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ABSTRACT

This report describes an intervention program for increasing mathematical achievement of African American students. Within the targeted population, it was evident that the disparity in math achievement between African American and White students was increasing each year. The targeted population consisted of sixth, seventh, and eighth grade mathematics students in a stable, middle class neighborhood. The problem of growing disparity was documented by the examination of each class's 3 previous years of mathematics results according to the Iowa Test of Basic Skills. Analysis of probable cause data revealed that teachers heavily favor the Westernized approaches of verbal/linguistic and logical/mathematical instructional styles. Student surveys indicated that a schism existed between teaching methods and learning processes. Faculty reported an overemphasis on the Westernized approach to teaching within their math classes. A review of curricular content demonstrated a lack of emphasis on the teaching strategies prevalent in culturally responsive curriculum. A review of strategies suggested by experts in the field posed the following solutions: implement the multiple intelligences theory in all aspects of teaching and learning, include the contributions of mathematicians of various cultural backgrounds to ensure a culturally responsive curriculum, and clearly communicate expectations to students in a non-coercive, unbiased manner. Post intervention data indicated an increased diversity in teaching strategies, an expansion and understanding of learning styles, elevated teacher and student enthusiasm, and a desire on the part of students to continue with the multiple intelligences in mathematics, as well as integrate them into other curricular areas. Appendixes include: survey of multiple intelligences; student survey of classroom/learning experiences, sample intervention lesson plans; and Transcripts of Two Focus Groups conducted May 31, 2001. (Contains 47 references and 17 figures.) (Author)

IMPROVING UPPER GRADE MATH ACHIEVEMENT VIA THE INTEGRATION OF A CULTURALLY RESPONSIVE CURRICULUM

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An Action Research Project Submitted to the Graduate Faculty of the

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Field-Based Masters Program

Chicago, Illinois

December, 2001

ABSTRACT

This report describes an intervention program for increasing mathematical achievement of African American students. Within the targeted population, it was evident that the disparity in math achievement between African American and White students was increasing each year. The targeted population consisted of sixth, seventh, and eighth grade mathematics students in a stable, middle class neighborhood. The problem of growing disparity was documented by the examination of each class's three previous years of mathematics results according to the Iowa Test of Basic Skills.

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A review of strategies suggested by experts in the field posed the following solutions: implement the multiple intelligences theory in all aspects of teaching and learning, include the contributions of mathematicians of various cultural backgrounds to ensure a culturally responsive curriculum, and clearly communicate expectations to students in a non-coercive, unbiased manner.

Post intervention data indicated an increased diversity in teaching strategies, an expansion and understanding of learning styles, elevated teacher and student enthusiasm, and a desire on the part of students to continue with the multiple intelligences in mathematics, as well as integrate them into the other curricular areas.

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Without the love, understanding, and support of our families, this journey through the Master's Program would have been a much more difficult one. We would like to thank our families for their support throughout every step of the journey.

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

Due to the lack of a culturally responsive curriculum, the targeted sixth, seventh, and eighth grade students have exhibited a gradual drop in mathematical achievement as evidenced by cumulative records, standardized test scores, and increased enrollment in math tutorials.

Immediate Problem Context

Built approximately 60 years ago, the targeted school is one of six elementary schools participating in the International Baccalaureate Middle Years Programme (IBMYP) within the region. The IBMYP is another way of focusing a school's curriculum so that connections within the classroom are made with the outside world in areas such as the environment, health and social education, and community service. The school is composed of kindergarten through eighth grade students. The school's internal structural capacity allows for one classroom per grade. Housed within the school are a library/media center, a multipurpose gymnasium, and a Synergistic Technology Laboratory. In recent years, with greater interest in the neighborhood and its high achieving public schools, overcrowding has plagued the school. In some instances, 22' by 30' classrooms need to house upwards of 40 or more students.

Enrollment reported as of October 15, 1999 for the school's 298 students was 66.44% African American, 26.51% White, 2.68% Hispanic, 2.01% Asian, 1.68% Mexican, and 0.67% Native American (Annual Racial/Ethnic Survey, 1999). The average class size is 32.6. According to the 2000 school report card, 19.1% of the student population come from low-income homes and no students are categorized as Limited-English-Proficient. The school has a 95.7% attendance rate, a 10.6% mobility rate, and a 0.0% chronic truancy rate. Thirty-five percent of the school's twenty faculty members are minority, while 65% are White. Fifteen percent of the faculty is male. Forty-five percent of faculty members have attained master's degrees or better.

From a core subject instructional perspective, 90 minutes per day are devoted to language arts, 50 minutes to math, 40 minutes to science, and 40 minutes to social studies. On a weekly basis, students also receive instruction in foreign language, music, physical education, health, and character education.

Instruction in reading and math is designed to accommodate students working above or below grade level via a "walking" program. Based on standardized test results, academic achievement, maturity level, and teacher observations, a student's instructional level is determined, and the student receives instruction at his or her individual instructional level. In essence, a student "walks" to the classroom where the needed instruction is being delivered. An observation on the part of the researching teachers is that once a student's track has been determined (reading at an instructional level higher than one's grade level), deviation from the track rarely occurs.

To ease the large class sizes throughout the school, non-homeroom teachers provide small-group instruction in the main subjects of reading and math. Students in

need of remediation, as well as those needing enrichment, are pulled out and instructed in an environment that is deemed more suitable for their needs. Oftentimes, these instructional locations (hallways, gymnasium, stage, and media center) are counterproductive due to continual intrusions from noise, high traffic, and interruptions.

The needs of students who are academically challenged are addressed in a variety of manners. Three learning disabilities resource teachers lead pull-out programs and assist students in full inclusion settings. Additionally, small-group instruction is given in reading and math to students who are deemed at risk. Early morning and after school tutorials, as well as The Lighthouse Program (a participation-recommended direct instructional program), are offered throughout the school year for reinforcement, remediation, and individualized instruction.

Beginning with first grade, students are assessed using the Iowa Test of Basic Skills, the Illinois Goal Assessment Program, and quarterly report cards. Letter grades for classroom performance are given as follows: A (95-100), B (87-94), C (75-86), D (70-74), and F (69 or lower).

Class A

One class within the targeted school is comprised of heterogeneous students brought together for the purpose of math instruction. At this seventh grade instructional level, the class consists of sixth grade students working above grade level, seventh grade students working at grade level, and eighth grade students working below grade level.

Class B

Class B is an advanced eighth grade math class within the targeted school working on high school algebraic concepts. Due to its limited class size, Class B's

location changes from year to year (ie: library/media center and second floor hallway). The teacher researchers do not find the existing environment to be conducive to learning because it has limited board space, immobile tables, frequent interruptions, and other instruction occurring simultaneously in the same general space.

The Surrounding Community

The targeted school is located in a neighborhood of a large Midwestern city. This neighborhood is filled with uniquely built older homes that are perched on wide, tree-lined streets. While predominantly White and Irish Catholic, the neighborhood has gained some semblance of social, racial, economic, and ethnic diversity in recent years.

The population within a one-mile radius of the school is 22,451. The racial composition of the surrounding community runs counter to the racial makeup of the school in that 73.5% of the neighborhood's residents are White, 24.1% are African American, 1.7% are Hispanic, and 0.7% are of other races (U.S. Census Bureau, 1990). This greatly contrasts with the racial composition of the targeted school as almost two-thirds of the school population is African American while the surrounding community is almost three-fourths White. See Figure 1 below.

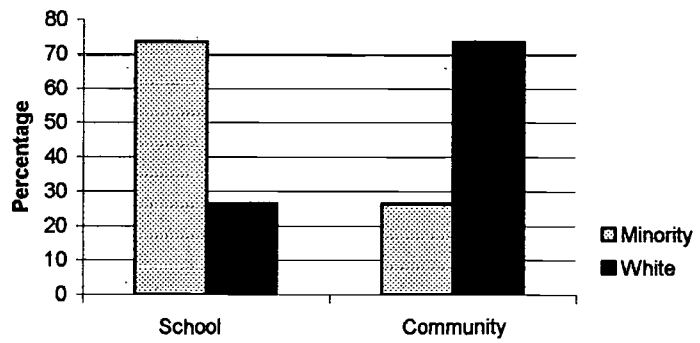

Figure 1. Comparison of targeted school and surrounding community demographics.

Within the surrounding community, 2.6% of adults 18 and older have an educational level less than 9th grade, 5.6% have an educational level between 9th and 12th grades, 18.6% are high school graduates, 23.7% have some college, 5.3% have associate's degrees, 26.4% have college degrees, and 17.8% have graduate degrees. Occupationally, 75.8% of community residents are employed in white-collar professions, while 24.2% are employed in blue-collar occupations (U.S. Census Bureau, 1990).

Of adults 16 and older, 66.1% are employed, 30% are not in the labor force, and only 3.8% are unemployed. The average family household income within a one-mile radius of the targeted school is $99,027. In contrast, the targeted school's percentage of low-income families is 20.9%, and the region's percentage of low-income families is 77.6% (U.S. Census Bureau, 1990). Comparing the surrounding community's average home price of $188,000 (Villager, 4/00) with the targeted school's number of families receiving public aid (20.9%) illustrates certain socioeconomic disparities.

According to the neighborhood's planning association, the targeted school's surrounding neighborhood contains one of the largest urban districts on the National Register of Historic Places. Frank Lloyd Wright, Walter Burley Griffin, H.H. Waterman, and Murray Hetherington are a few of the critically acclaimed architects who have designed some of the historic neighborhood's architecturally significant homes. To remind neighborhood residents and visitors of the architectural richness of these homes, plaques displaying the historical information are prominently displayed. The beauty of these homes is displayed each year during the annual neighborhood home tour.

The target school's surrounding community is filled with a plethora of cultural and recreational opportunities including two regional libraries, a performing arts center, a

historical society, an annual, family-oriented outdoor orchestral concert, a variety of bicycle tours, an annual 10K running race through the historic neighborhood, and various recreational centers.

National Context of the Problem

The cultural makeup of the public education system, as a whole, is constantly changing. The student body is becoming increasingly diverse, and minority students are forming the most rapidly growing group (Montgomery, 1998; Clark, 1999). Hodgkinson, in 1992, projected that by 2010, 12 states and the District of Columbia will have significant minority populations. About half of the nation's 64.4 million young people will be African American, Hispanic, American Indian, and Asian American. The "minority" population will no longer be the minority.

"With the changing composition of today's student population, the need to provide educational programs that address the complex issues related to multiculturalism and diversity is becoming more and more evident" (Sanchez, 1995, p. 3). Consequently, a significant variance in learning styles is the byproduct of the diversity of the classroom's cultural makeup (Montgomery, 1998). Educators will agree that students approach learning in many different ways and that teachers need to take these differences into account when developing their methods of instruction. Since today's teaching methods are entrenched in Westernized culture, teachers must add culturally responsive instructional methods to their repertoires to reach these diverse learning styles.

Mathematics instruction, in particular, has not changed to reflect the ever-increasing diversity of the student population. As per the Third International Mathematics and Science Study (TIMSS) ordered by President Clinton, a strong need for

improvement in math and science instruction is vitally important to the welfare of the nation's educational system ("An Action Strategy," 1998). Children's ethnic background and cultures influence the manner in which they learn concepts and process information. Curricular and instructional methodologies, therefore, must be adapted to accommodate alternative learning styles (Clark, 1999).

