to work

on pretty much anytime we do group work of any kind.

Interviewer: Okay, well that's good, because the interpersonal intelligences is probably the most important one to have when it comes to life-skills, so starting it in school at a smaller level is great. Okay, well, you had said in the last interview that you think the students benefit from things like the bodily/kinesthetic intelligence. Do you think that the test results will show that your students understood things, like using rulers…and maybe whether or not they enjoyed it?

Miss Maple: Yes, I think so. Sometimes I like to do different kinds of tests. I don't like to always use the tests from the book where they have to show me with their study buddy what the answer is, then they switch and the buddy has to show me. I think that it's important with math for student to be able to show me how they get an answer, not just write the answer, maybe from a guess or looking at their neighbor's paper. Also, after the tests are in, and I see that someone is doing something wrong, I can have the student show me and maybe he is showing me the right thing, but writing the answer wrong. And if he is doing something wrong, I can make it right.

Interviewer: Okay, good. I have one last question. Did it bother you that I was in the classroom while you were teaching? Do you think that you changed anything about how you teach when I was in the room?

Miss Maple: Oh, not at all. It doesn't really bother me to have someone watching me teach. I actually enjoy having other people in the classroom. I've had Special Ed. teachers in and out of my classroom for the past couple of years and we both go about our business as usual…sometimes we co-teach and that's fun, too. I've had two student teachers now and I've really enjoyed that, too. I mean, it's funny, because sometimes I realize that maybe I've explained something that ended up being a little over their heads and I can look over at you sitting there watching me and I'm like, oh great, she probably thinks I'm crazy for trying to teach this way…haha.

Interviewer: Yeah, well I just saw that as a true sign of a good teacher, I mean, no one is perfect and it's nice to see that I don't have to be perfect to be a good teacher.

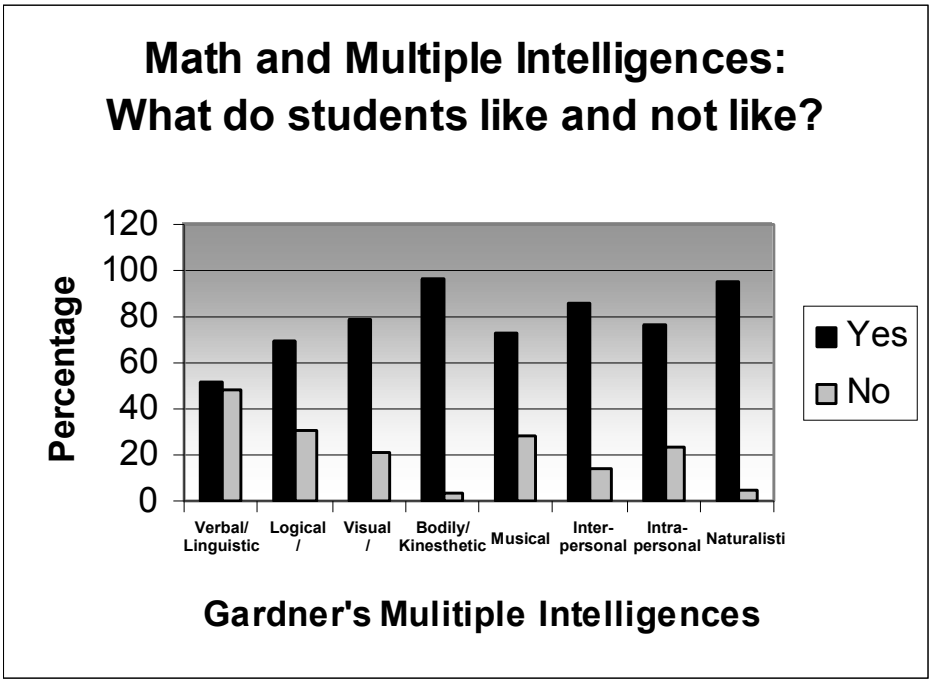
Miss Maple: Yeah, I mean, I don't expect anyone to come in here and think that I'm the perfect teacher. This is my ninth year of teaching and I've taught measurement every year. For some reason, this year I decided to explain it in a different way, which evidently didn't seem to work out too well. I guess every year is different, though. It depends on the kids.

Interviewer: Alright, great! Well, thanks for talking with me and letting me come in to your classroom.

Miss Maple: You're welcome, good luck with your research.

How do you feel about…?

1) Doing math worksheets?	☺	☹
2) Doing puzzles?	☺	☹
3) Solving number stories?	☺	☹
4) Using the hundreds grid?	☺	☹
5) Doing Math Boxes?	☺	☹
6) Using your white board?	☺	☹
7) Singing about math?	☺	☹
8) Using rulers in math?	☺	☹
9) Working in groups for math?	☺	☹
10) Tracing shapes in math?	☺	☹
11) Asking questions when you need help with math?	☺	☹
12) Listening to music while you work on math things?	☺	☹
13) Collecting and counting things in nature? (rocks, bugs, leaves)	☺	☹
14) Pattern counting?	☺	☹
15) Using attribute blocks?	☺	☹
16) Writing about math?	☺	☹



I surveyed a group of 22 second graders about activities within mathematics. Students chose whether they liked or did not like each activity by coloring in the appropriate smiley or sad face icon. Each activity listed on the survey corresponded to one of the eight intelligences. I then created this graph based on the responses.

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