The long-term implications for changes in the student demographic makeup are multifold. Not only will learning styles and teaching styles need to converge, a future-oriented focus must be maintained to ensure minority candidates for math and science related careers. Due to the lack of a culturally responsive curriculum, we face the long-term potential of a serious shortage in the number of minorities (African Americans, Asian Americans, Hispanics, and American Indians) qualified and prepared to enter occupations in the fields of science and mathematics. "In the years ahead, these underrepresented minorities will constitute a growing population within a pool of students from which a highly skilled workforce will be drawn" (Clark, 1999, p. 1).

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

As evidenced in a review of the current literature, as it relates to student achievement in mathematics on a national level, the targeted group of students exhibited the same increasing disparity between Caucasians and African Americans. In order to document the lack of student achievement, information was taken from a comparative analysis of standardized test scores for three different classes over a three-year span (Figures 2, 3, and 4). The variance between the achievement of White and Black students is increasing each year within each graduating class, and, therefore, in need of attention.

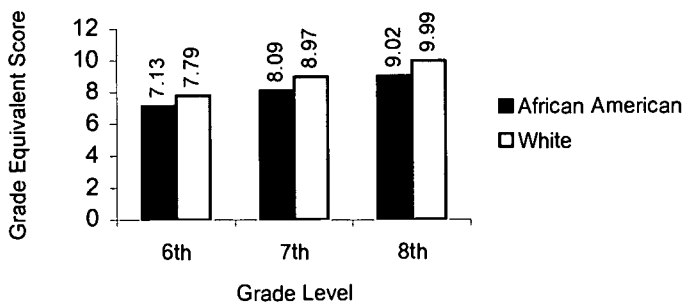

Figure 2. Comparison of class of 2000 Iowa Test of Basic Skills grade-equivalent scores for grades 6-8.

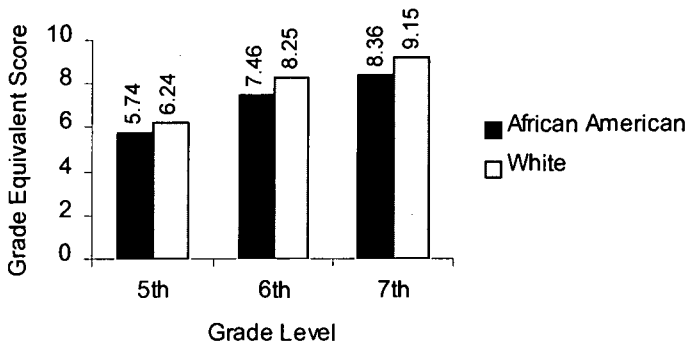

Figure 3. Comparison of class of 2001 Iowa Test of Basic Skills grade-equivalent scores for grades 5-7.

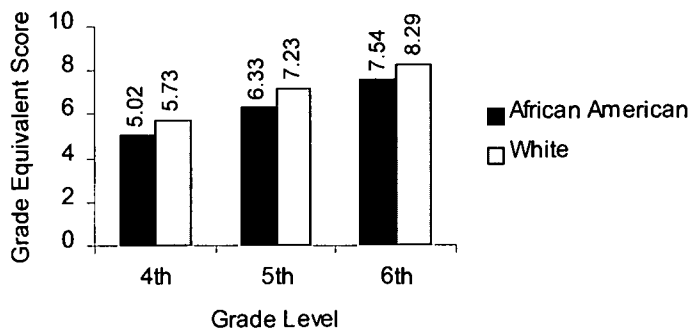

Figure 4. Comparison of class of 2002 Iowa Test of Basic Skills grade-equivalent scores for grades 4-6.

While mathematical standardized test scores are on the rise for both White and African American students in the targeted group, the escalating disparity, or achievement gap, between the two groups is of mounting concern to the teacher-researchers. A more thorough evaluation of the ITBS test results was conducted to determine possible causes for the growing disparity between the two racial groups. The ITBS results also allowed for the viewing of student sub-skills, so that the achievement gap could potentially be narrowed to a few specific areas. A student's comprehensive math ITBS score, or cumulative math total, is the compilation of three sub-tests: concepts and estimation, problem solving and data interpretation, and math computation.

While the teacher-researchers agree in the belief that standardized tests contain some form of bias, the Iowa Test of Basic Skills was the best-available assessment tool that contained the least amount of interpretation bias. A racial breakdown of students' scores on the sub-tests further illustrates the growing disparity that exists between the two groups of students. While the average stanine score on the math computation sub-test was the same for both racial groups, the average stanine score for White students was 1.13 higher on the concepts and estimation sub-test and .91 higher on the problem solving and data interpretation sub-test. Stanines, as utilized in educational terminology, are groupings of percentile ranks from one through nine that allow student scores to be broken into convenient categories that help teachers, parents, and students more readily identify strengths and weaknesses is specific areas.

Despite the three-year continual rise in scores, as evidenced in Figures 2 through 4, the growing achievement gap between the two ethnic groups remains a concern within the targeted school. Thus, a change in teaching styles and strategies seems necessary to

counteract the increasing disparity between the two ethnic groups. To further examine and give credence to the Iowa Test of Basic Skills results, the teacher-researchers administered two other assessments to the test subjects to determine the validity of the test scores.

During the first week of the second semester, all 37 students in the targeted group were administered two data gathering tools to assess dominant intelligences and preferred learning styles. The assessments were given to the students following a thorough explanation of the action research project. Prior to the assessments, consent-to-participate forms from both parents and student had been received. After being assured of anonymity, the assessments took place in each teacher-researcher's mathematics classroom. The teacher-researchers made every attempt possible to make the atmosphere inviting and non-threatening.

First, students were given an assessment containing a series of yes/no multiple intelligences statements that identified each student's preferred expression of learning (Appendix A). In completing the assessment, students were asked to indicate whether they felt the statements applied to them personally. For each statement expressing some characteristic of each test subject, he or she was asked to respond with "true" in the event that the statement was a true indicator of his or her personality. When the test subject felt as though a statement was not a true indicator of his or her personality, he or she was asked to respond with "false." If the statement was sometimes true or sometimes false, the students were asked not to respond to the statement.

The 35 statements were distributed in such a way that each intelligence was represented by five questions randomly distributed throughout the survey. By tallying

the number of true responses, the teacher-researchers were able to establish the dominant intelligence, or in most cases, dominant intelligences for all of the test subjects. If a student responded "true" to four or more statements that targeted a specific intelligence, that student was considered to possess a "strong ability" in that intelligence.

As mentioned earlier, each intelligence was represented on the multiple intelligences assessment by five true/false statements. Therefore, students could have scored zero through five within each separate intelligence. A score of zero indicates no apparent strength within a particular intelligence, while a score of five indicates a noticeable dominance within a particular intelligence. Scores of one through four demonstrate varying intensities of the respective intelligences.

The result of the assessment demonstrated that the targeted students had a wide variance of dominant learning styles (See Figures 5-11 below).

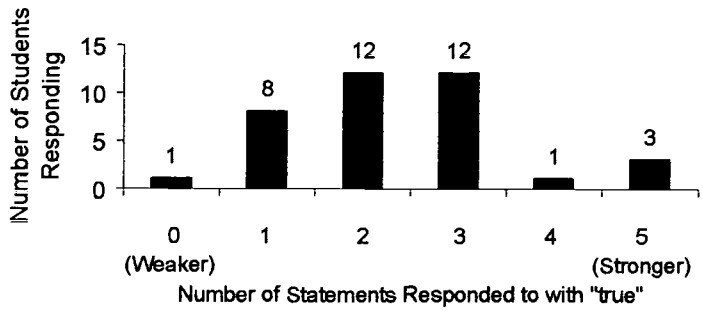

Figure 5. Number of students responding "true" to verbal/linguistic statements.

In terms of the verbal/linguistic intelligence, the majority of responses did not fall within the dominant range, or when a student has responded with true to four or five statements relating to a specific intelligence. This is consistent with the teacher-researchers' classroom observations. When lessons rely on discussion, a few students

tend to monopolize the conversation, while the majority of students seem reluctant or uncomfortable participating. For instance, during monthly whole-class Socratic discussions, a handful of students tended to dominate the discussion. Therefore, one of the teacher-researchers suggested limiting the number of responses to three per student. Even when the discussion-controlling students had used their three opportunities to respond, the number of responses from the other students remained nearly the same.

The teacher-researchers have also noted in anecdotal records that many of the students in the targeted group tend to rely heavily on teacher modeling with written assignments. The teacher-researchers' have observed that this group of students experiences difficulty reading and following written directions. For instance, the teacher-researchers are frequently asked questions that have been addressed both verbally and in written form. With only 4 of 37 student responses falling into the dominant range for verbal/linguistic intelligence, the teacher-researchers are further reaffirmed in their belief that this is an intelligence that needs to be further developed.

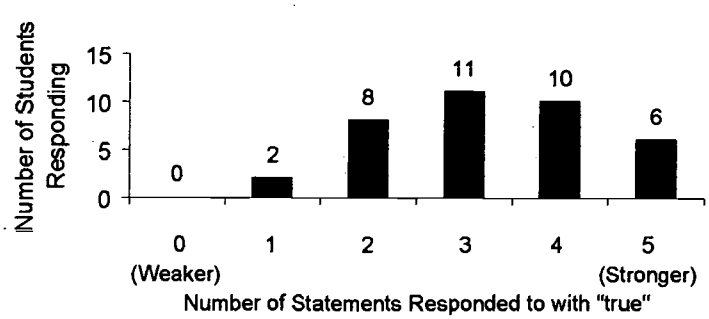

Figure 6. Number of students responding "true" to logical/mathematical statements.

Forty-three percent of student responses indicated a dominance in the logical/mathematical intelligence, while 73% of all student responses fell into the upper

half of the data range. This strong student inclination that was demonstrated on the multiple intelligences test runs counter to daily observation on the part of the teacher-researchers. Hence, students might have a greater perception of their mathematical and logical abilities than truly exists. For instance, the targeted students were administered a practice skills test that contained questions at a lower level than the one in which they are receiving instruction. Upon receiving the results of the test, students were confounded to find their scores at an average to below-average level. In fact, several students approached the teacher to check on whether errors were made in scoring. Teacher-researchers believe, based upon observations, that students' perceptions of their own logical/mathematical abilities do not match their classroom performance.

During daily mathematical activities that are strengthened through teacher modeling for the internalization of key concepts, students demonstrate a propensity to bypass the modeled technique and rely too heavily on mental math and other shortcuts to solve similar problems. The teacher-researchers struggle with this inflated perception of mathematical abilities because it is a metaphorical roadblock to student progress and subsequent success.

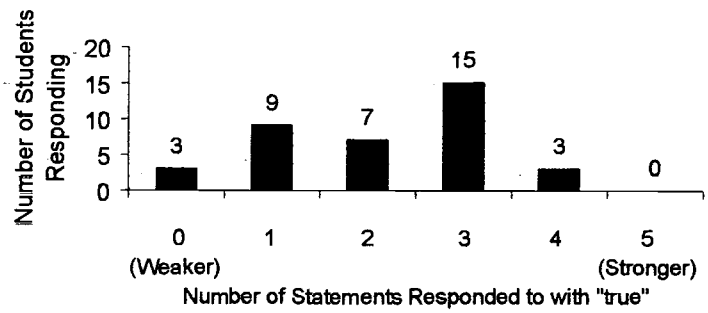

Figure 7. Number of students responding "true" to visual/spatial statements.

As only 3% of student responses showed dominance in the visual/spatial intelligence, it is apparent to the teacher-researchers that this area of intelligence also needs further development. This supports teacher-researcher classroom observations that the students tend to favor auditory processing, rather than visual/spatial processing.

When student-created diagrams can be of assistance in the problem solving process, the teacher-researchers have noticed a strong propensity on the part of students to avoid doing so. Consequently, the targeted group of students fares poorly when faced with mathematical problems involving geometry and problems requiring student-generated pictures to accurately map out the logical progression of the problem. The teacher-researchers feel that if students utilized this problem-solving technique more effectively, they would be more successful.

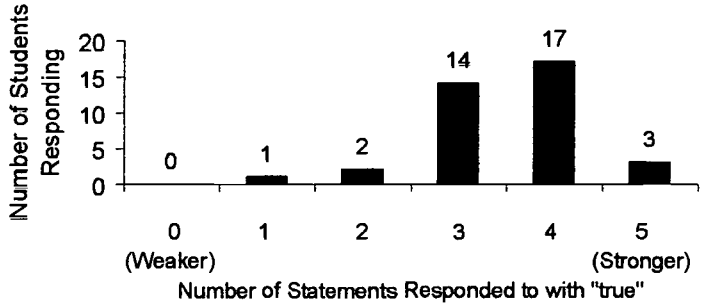

Figure 8. Number of students responding "true" to bodily/kinesthetic statements.

Almost 92% of the targeted student test subjects fell into the upper half of the bodily/kinesthetic data range, which concurs with the teacher-researchers' anecdotal observations. This is further evidenced by the students' involvement in athletic activities, dance classes, participation in all-school theatrical presentations, and in-class activities. When students are not grasping mathematical concepts presented in a traditional manner,

the use of bodily/kinesthetic activities has overwhelmingly led to success in the understanding of these concepts.

For instance, when students in the targeted group were having difficulty distinguishing between mathematical properties, the teacher decided to allow the students to become physically active in order to achieve a better understanding. Students were assigned a variable or mathematical symbol on an $8^1/_2$" by 11" piece of construction paper. Students were then asked to arrange themselves, while holding the cards, to represent a number sentence illustrating the given property. After conducting this activity for all mathematical properties, every student in the targeted group earned a perfect score on a written quiz.

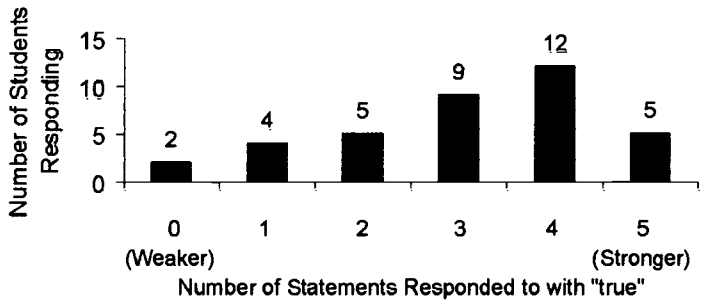

Figure 9. Number of students responding "true" to musical/rhythmic statements.

Of the 37 targeted student test subjects, 70% of all responses fell into the upper half of the musical/rhythmic intelligence data range. This is not surprising to the teacher-researchers in that students in the test group participate heavily in musical/rhythmic activities throughout the school including chorus, assemblies, musical productions, dance-oriented productions, and school social events.

When it was determined that multiple-step computation was a perennial problem within one of the teacher-researchers classrooms, a musical/rhythmic solution was developed. Students in the targeted classroom were charged with the task of incorporating the order of operations to a musical number. After each group presented its song to the class, a post test was administered in which students scored exceptionally high. The teacher-researchers conclude that this was due to the students preferred capacity to process music auditorally. By internalizing, through the use of music, the order of operations was further strengthened, thus alleviating confusion during multiple-step computation.

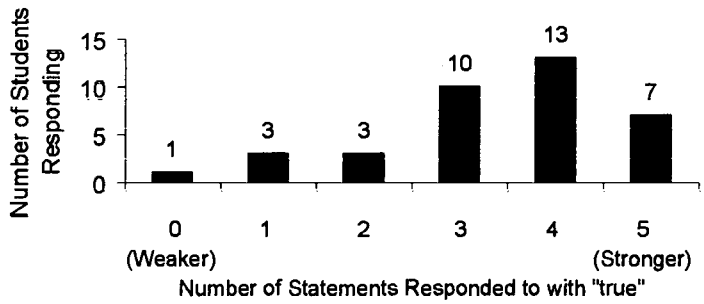

Figure 10. Number of students responding "true" to intrapersonal statements.

While the teacher-researchers' previous classroom observations led them to believe that a large percentage of students would demonstrate strength in interpersonal intelligence, they were surprised to discover the students' strength in intrapersonal intelligence. The teacher-researchers found this unexpectedly intriguing in that they have infrequently observed students reflectively and introspectively processing their work. The teacher-researchers conclude this because when students have been asked to complete PMI (Pluses/Minuses/Interesting Aspects) worksheets or similar metacognitive tools, the majority of student responses have been superficial and lacked depth.

However, Gardner (1983, p. 241) explains that both interpersonal and intrapersonal intelligences are "intimately intermingled in any culture" and "neither form of intelligence can develop without the other."

Gardner's belief in the balance between the interpersonal and intrapersonal intelligences is substantiated upon closer examination of the results from the multiple intelligences survey that was administered by the teacher-researchers. Rather than look at each of the two personal intelligences individually, the teacher-researchers examined the existence of a relationship between both. Of the 29 students who showed a dominance, or a score of four or five in one of the personal intelligences, 12, or 41%, showed dominance in both. Therefore, the correlation between the two intelligences indicates that both interpersonal and intrapersonal intelligences need to compliment one another during activities. As with all activities, reflection for the purpose of improvement is key. However, the teacher-researchers recognize that they are missing many opportunities to utilize both personal intelligences in conjunction with one another.

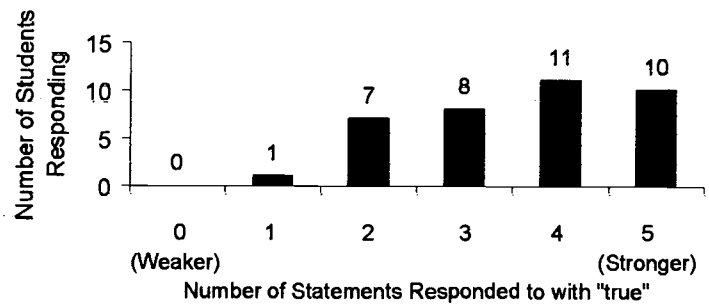

Figure 11. Number of students responding "true" to interpersonal statements.

As demonstrated in Figures 5 through 11, a wide distribution of dominant intelligences is found throughout the 37-student test subjects, indicative of the many different learning styles, or preferences, that need to be addressed with varying teaching

styles. Furthermore, many of the student test subjects possessed one or more dominant intelligences. Of the students tested, more than 84% showed a dominance in more than one intelligence; 24% of students showed dominance in four of the seven intelligences; 43% of students showed dominance in three; and 20% of students showed dominance in two intelligences.

The researchers were somewhat surprised to discover three students having dominance in only one intelligence, while two showed no preferred expression of learning. While Gardner would argue that every individual possesses multiple intelligences, the data was collected based on student responses to the survey. A more comprehensive and interactive survey could possibly have drawn out more information, thus allowing for the identification of every student in at least two intelligence categories. Since people have the capacity to possess more than one dominant intelligence, the teacher-researchers were not surprised to discover that the data showed that the 37 test subjects possessed a total of 101 dominant intelligences.

As stated previously in the text, a score of four or five on any individual intelligence indicated a dominance. Of the 37 student test subjects who were assessed, 21 tested dominant in interpersonal intelligence, 20 tested dominant in bodily/kinesthetic intelligence, 20 tested dominant in intrapersonal intelligence, 17 tested dominant in musical/rhythmic intelligence, 16 tested dominant in logical/mathematical intelligence, four tested dominant in verbal/linguistic intelligence, and three tested dominant in visual/spatial intelligence (See Figure 12).

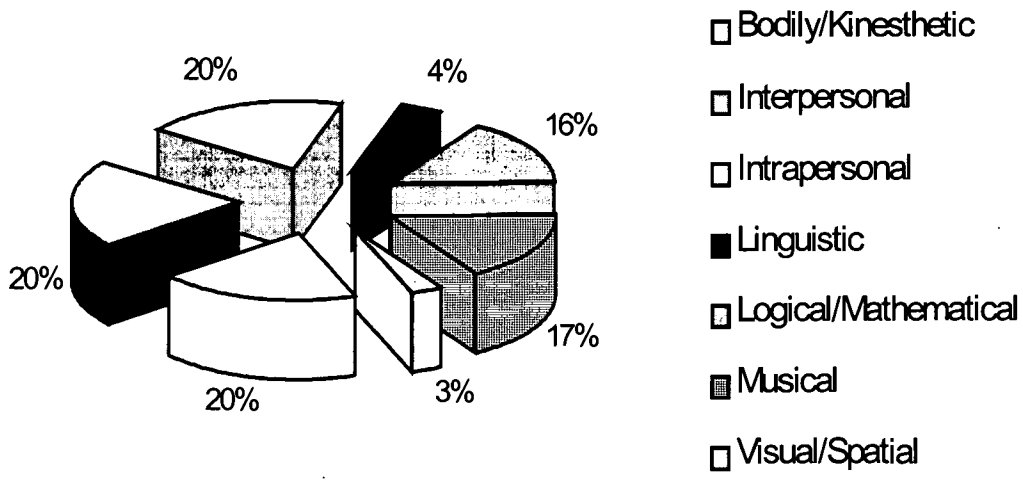

Figure 12. Distribution percentage of dominant intelligences among the 37 student test subjects.

By looking at the percentage breakdown of the data, many interesting implications and relationships can be drawn. As supported by recent literature, many of the African American test subjects demonstrated tremendous aptitude toward the bodily/kinesthetic and musical/rhythmic intelligences, which is confirmed by teacher observations. As previously mentioned, the teacher-researchers found the results of the inter/intrapersonal facet of the multiple intelligences survey to be contrary to previous classroom observations. The teacher-researchers are in agreement that lessons should continue to contain musical/rhythmic, bodily/kinesthetic, and inter/intrapersonal elements. While many positives were realized during data interpretation and teacher-researcher observation, the teacher-researchers discovered virtually untapped intelligences in need of additional development.

The teacher-researchers found the students' levels of dominance in visual/spatial and verbal/linguistic intelligences to be undeveloped. Ironically, while Westernized

culture has a tendency to focus teaching strategies on the verbal/linguistic intelligence, only 4% of student responses showed a dominance in this intelligence. The students' performance in the logical/mathematical intelligence was no surprise; Figure 6, depicting the range of dominance in student responses, is in accordance with teacher observations.

Research indicates that the traditional classroom teacher emphasizes the logical/mathematical and verbal/linguistic intelligences in his or her instruction. Of 101 dominant intelligences found in the 37 student test subjects, only 16 showed a strong preference in the logical/mathematical intelligence and only four showed strong preference in the verbal/linguistic intelligence. This supports the teacher-researchers' position that many students are being denied instruction in a manner that compatibly accommodates their learning styles and preferences.

The targeted group of students was also administered an open-ended, three-question survey (Appendix B). The survey was designed to determine each individual student's comfort level during learning activities. The survey solicited their individual opinions relating to the classroom activities from which they have learned the most, those from which they have learned the least, and the activities that the students most enjoyed.

Prior to conducting the open-ended survey, the teacher-researchers discussed its content and purpose to make the student test subjects feel at ease. The students were assured anonymity would be respected, and all student responses would be viewed with objectivity. The atmosphere in which the survey was conducted was friendly, with students exhibiting genuine feelings of comfort as they answered the questions honestly.

The 37 student test subjects generated 77 total responses to the first question pertaining to which classroom activities each student felt were most beneficial from a

learning perspective (see Figure 13). Twenty-four student responses, or 31%, indicated a preference for hands-on learning experiences, while 20 student responses, or 26%, indicated a preference for cooperative learning activities. Seventeen student responses, or 22%, pointed to a preference for class discussion, while six student responses, or 8%, of responses favored homework/research or academic competitions. Only four student responses, or 5%, revealed demonstration and performance activities as preferred academic experiences. Each student was allowed to make as many responses as he or she wished.

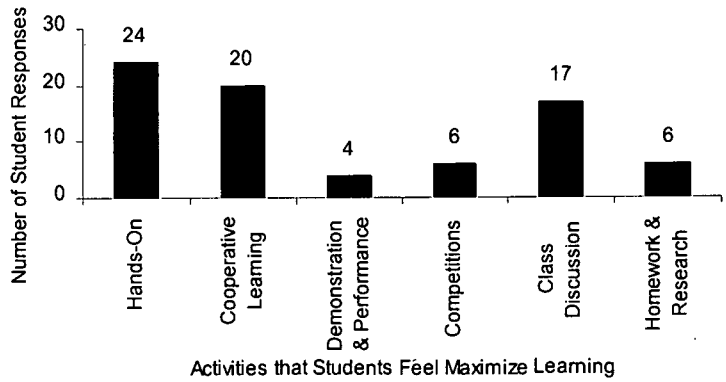

Figure 13. Activities students felt maximize learning.

In reply to the second open-ended question regarding which classroom activities minimized the learning process, students in the test group generated 39 responses, or roughly half as many disapproving responses as there were positive responses in question one (see Figure 14). Of the 39 student responses, 10, or 26%, found lecture to be a classroom activity that minimized learning. Eight responses, or 21%, found writing assignments to curtail learning, while six student responses, or 15%, found discussion to diminish the learning process.

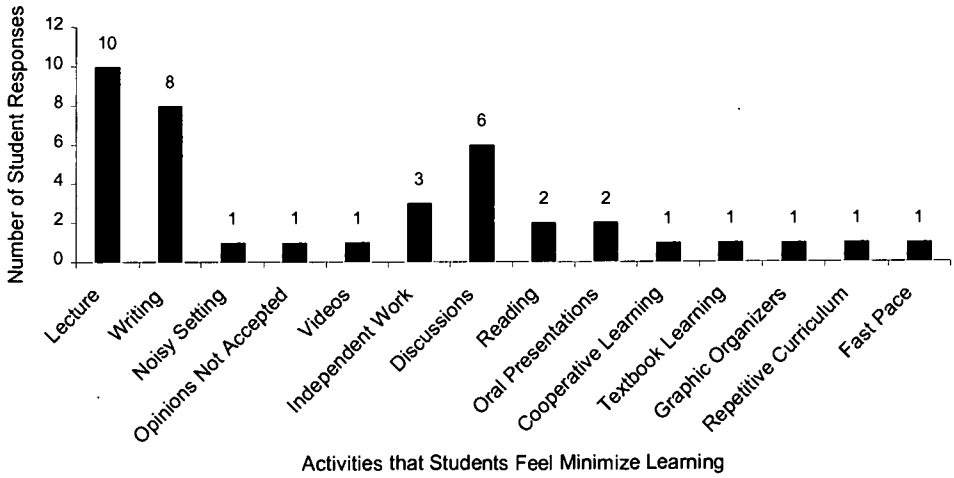

Figure 14. Activities students feel minimized learning.

Survey question number three asked students to respond to the types of classroom activities they found most enjoyable (see Figure 15). This question is distinctly different than question number one in that it removes learning as a variable and simply asks students to respond to which activities they enjoyed the most, regardless of whether knowledge was acquired during the activities. Twenty-three of the 64 responses, or 36%, favored hands-on learning activities. Fourteen of the 64 responses, or 22%, preferred class discussion as an enjoyable classroom activity. Six of the 64 responses, or 9%, favored cooperative learning. The remainder of the responses from survey question number three were distributed across 9 other categories, none of which contained more than 4 responses.

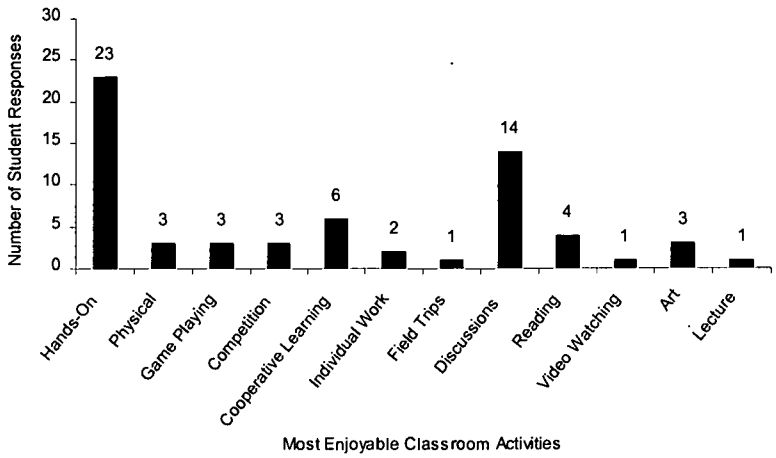

Figure 15. Activities students found to be most enjoyable, regardless of knowledge acquisition.

Many parallels, including some of a contradictory nature, exist when the responses from all three questions are viewed critically. For instance, hands-on activities were seen in a positive light in both survey questions one and three. Students viewed class discussions both positively and negatively. Twenty-two percent of the responses indicated that class discussions are an activity that maximizes learning, while 15% found class discussions to be an activity that minimizes learning. The teacher-researchers found irony in the fact that classroom discussions could be perceived so differently by the same group of students.

While the 77 responses from question number one were straightforwardly-situated within 6 distinct categories, the responses to question number two varied considerably more in content, having been spread over 14 different categories. The teacher-researchers note, however, that the number of positive responses, as documented in question number one, outnumber the negative responses, as documented in question number two, by almost a two responses to one response margin. This indicates that

students perceive more positive than negative learning activities are occurring at the school. The teacher-researchers feel that this positive student perception of school will ease the implementation of the planned intervention.

The 37 students who were assessed via the multiple intelligences test and the three-question survey were also assessed with the Iowa Test of Basic Skills in the subskill of mathematics. For the purpose of triangulating these test scores with the two aforementioned assessments, only the total cumulative math score was used. In addition to being ranked by grade-level equivalent and percentage rank, students' raw scores were also converted to stanines. The results of the conversion can be seen in Figure 16.

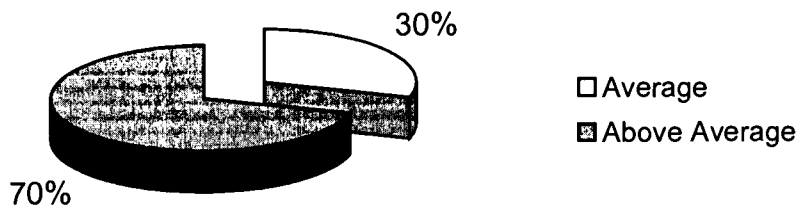

Figure 16. Student raw score conversion according to the Iowa Test of Basic Skills.

As revealed in Figure 16, 100% of the test subject students scored in either average or above average stanine categories. While it is worthwhile to note that none of the test subject students scored below average, it is even more amazing to note that 70% scored above average. Factors contributing to this unexpectedly high result can be attributed to the school's emphasis on math instruction via the increased length of

instructional time, remediation through Lighthouse and Social Center programs, and vertical team planning.

Examining and triangulating the results of the multiple intelligences test, the three-question, open-ended survey, and the Iowa Test of Basic Skills, give the teacher-researchers cause to develop, plan, and implement an intervention to close the mathematics achievement gap between White and African American students in the targeted group. In longitudinally analyzing the results of the three ITBS mathematics sub-tests over a period of three years, an ever-increasing gap in mathematics achievement was apparent.

To further investigate the cause of the achievement disparity, the teacher-researchers administered a survey to assess dominant intelligences and an open-ended, three-question survey to assess student learning preferences. As shown in the open-ended survey, student preference for hands-on activities and cooperative learning correlate with the results of the multiple intelligences test in which the bodily/kinesthetic intelligence and the interpersonal intelligence garnered much student support. The results of the survey question identifying activities that students felt minimized learning (lecture, writing, and discussion) are supported by the lack of dominant scores in the verbal/linguistic aspect of the multiple intelligences test.

The multiple intelligences test showed a wide variance in the dominant intelligences throughout the 37 students in the targeted group. Interestingly, the intelligences that were preferred by the students were those that the teacher-researchers felt were underutilized during classroom instruction. When asked on the three-question, open-ended survey which activities maximized learning, the leading student responses

appeared to coincide with the intelligences in which students showed greatest dominance. Thus, the teacher-researchers had cause to develop an intervention that from all appearances would counteract the growing disparity between the two racial groups.

However, it is important to note that this study is not primarily concerned with the achievement of African American or White students, but rather the achievement gap that exists and progressively expands as students proceed from grade level to grade level. On average, both racial groups perform above grade level on standardized tests. African American students, however, are not displaying the achievement growth of their White counterparts, thus creating the expanding gap.

Probable Causes

Teaching Influences

As evidenced by a thorough review of current literature, the probable causes resulting in the disparity between White and African American students in mathematics achievement can be broken down into three distinct categories: teaching influences, lack of high expectations, and cultural incongruence.

Research indicates that the influence a teacher has begins with his or her instructional methodology. If teaching methodologies do not correspond with the student learning styles, disharmony will occur and impede the learning process. Students bring a potpourri of learning styles to the classroom (Banks, 1988, p. 465; Harvard Education Letter, 1988, p. 1; Montgomery, 1998, p. 1; Murphy, 1996, p. 2), which remain underdeveloped when educators utilize narrowly focused methods of instruction. According to the Western-European method of instruction, we traditionally view intelligence via two methods: verbal and computational (Brualdi, 1996, p. 1; White,

Blythe & Gardner, 1992, p. 129). These two methods can be aligned with the two most prevalently targeted intelligences, verbal/linguistic and logical/mathematical. The effects of such narrowly focused instructional styles severely hinder students who posses dissimilar dominant intelligences.

Schools tend to place emphasis on a written demonstration of knowledge, while some African Americans rely upon verbal expressiveness to demonstrate their understanding (Malloy & Malloy, 1998, p. 249). This may detrimentally influence teachers in the appraisal of student intelligence; a variety of assessment tools may be utilized to accurately assess student knowledge.

In a traditional school setting, literature shows that schools teach individualism while African Americans seek interdependence (Malloy & Malloy, 1998, p. 249). Children who excel in learning environments allowing for cooperation, collaboration, and conferencing may feel stifled by a classroom teacher emphasizing independent learning activities.

This is exemplified when children have learning experiences at home that conflict with learning experiences at school. The way in which a child learns about the world (learning style) is different from the way he or she learns in school (Swisher, 1991, p. 1,2; Tharp, 1989, p. 349, 350). Because of this inconsistency in learning between school and home, students may not be able to connect school experiences with real-life experiences, the ultimate goal of education. The influence the teacher has on the learning experiences of students is of utmost importance. Current literature suggests that if teaching strategies do not match students' learning styles, the educational experience between teacher and pupil will be hampered.

Teachers tend to lack knowledge of their students' cultural background that may hinder their impact in the educational process. Teachers can rarely identify the distinctive traits in various ethnic groups that call for unique instructional strategies. In the event that they are knowledgeable, they don't know how to adapt instruction accordingly (Vasquez, 1990, p. 299). Research indicates that pre-service teacher training programs are not doing an adequate job in meeting the needs of diverse cultural and ethnic groups (Coballes-Vega, 1992, p. 1; Ladson-Billings, 2000, p. 211).

Curriculum does not take into account the students who lie outside the universally-accepted Western-European culture. When conflicts exists between the home culture and the culture of the school, academic achievement is negatively impacted (Foster & Peele, 1999, p. 177-178). Additionally, teachers sometimes misinterpret the behaviors of students because they do not understand the cultures from which they come (Cole, 1995, p. 10). Research indicates that a teacher's lack of cultural awareness can impede the important teacher-student relationship, thus impeding the learning process.

Equally as damaging as the misinterpretations that emanate from a teacher's lack of cultural awareness, are the cultural assumptions that teachers make. Cultural assumptions of African American achievement are harmful because they can lead to a perpetuation of stereotypes (Graybill, 1997, p. 311-312). Current literature cautions teachers to avoid making stereotypical assumptions based on membership in a cultural group (Swisher, 1991, p. 2; Tharp, 1989, p. 357).

Another stumbling block in the quest to understand the differences in cultures are pre-existing societal stereotypes. It is most unfortunate that African Americans are often not seen as a distinct culture, but rather as "a corruption of White culture or a counter-

productive culture" (Ladson-Billings, 2000, p. 206). Because the influence of the teacher is crucial, teachers need to be aware of the impact of cultural assumptions.

Not only does a teacher influence what and how students learn, he or she also influences the environment in which learning takes place. Traditional classrooms, which are the rule more than the exception, have proven to be non-conducive learning environments. Students have strengths and talents that are untapped in the traditional classroom (White, Blythe & Gardner, 1992, p. 127) due to differences between teaching and learning modalities. This standardized approach to education neglects many students (White, Blythe & Gardner, 1992, p. 129).

One must work out any conflicts inhibiting student learning that arise as the result of a clash between teaching and learning styles. Once these conflicts have been recognized, one must realize that it is not enough to simply acknowledge their existence (Montgomery, 1998, p. 7). A healthy learning climate helps in the identification and reduction of such conflicts so that learning can be maximized.

In order to establish a conducive learning environment, a teacher must walk an educational tightrope constructed from the varying learning styles of a diverse student body. While ensuring that the teacher's style targets the way in which the majority of students learn, he or she must make sure that it is not at the expense of another ethnic group. Some classroom practices favor one ethnic group at the expense of another (Vasquez, 1990, p. 300).

A teacher who only utilizes the knowledge of how one group of students learns and adapts instruction accordingly may be doing a disservice to students learning in a

dissimilar fashion. An educator employing a variety of teaching strategies navigates the educational tightrope to meet the needs of diverse groups of students more effectively.

Unfortunately, when a teacher creates a conducive learning environment, educational opportunities are still missed because of the pressure that is created by state mandated testing. In the curriculum alignment process, goals drive the system. Standardized tests dictate what should be learned and how it should be taught (Costa & Kallick, 1992, p. 275, 276).

Because the influences of a teacher are so far reaching, teachers must be aware of the magnitude of their impact. With the strides being made in current educational research, teachers must stay abreast of the literature. Four important components of a teachers influence include the adaptation of teaching and learning styles, the awareness of students' cultural heritage, the dangers of cultural assumptions, and the creation of conducive learning climates.

Lack of High Expectations

The triangulation of expectations between teachers, parents, and the community plays a significant role in the outcome of the educational process. A review of current literature indicates a prevalence of low expectations. This lack of high expectations on the part of teachers, parents, and the community result in inadequate student effort culminating in poor test scores.

The expectations of teachers are magnified in that tasks undertaken by students are quantified, whereas parents and community members tend to give feedback in ways that are not easily measured. Teachers need to be aware of the impact of their expectations. Whether conscious or not, teachers behave differently toward students

based on beliefs and assumptions they have about them (Lumsden, 1997, p. 1). Whether based on individual traits or group traits, lowered teacher expectations resulting from generalizations are detrimental to the learning process.

Expectations of the teacher play a large role in the performance of the student (Lumsden, 1997, p. 1). Teachers maintaining high levels of expectations for their students tend to cultivate high expectations in students, while teachers with low expectations tend to cultivate complacent attitudes with regard to success.

Teachers need to have a thorough understanding of the various cultures that comprise their classrooms. Kids can be underestimated when educators are not familiar with their cultural socialization patterns (Nelson-Barber & Estrin, 1995, p. 177). By becoming familiar with students' cultures and socialization patterns, teachers can tailor their expectations on an individual level, while at the same time maintaining high overall classroom prospects for success.

The expectations that parents hold for their children play just as important a role as teacher expectations. By personally demonstrating high levels of effort and expectations, parents set the stage for their child's academic success (Reglin and Adams, 1990, p. 143-149). On the contrary, parents who do not model adequate amounts of effort and do not convey the importance of achievement tend to have children with similar attitudes. Lack of parental expectations and support for African American students have resulted in them lagging behind European Americans on standardized tests. This gap grows larger as students get older (Kim & Hocevar, 1998, p. 175).

The third influence on how a child perceives and ultimately takes responsibility for his or her effort and achievement, as they relate to expectations, is the community to

which the student belongs. The members of a community can include, but not be restricted to, friends, family, neighbors, parents of friends, and the individuals, both adults and children, who comprise the school's population. The impact of community members can have both positive and negative influences. The Westernized culture has a tendency to lower academic expectations, insulate kids from failure, and overstate one's abilities (Eaton & Dembo, 1997, p. 433-434). "The higher achievement of Asian and Asian American students may occur in part because they believe all performance is linked to an internal and controllable source – effort" (Eaton & Dembo, 1997, p. 434).

Expectations, although often times overlooked, play an important role in the academic development of children. Research has indicated that expectations can not come solely from the child's educational environment. Rather, they must come from a number of sources, namely parents and community members, as well as teachers. If all three work in conjunction to raise expectations, student achievement has been shown to increase at a higher rate. As it currently stands, our lack of high expectations negatively impacts student achievement. As far as the level of expectations is concerned, one should heed Aisa Hilliard's cautionary warning of, "Our current ceiling for students is really much closer to where the floor ought to be" (Hilliard, as quoted in Lumsden, 1997, p. 1).

Cultural Incongruence

Cultural incongruity, or the lack of a culturally responsive curriculum, exists when conflicts arise between curriculum and student ethnicity. For instance, schools assume that Mexican American and American Indian cultures are anti-scientific (while believing Western culture is propitious to scientific development) (Marinez & Ortiz de Montellano, 1988, p. 1). Consequently, when students from various ethnic backgrounds

fail to see their culture represented in academic endeavors, feelings of inferiority or low self worth prevail. In the traditional classroom setting, students are rarely exposed to the contributions of members from the ethnic groups that embody the classroom population.

Most of the material available on the development of science and the science curriculum reflect this ethnocentric orientation (Marinez & Ortiz de Montellano, 1988, p. 1). Current texts, if schools have the resources to purchase them, now include a focus on the accomplishments and contributions of people from diverse ethnic groups. However, even if new materials are acquired by schools, it is the responsibility of the teacher to incorporate the materials into the curriculum, which most times is already inundated with content. Opportunities to build upon students' past experiences are often missed due to issues of time and the overabundance of curriculum that needs to be presented (Nelson-Barber & Estrin, 1995, p. 174).

Similar to the lack of cultural representation in the science curriculum, there have not been many links to students' culture in the mathematics classroom either. Many groups are underrepresented in math so students may see math as a subject with very little meaning or value in current or future lives (Strutchens, 1995, p. 1). This, however, is not a problem that is restricted to science and math; reading, fine arts, and technology classes share this dilemma.

There are many reasons why cultural incongruities exist in today's educational institutions. For instance, most teachers are recruited from the dominant culture and their behavior is shaped by that culture. Those educators who head classrooms not mirroring their own ethnicity are challenged to become well-versed in the cultural makeup of their students. Breakdowns in communication happen when cultures do not communicate

effectively (Graybill, 1997, p. 313; Zeuli & Floden, 1987, p. 10). A learning environment is hampered when students and teachers are not able to successfully communicate from different cultural perspectives.

Unfortunately, cultural conflict exists, and it is a reality that students must be prepared to face (Curtis, 1998, p. 135). Students will always be interacting with people from different cultural backgrounds. Thus, the classroom provides the perfect training ground for students to learn acceptance of those individuals who are culturally different.

The problem of cultural incongruity is not restricted to the classroom. In fact, cultural incongruity in the classroom has a direct impact on the career choices that students will make regarding their future employment. Existing curriculum does not meet the needs of diverse students who will become a bigger portion of the American job force in the years to come (Ukpokodu, 1996, p. 2).

There are a small number of minority students and few Mexican American and American Indian children taking math and science beyond what is required (Marinez & Ortiz de Montellano, 1988, p. 1; Murphy, 1996, p. 1). As a result, students from certain ethnic groups are under-represented in careers that require high-level math and science skills (Nelson-Barber & Estrin, 1995, p. 174). In fact, there is a potential of a serious shortage of students entering science and math fields-particularly minorities (Clark, 1999, p. 1).

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

Just as the literature chronicled the problems association with the lack of a culturally responsive curriculum, it also addresses a plethora of possible solutions that have been narrowed to three distinct categories. To confront and reverse the disparity of math achievement between Black and White students in the targeted educational setting, teaching styles must be broadened, expectations must be heightened, and cultural incongruity must be diminished.

Broaden Teaching Styles

One way to make the curriculum more accessible to all students is to expand teaching strategies to fit the diverse number of learning styles. Since students learn in a variety of ways, teachers have to expand their instructional styles to connect with as many student learning styles as possible. The responsibility for identifying and adapting instruction rests heavily on the teacher. While teaching and learning are usually accomplished using the Western-European method of instruction, lecture and discussion, many students have yet to tap into unknown learning styles. Hence, when new instructional styles that target these previously unused and untapped learning styles are

exercised, students are exposed to greater learning opportunities than they have ever known.

Learning through myriad ways allows for greater understanding and opportunities for application; when students are instructed through a multitude of means, transfer can easily take place due to the internalization of the knowledge. When adapting to fit the diverse needs of their students, teachers can alter their instructional styles to match the learning styles of their students via the use of Howard Gardner's eight multiple intelligences: bodily/kinesthetic, musical/rhythmic, visual/spatial, logical/mathematical, verbal/linguistic, naturalistic, interpersonal, and intrapersonal.

Bodily/kinesthetic intelligence is categorized as using one's body to gain a better understanding of the world. Students use their bodies to express emotions, play games, and create new products. This intelligence is essentially learning by doing (Gardner, 1983, p. 206).

Musical/rhythmic intelligence involves understanding and expressing one's self through musical and rhythmic movements or dance. Students with strengths in musical/rhythmic intelligence are adept at composing, playing, or conducting music. Furthermore, persons dominant in the musical/rhythmic intelligence also enjoy engaging in rhythmic games and activities (Gardner, 1983, p. 103, 104).

Visual/spatial intelligence involves the unique ability to use visual arts to understand and demonstrate knowledge of a subject. Predominantly utilized in this intelligence are such skills as painting, drawing, and sculpting. Visual/spatial learners are also able to perceive and visualize objects from different perspectives and angles (Gardner, 1983, p. 173).

Logical/mathematical intelligence is predominantly used during instruction in the traditional classroom setting. Most educational tools, including textbooks, standardized tests, and hands-on activities cater to the logical/mathematical intelligence. It involves inductive and deductive reasoning, patterns, symbols, and the ability to see objects individually and as parts of a whole (Gardner, 1983, p. 143, 144).

Verbal/linguistic intelligence, when coupled with the logical/mathematical intelligence, comprises the majority of instruction approaches in the traditional educational system. Someone with verbal/linguistic intelligence possesses a strong command of language, both oral and written. This intelligence encompasses story telling, symbolic thinking, conceptual patterning, reading, and writing (Gardner, 1983, p. 78).

Naturalistic intelligence is related to the realm of understanding, appreciating, and enjoying the natural world. Persons who exhibit strength in the naturalist intelligence are very much at home in nature. Expertise in recognizing and classifying the many species of flora and fauna are demonstrated by persons possessing the naturalistic intelligence (Lazear, 1999, p. 4).

Interpersonal intelligence involves the capacity to work in conjunction with others in group settings. People with strength in interpersonal intelligence have the ability to communicate verbally and non-verbally with other people. A person who relies strongly on interpersonal intelligence is skilled at organizing, leading, communicating, and negotiating (Gardner, 1983, p. 239).

Intrapersonal intelligence "involves the capacity to understand oneself, to have an effective working model of oneself – including one's own desires, fears, and capacities – and to use such information effectively in regulating one's own life" (Gardner, 1999, p.

239). A person with strength in the interpersonal intelligence is perceptive in observing people's moods, temperament, motivations, and intentions. Furthermore, people possessing intrapersonal intelligence are very empathetic (Lazear, 1999, p. 4).

The first thing a teacher can do to facilitate the introduction of different learning styles is to assess students to determine their dominant learning styles. Once the assessment has been completed, teachers can plan learning experiences that incorporate those preferred ways and allow for them to manifest themselves (Brualdi, 1996, p. 3; Swisher, 1991, p. 3; White, Blythe, & Gardner, 1992, p. 129). Ideally, for this manifestation to occur, teachers must expand teaching styles to encompass as many of the eight intelligences as possible in order to maximize learning opportunities and discoveries for students. Literature indicates that teachers must be the impetus behind this process of expanded learning.

One way teachers can expand student learning styles is by providing a learning atmosphere that encourages risk taking during the learning process. During this process, teachers must encourage students with dominant learning strategies other than their own (White, Blythe, & Gardner, 1992, p. 129). By encouraging students to participate in learning activities that utilize learning styles they are accustomed to, students are being given the springboard to stretch to the unfamiliar (Malloy & Malloy, 1998, p. 252).

Thus, the role of the teacher becomes one of identifying the individual learning styles of students and then working to develop students' weaker areas (Brualdi, 1996, p. 3). When faced with large class sizes and a variety of dominant intelligences spread throughout the learning population, lessons that highlight more than one intelligence will lessen this seemingly overwhelming task. By continuing to gradually expose students to

learning in new ways, teachers will become more comfortable expanding their repertoire of teaching practices (Swisher, 1991, p. 3). Moreover, as students receive greater exposure to varied learning styles, not only does the planning and organization on the part of the teacher become easier, the acceptance of different learning styles becomes second nature for students.

When utilizing a multiple intelligences approach during instruction, teachers need to be particularly aware of their own tendencies to revert back to their natural inclination to teach to their own strengths. It is important for teachers to self-reflect and modify their teaching styles to make teaching more rewarding and enhance student learning concurrently (Montgomery, 1998, p. 7). As with the use of multiple intelligences as an instructional strategy, alternative forms of assessment can be used to assist teachers in increasing student motivation and participation.

Traditional means of assessment typically leave no room for alternative solutions. Furthermore, traditional assessments do not take into account the processes involved in learning since they simply focus on the outcomes of the learning activity. To more accurately assess the learning process, teachers should encourage problems with different solutions to show diversity in learning styles (Malloy & Malloy, 1988, p. 254; White, Blythe, & Gardner, 1992, p. 129).

By allowing students to work together and reach consensus during the problem-solving process, many multiple intelligences can be employed in a single activity. One way this can be achieved is through activities such as group projects and cooperative learning. Cooperative learning has been proven to assist students with varied learning styles (Singham, 1998, p. 13). While most teachers thrive on controlling the manner with

which information is disseminated, the use of teaching strategies such as cooperative learning can be a marked departure from the traditional and signal progress toward the broadening of teaching strategies.

As teachers expand their instructional strategies, a normal outgrowth should be an equally extensive awareness of his or her students' cultural backgrounds. Teachers must understand the cultural backgrounds of their students while understanding that ethnic group communication styles are both linguistic systems and expressions of cultural styles (ASCD, 1995, p. 10; Gay, 1981, p. 50). Therefore, unless the whole student, from both a language and cultural perspective, is taken into account, the process of meeting student learning styles will be incomplete. However, not only should teachers research the cultural backgrounds and learning styles of their students, they should also observe their behaviors to ascertain a more thorough understanding of them.

Much can be learned by simply observing students' behaviors throughout the learning process. Cultural knowledge is incomplete without being coupled with the specific behavioral knowledge that student observation provides. Teachers need to observe students' cultural traits then adapt instruction based on those cultural distinctives (Murphy, 1996, p. 2; Vasquez, 1990, p. 302). Teachers ultimately must provide instruction that supports students' varied cultural styles and experiences to maximize learning.

One way to ensure that teachers are sensitive to, and knowledgeable of, students' cultural differences is by way of teacher training and education programs. Colleges and universities should restructure field experiences so that student-teachers can see the strengths of cultures and multicultural education before entering the teaching profession

(Coballes-Vega, 1992, p. 1; Ladson-Billings, 2000, p. 211). By doing so, teachers will be better prepared to face the growing cultural diversity that exists within the classroom.

In order to face the reality of cultural diversity in today's classroom, teachers must come equipped with an understanding of the different cultures, an ability to observe the uniqueness of student cultural behavior, and the wherewithal to broaden their teaching styles to address these differences. A failure to adapt instruction to the changing needs of a diverse student body leads to missed learning opportunities in the classroom. When instruction is compatible with students' culture, learning improves (Tharp, 1989, p. 350).

In addition to acquiring knowledge of the differences that exist within the various cultures comprising their classrooms, teachers must also avoid cultural generalizations and stereotypes that may inadvertently harm the learning process. It is important not to be culture bound in the ways of assessing students' capacities to think or learn (Harvard Education Letter, 1988, p. 2). It is important for both teachers and students to be knowledgeable of each other's cultures so that better self-development and intercultural understanding can occur (Malloy & Malloy, 1998, p. 250). What is true for one student may not necessarily be true for someone of the same ethnicity. It is through a comprehensive understanding of other's cultures that better teacher-student and student-student relationships will evolve.

Once a complete understanding of students' cultures is acquired, one must be cognizant of the fact that restricting the study and celebration of a culture to a monthly timeframe demeans that culture. Curriculum, therefore, must be restructured to include a deeper study and understanding of cultural contributions to society and not simply an

examination of a culture based on food and festivals (Curtis, 1998, p. 137). By digging deeper into the cultures that comprise a classroom, teachers and students will have a greater appreciation for the culture within their classroom and one another.

Not only is the understanding of the cultural makeup of a classroom important, the environment that it is delivered within is also vital to the educational process. There are a number of ways teachers can make classroom environments more conducive to learning. The teacher should enhance the learning environment with five types of stimuli: environmental, emotional, sociological, physical, and psychological (Thomson & Mascazine, 1997, p. 1). Environmental stimuli include light, sound, temperature, and room design. Emotional stimuli consist of structured planning, persistence, motivation, and responsibility. Sociological stimuli refer to pairs, peers, adults, self, group, and varied. Physical stimuli refer to perceptual strengths, mobility, intake, and time of day. Psychological stimuli include global/analytic, impulsive/reflective, and right or left brain dominance.

In conjunction with the five types of stimuli that are essential for a more conducive learning environment, teachers also need to be aware of and address potential conflicts that exist between students. Disharmony, elitism, and malice can create an atmosphere that can interfere with learning even in an environment that contains the five stimuli. Therefore, unless a harmonious relationship between students exists within a favorable learning environment, teachers will not have the ability to capitalize on learning opportunities. Teachers need to minimize, if not resolve, the incompatibility of students (Gay, 1981, p. 44).

Once an optimal environment for learning has been established, teachers must pay close attention to the cues they send out to students. Tone, facial expression, and body language sometimes undermine or overplay the original message being delivered. Teachers should strive to create a warm and inviting environment through an awareness of their non-verbal communication.

After a positive personal rapport has been established and students feel confident and self-assured in the classroom, it is important to ensure that the delivery of instruction continues in the same fashion. Teachers are responsible for students' feelings of safety within the classroom; when students feel comfortable, they can approach the teacher, make suggestions, participate in discussions, and feel empowered to take risks. This comfort level can be accomplished by paying attention to wait time, monitoring the rhythm of instruction, and responding positively to student ideas and queries (Tharp, 1989, p. 351).

By inviting students to play an active role in the decision-making processes, a feeling of ownership is established. Consequently, students perceive a higher degree of equity with the teacher, causing them to observe and respect the decisions they participated in making. It is important to involve and empower students to participate in classroom decisions relating to classroom management and instruction (Ukpokodu, 1996, p. 4).

Heighten Expectations

Once teaching strategies have been broadened, the internal dynamics of the classroom need to be linked to positive external dynamics. In most models, the natural progression tends to advance toward increasing teacher, parent, and community

expectations. Expectations give students goals that not only drive their learning, but give them the motivation to achieve. Once goals and positive outcomes have been obtained as a result of externally set expectations, a desired domino effect can occur. If enough positive outcomes are garnered as a result of externally set expectations, students can increase their potential to internalize higher expectations for themselves.

Establishing high expectations begins with the teacher. As a role model, a teacher must convey his or her own personal expectations so students can see how expectations drive achievement. Furthermore, the expectations the teacher has for his or her students play a crucial role in student achievement. The expectations students have for themselves are altered with the expectations, either negative or positive, that teachers have for them. Therefore, teachers should set expectations high since students rise or fall to a teacher's level of expectation (Clark, 1999, p. 3; Lumsden, 1997, p. 4; Strutchens, 1995, p. 3).

Just as cultural assumptions and generalizations are damaging to instruction, expectations based on bias are equally damaging to student achievement. It is imperative for teachers to establish a uniform set of expectations, regardless of sex, race, and socioeconomic status (Lumsden, 1997, p. 2). Tracking students according to preconceived and unfounded notions is detrimental because it sends an unspoken message to students that teachers have different levels of expectations for different students. Ultimately, everyone deserves the same opportunity. Lowered expectations lead to lowered achievement and decreased sense of self worth. Teachers are cautioned against ability grouping in that it has the potential to create a self-fulfilling prophecy of failure (Clark, 1999, p. 3; Lumsden, 1997, p. 2).

Not only should expectations be set equally high, they should also be expanded to offer a wider variety of opportunities for success (White, Blythe, & Gardner, 1992, p. 127). Teachers are the catalysts for motivating students to individualize and expand their own goals. As group goals are set, teachers need to lead individual students to further develop these baseline goals and personalize them to help students reach their potential. This course of action leads students to the realization that teachers believe all students can learn and, consequently, adapt instruction accordingly (Strutchens, 1995, p.3).

While student expectations are strongly influenced by teachers, parents should view their influence as an equally important component. The impact of parental expectations in relation to student achievement is frequently understated. We must educate parents regarding the impact of their influence on student expectations. Student expectations can be influenced by the degree with which parents support the school (Clark, 1999, p. 4; Kim & Hocevar, 1998, p. 176). If parents invest their time and show support for various student programs, students are sent an unspoken message of the importance of education.

It is not the sole responsibility of the teacher to impart the importance of education to students. Parents can communicate the importance of education to their children in a variety of ways (Kim & Hocevar, 1998, p. 176). By playing an active role within the school via attending parent-teacher conferences, volunteering time, and supporting fundraisers, parents proactively communicate their belief in the importance of, and support for, the school. Parents can also communicate the importance of education by example. By sharing their own educational experiences, relating how higher education has had a positive impact on their lives, and demonstrating how the problem-

solving skills that they acquired in education enable them to succeed in everyday life, parents also communicate their support for education (Murphy, 1996, p. 2).

Additionally, community influences also impact expectations for achievement. When working in partnership with teachers and parents, community members can play an important role due to frequent daily interactions with students. While teachers and parents tend to focus on academic expectations, community members can influence social expectations in a positive manner. Community members, such as store owners, coaches, park district personnel, and neighbors have the capacity to become positive role models for social interaction. By bringing together the three different positive influences, parents, teachers, and community members, their efforts should culminate in a well-rounded individual.

The influence of community members is demonstrated to varying degrees within many cultures. For instance, the Asian-American culture is greatly involved in setting expectations and promoting levels of acceptable behavior. Unique to their culture are many characteristics that other cultures once possessed, but have slowly devalued due in part to the pressure to assimilate into a technologically-advanced world that promotes individuality and quantity over quality. Asian-Americans promote a fear of failure, downplay the significance of one's individual ability, and instill a sense of family pride. Asian-Americans tend to out-perform non-Asians on standardized tests (Eaton & Dembo, 1997, p. 434). Community expectations can have some bearing on student achievement.

Working in conjunction with one another, the three different facets influencing students' expectations, achievement, and lives can not be understated. No one group can work on its own to achieve the desired results that have been put in place for children of

this generation. A thriving and successful relationship between parents, teachers, and community members can increase the potential for heightened student achievement (Sanchez & Others, 1995, p. 3).

Inclusive Curriculum and Career Opportunities

Once teaching styles have been broadened to be culturally responsive and the expectations of teachers, parents, and community members have been clearly demarcated to set the foundation for student achievement, teachers must adopt a more inclusive curriculum so that student achievement can reach its potential. Culturally responsive curriculum focuses on the strengths of the many diverse cultures that encapsulate each classroom. Exposing students to the contributions of individuals from various cultures can be the impetus from which students can pursue career opportunities.

While other subject areas lend themselves to the study of contributions made by individuals from various ethnic groups, the study of mathematics tends to focus more on the concepts and computational aspect, while focusing less on individual contributions. By identifying diverse cultural contributions to the field of mathematics and including the history of mathematical concepts as it relates to the various cultures, students will be provided with real-life cultural examples from which they can increase cultural pride (Strutchens, 1995, p. 2). By studying the accomplishments of various cultures as they relate to mathematics, positive attitudes toward different cultural groups are fostered (Strutchens, 1995, p. 1).

When a culturally responsive curriculum has been adopted, and cultural differences are viewed in a positive manner, the interactions and relationships between teachers and students are strengthened. This cathartic experience leads both parties to a

greater mutual respect for one another's cultures, thereby instilling a sense of partnership, or a situation in which both parties share an ownership stake in the learning process (Strutchens, 1995, p. 1).

The opportunity for learning, unfortunately, is not equitable for all students. Ability tracking, as some schools practice, denies students accessibility to learning experiences deemed outside their ability level. Making higher-level mathematics available to all students requires the examination of the school's social structure and grouping practices. One must also examine school climate, assessment practices, extracurricular activities, staff expectations and school-wide responses to diversity in order to eliminate the educational caste system (Strutchens, 1995, p. 4).

Once opportunities in mathematics instruction are opened up to those students who desire such opportunities, students should be exposed to a variety of problem-solving applications. Students should be encouraged to explore math concepts and solve problems related to their everyday experiences (Nelson-Barber & Estrin, 1995, p. 175; Zeuli & Floden, 1987, p. 9). By making the link in mathematics transferable, students can apply the acquired concepts and related computations to many other situations.

The demonstration of this acquired knowledge can be showcased in many formats. Unfortunately, traditional forms of assessment can be viewed as unfair or inflexible for students who need to express their knowledge using alternative means. Portfolios and performance assessments can be utilized to provide students with options that have the potential to bring meaning to their learning experiences (Nelson-Barber & Estrin, 1995, p. 177).

As previously stated, the study of math at all levels has been notoriously devoid of the contributions of individuals from many different cultures. These omissions, whether conscious or unconscious, can greatly impact the career paths that many students chart for themselves. Research suggests that teachers should work to develop a heightened sense of math and science interest in minority students to provide them with career options (Marinez & Ortiz de Montellano, 1988, p. 1). Teaching about minorities' cultural contributions enables students of those cultures to experience pride and take an interest in previously inconceivable career opportunities (Marinez & Ortiz de Montellano, 1988, p. 4).

Project Objectives and Processes

As a result of multiple intelligences in mathematics instruction during the period of January 2001 to May 2001, the targeted mathematics students will be able to recognize and internalize one or more of the intelligences, as measured by teacher-constructed surveys and a focus group with interviews.

As a result of the introduction of new teaching styles in mathematics during the period of January 2001 to May 2001, the targeted mathematics students will be able to exploit their new learning styles, as measured by teacher-constructed surveys, interviews, and focus groups.

As a result of the introduction of new teaching styles, the use of multiple intelligences, and heightened teacher expectations during the period of January 2001 to May 2001, the targeted math students will increase mathematics achievement at a more rapid pace, as measured by the Iowa Test of Basic Skills and teacher observation.

As a result of increased emphasis on culturally-inclusive curriculum during the period of January 2001 to May 2001, the minority mathematics students within the targeted mathematics class will narrow the gap between themselves and Caucasian students, as measured by the Iowa Test of Basic Skills and teacher observation.

In order to accomplish the project objective, the following processes are necessary:

1. Teacher-developed surveys and professionally-developed tests will be administered to assess each student's preferred learning style(s).

2. Teaching strategies and teaching styles that foster greater student awareness of dominant and deficient personal learning styles will be constructed.
3. Contributions of mathematicians mirroring the cultural makeup of the students will be included in the curriculum to foster cultural pride and heighten the interest of the students.
4. Teachers will not only heighten expectations, but will maintain the same level of expectation regardless of race.

Project Action Plan

January 22 - 26 (Week 1): The teachers will assess the students in the two target groups in terms of their preferred learning styles via a multiple intelligences Test. The teachers will objectively assess their current teaching style for instructing the target groups as well. Teachers will also gain feedback from a three-question, open-ended student survey to determine the learning activities students enjoy most. Teachers will re-evaluate their expectation levels on both a classroom basis and an individual basis. Expectations will be clearly communicated to the students and will not be altered due to the students' ethnicity. [Both teachers will distribute the Multiple intelligences tests during the week in mathematics class. The results will be scored after school during the teachers' free time]

January 29 – February 2 (Week 2): The two teachers of the targeted math classes will develop long-range lesson plans to be implemented during the scheduled intervention time period (January through May, 2001) targeting the learning styles prevalent in the targeted classroom. [Both teachers will work on the lesson planning process during their own free time after school]

February 5 - May 18 (Week 3 – Week 16): The contributions of mathematicians with the same cultural background of the students will be highlighted and integrated throughout the curriculum in the two targeted math classes. The teachers will write and begin implementing specific lesson plans designed to instruct using a variety of Multiple intelligences previously not employed in their classrooms. Lessons will be constructed to target more than one intelligence per class period and will intentionally veer away from the traditionally over-utilized multiple intelligences of verbal/linguistic and logical/mathematical. The teachers will target the following intelligences as per the following weekly schedule:

- Week 3: Musical/Rhythmic and Bodily/Kinesthetic
- Week 4: Musical/Rhythmic and Bodily/Kinesthetic
- Week 5: Visual/Spatial and Logical/Mathematical
- Week 6: Visual/Spatial and Logical/Mathematical
- Week 7: Naturalistic and Intrapersonal
- Week 8: Naturalistic and Intrapersonal
- Week 9: Verbal/Linguistic and Interpersonal
- Week 10: Verbal/Linguistic and Interpersonal
- Week 11: Musical/Rhythmic, Logical/Mathematical, and Verbal/Linguistic
- Week 12: Musical/Rhythmic, Logical/Mathematical, and Verbal/Linguistic
- Week 13: Bodily/Kinesthetic, Visual/Spatial, and Intrapersonal
- Week 14: Bodily/Kinesthetic, Visual/Spatial, and Intrapersonal
- Week 15: Naturalistic, Interpersonal, and Bodily/Kinesthetic
- Week 16: Naturalistic, Interpersonal, and Bodily/Kinesthetic

Methods of Assessment

May 7-May 18 (Weeks 17 and 18): In order to assess the effects of the intervention, teachers will review anecdotal records or classroom observations and examine student performance based on in-class averages. In addition, teachers will randomly form two focus groups to interview and provide feedback on the previous weeks' learning experiences. Two groups will be formed to allow for ample opportunity for student dialogue and allow for reliable reporting. Teachers will also examine the results of the mathematics subtests of the Iowa Test of Basic Skills to determine if the gap between African American and Caucasian students has been decreased as a result of the use of the interventions. Anecdotal logs of individual student achievement will be kept. Once the data from all of the tools has been triangulated, conclusions will be drawn.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objective of this project was to introduce a more culturally responsive mathematics curriculum via the use of multiple intelligences in order to bridge the gap of mathematical achievement between White and Black Students, as evidenced on the mathematics subtest of the Iowa Test of Basic Skills (ITBS). Over the course of the 14-week intervention period, lessons containing the eight multiple intelligences were gradually integrated into the mathematics curriculum. The first eight weeks of the intervention were divided into four two-week periods. During each two-week period, two multiple intelligences were targeted. During the final six weeks of the intervention, three multiple intelligences were targeted during each of the three two-week periods. Prior to the start of each lesson, students were informed of what specific intelligence would be integrated into the lesson that day.

The teacher-researchers collaboratively wrote lesson plans that incorporated the multiple intelligences that were targeted during specific weeks. They also devised lessons that would incorporate similar types of activities, despite the different levels being taught, so as to be consistent with each group of student test-subjects. Lesson plan samples utilizing the eight multiple intelligences can be found in Appendix C.

When cooperatively developing the lesson plans, the teacher-researchers strategically paired intelligences. To aid in helping students feel at ease at the onset of the intervention, the teacher-researchers began with two intelligences that were perceived to contain the greatest appeal for students, the bodily/kinesthetic and musical/rhythmic intelligences. By utilizing these two intelligences at the inception of the intervention, the teacher-researchers felt as though the students' interests would be adequately captured and the tone of the intervention would be set at a very high level. Following this initial motivational period, a different procedure was followed. During the remaining weeks of the intervention, the lessons were strategically prepared pairing intelligences that were assessed to be strengths of the majority of students with intelligences that were assessed to be in need of greater development, according to the results of the multiple intelligences survey (see Appendix A).

Even though students' interests were captured, and many interesting lesson plans were developed, many scheduling problems were encountered throughout the course of the intervention. During the first part of the intervention, many state and federal holidays reduced school weeks from five days to four. Additionally, many school-wide activities, such as assemblies and field trips, interrupted the regularly scheduled mathematics program. During the final weeks of the intervention, eighth grade math instruction was hampered by graduation practice, the annual eighth grade trip, and a charitable walk-a-thon. While not a direct impact on instruction, successive interim principals, followed by the permanent placement of a new principal, as well as the hiring of a new eighth grade teacher and assistant principal, contributed to a less than ideal implementation of the planned intervention.

Of the 70 potential mathematics lessons intended to integrate the multiple intelligences, one teacher-researcher encountered 16 missed classes, while the other teacher-researcher experienced 11 missed classes due to the aforementioned scheduling problems, as well as other isolated interruptions. Additionally, the intervention was interrupted with one week of ISAT testing, one week of spring break, and one week of ITBS testing. Instructional inconsistency such as this was frustrating to the teacher-researchers who found themselves quite often backtracking to reacquaint students with both a fundamental understanding of mathematical concepts and the working knowledge of the multiple intelligences.

While the multiple intelligences may have been new to mathematics instruction, students in the targeted group had been exposed to the use of multiple intelligences, without being identified as such, in the Synergistic Technology Lab. The technology lab, which consists of fourteen modules, provides the students with many hands-on, cooperative, yet independent learning experiences. Within these learning experiences, students utilize the bodily/kinesthetic intelligence when they design, cut, paint, and race a dragster at the research and design module, conduct light and heat experiments at the applied physics module, and design, build, and test a tower constructed from balsa wood at the engineering towers module. Similarly, the remaining seven intelligences are utilized in the same, if not greater extent, throughout the technology lab.

During the sixth, seventh, and eighth grades, students are given the opportunity to complete all fourteen modules. This in-depth immersion into various science and mathematical concepts is completed in an environment that encourages learners to construct their own knowledge with little assistance from the teacher. While the students

complete each module actively engaged in activities using the various intelligences, labels are not assigned, so the students are unaware of the theory of multiple intelligences. It was only when given instruction via the intervention plan for mathematics that the students were able to understand and apply labels to the multiple intelligences.

Presentation and Analysis of Results

Despite teacher frustration and curricular interruptions, the teacher-researchers feel that students profited from the exposure to the multiple intelligences and corresponding lessons during the 14-week intervention. The results of the intervention can be interpreted both quantitatively, as evidenced on the ITBS, and qualitatively. The teacher-researchers detected an immediate improvement in the disposition of their students, an increased enthusiasm, and a heightened level of student motivation, as evidenced in each teacher-researcher's anecdotal records.

Typically, seventh and eighth graders do not enter the mathematics classroom appearing overjoyed to be in class, which has been the experience of the teacher-researchers. However, after being introduced to the multiple intelligences and participating in the first few lessons, students began coming to class with an observable tendency to inquire about what would be covered during the day's lesson. "What are we going to do next?" became the typical question of many students. This improvement in disposition was not only experienced by students, but by the teacher-researchers as well. Straying from the typical methods of teaching, the teacher-researchers felt invigorated and rejuvenated by the challenge of integrating the multiple intelligences into the curriculum.

The introduction of lessons that deviated from the ordinary spurred an increase in enthusiasm. Anecdotal records indicate that an increase in student enthusiasm was observable via an increase in classroom participation. While not statistically linked to one another, the increased level of enthusiasm, the teacher-researchers feel, led to an increase in the level of student motivation. From fewer missed homework assignments to greater pre-class preparation, an increase in student motivation was clearly evident and recorded in anecdotal records.

As the ITBS results were the foundation for determining whether the multiple intelligences-based intervention would narrow the achievement gap between White and African American students, it is unfortunate that the entire intervention could not be concluded before the ITBS was given. Of the 14 weeks for the planned intervention, the ITBS were given after only 10 weeks of the intervention. Thus, the impact of the intervention will not fully be realized by solely looking at the results.

When the pre-intervention data was gathered, the ITBS overall mathematics scores of the classes of 2000, 2001, and 2002 were the focus. At that time, the teacher-researchers tracked student scores over a three-year span. In order to determine whether a gap did exist between the two different racial populations, the teacher-researchers' baseline, or qualifying data, was taken from ITBS overall mathematics results for all students in the targeted grades. When a sufficient amount of incongruity was found to exist between African American and White test scores, an intervention targeting the multiple intelligences was devised, created, carried out, and assessed. It should be noted, however, that the number of students who participated in the intervention differs from the number of test scores that were used to assemble the initial qualifying baseline data.

While the baseline data were used (refer to Figures 2, 3, & 4) only to identify the existence of a notable problem within the targeted grade levels, only a portion of the student population, or 37 students within the targeted grade levels, was able to participate in the intervention because of class enrollments that were determined at the beginning of the academic year. Only the ITBS test scores of the students who participated in the intervention from the classes of 2001 and 2002 will be the source of examination and discussion from this point forward.

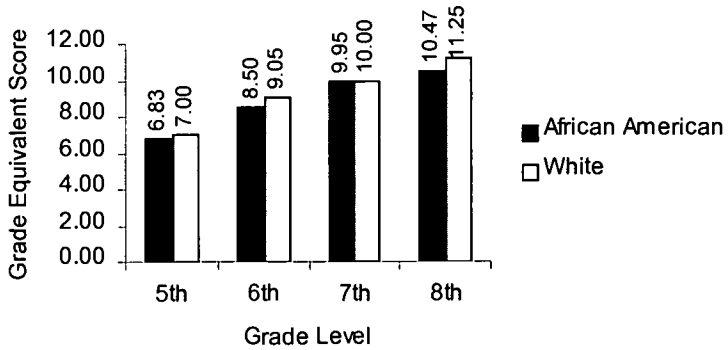

Figure 17. Comparison of targeted eighth grade mathematics students who participated in the multiple intelligences intervention for grades 5-8.

By solely examining the above graph, one could conclude that the intervention was unsuccessful since the disparity between Black and White achievement actually increased. However, one cannot focus on standardized testing data alone. From a qualitative perspective, the teacher-researchers observed noticeable improvement in student attitudes toward math. It is possible that students need to be exposed to the multiple intelligences for a longer period of time, during which far fewer curricular interruptions occur.

As demonstrated in Figure 17, the gap between White students and African American students was .17 in fifth grade, .15 in sixth grade, .05 in seventh grade, and .78 in eighth grade, with one-tenth being the equivalent of one month of achievement. When removing the targeted class of 2001 students who participated in the intervention from the class of 2001 population, fluctuation in ITBS results is also observable. When looking critically at the results, several factors present themselves.

The teacher-researchers conclude that the greatest single factor for the fluctuation of ITBS overall mathematics results is the lack of a consistent math program at the targeted school. Prior to the 1996-1997 school year, a successful departmentalized math program was in existence with one teacher taking responsibility for sixth, seventh, and eighth grade students. Since that time, there have been frequent changes in mathematics teaching assignments from year to year.

Additionally, changes in the teaching staff may possibly contribute to inconsistency in math test scores, as well as other ITBS sub-tests. With a consistently changing faculty, student comfort levels are affected; new teachers bring new rules, expectations, and policies. This, coupled with the change of eighth grade teacher, principal, and assistant principal may have contributed to an overall sense of instability within the culture of the school.

Furthermore, the student population at the targeted school has seen a significant increase in the enrollment of African American students in the last 10 years. With this demographic change, should come other changes. With the transposition of the majority and minority student populations occurring within such a short period of time, adaptations in teaching practices should be taking place. One could argue that even

though some teachers are attempting to change their teaching styles and teach to the changing student population, other teachers might not be employing successful strategies. It is possible that the lack of a school-wide mathematics program has only exacerbated the achievement gap between African American and White students.

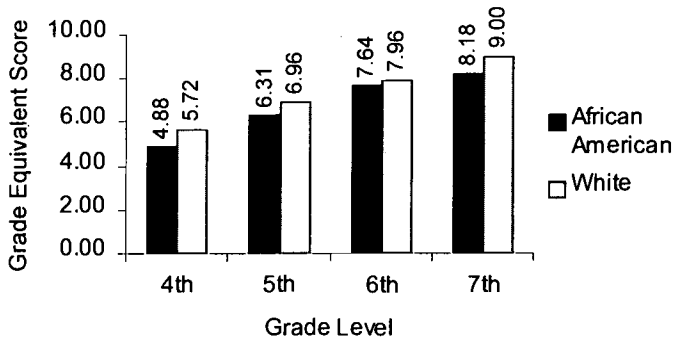

Figure 18. Comparison of targeted seventh grade mathematics students who participated in the multiple intelligences intervention for grades 4-7.

Similarly, the same type of disparity exists for all of the aforementioned reasons within the targeted seventh grade class. As demonstrated in Figure 18, the gap between White and African American students in mathematics achievement on the ITBS was .84 in fourth grade, .65 in fifth grade, .32 in sixth grade, and .82 in seventh grade. However, the results from the mathematics sub-test do not accurately portray all that took place during the intervention.

To determine the impact and gain a better understanding of the influence of the multiple intelligences instruction on the student test-subjects, the teacher-researchers conducted two focus groups. Although the focus group sessions were videotaped, the students appeared at ease and were forthcoming with honest, constructive feedback

pertaining to the multiple intelligences introduced during the intervention period. A transcript of the questions and responses to the two sessions can be found in Appendix D.

As evidenced by the results of both focus groups, the multiple intelligences approach was successful from the students' perspectives. Not only did students remember and discuss in detail certain activities that they enjoyed, they also highlighted the specific intelligences that were utilized. Throughout the five focus group questions, the students identified and discussed the various intelligences with the following frequencies: bodily/kinesthetic-11 times, verbal/linguistic, interpersonal, and visual/spatial-nine times, musical/rhythmic-seven times, intrapersonal and logical/mathematical-two times, and naturalistic-one time.

Clearly the students appreciate intelligences that are not usually highlighted in teaching strategies in the mathematics classroom. The two intelligences generally utilized within the traditional classroom are the verbal/linguistic and logical/mathematical intelligences. However, according to students participating in the focus groups, 11 of the 50 responses favored the bodily/kinesthetic intelligence, an intelligence once considered to only exist in physical education classes. Visual/spatial, an intelligence normally developed and associated in art class, gleaned the second highest number of responses with nine, as did interpersonal, an intelligence reserved for recess and lunch periods as believed by some past generations of teachers. Intrapersonal intelligence received only two responses, thus demonstrating that student reflection needs to be incorporated into the mathematics curriculum. The naturalistic intelligence, as demonstrated by the lone response it received, clearly needs further development. Ironically, the intelligence that

is most often referred to, or generalized, as the intelligence most often used by teachers in the mathematics classroom, logical/mathematical, received only two favorable responses.

When students were asked to quantify their satisfaction or dissatisfaction with the intervention, feedback was very favorable toward the intervention with all student responses being seven or higher on a scale of 1 to 10, with 10 being the highest. Additionally, students felt as though they learned more while being taught with the multiple intelligences. While voicing their enjoyment in using the multiple intelligences in math, students also suggested that the multiple intelligences should be used in other subjects.

Conclusions and Recommendations

While not generating data that proffers observable and measurable trends from the Iowa Test of Basic Skills to support the use of multiple intelligences in mathematics, qualitative data from the intervention consisting of student responses and reactions, anecdotal records, and focus group results overwhelmingly indicate a need to depart from the typical means by which mathematics is taught. Continuity with regard to teacher assignments should be sustained within the mathematics program. A consistent teaching methodology should also be established so that students are instructed within the parameters of an established mathematics program from grade level to grade level. Additionally, if the multiple intelligences are used to teach math, it is the teacher-researchers recommendation that they also be integrated into the other curricular areas.

Quite often, data does not immediately provide evidence to substantiate a particular change in educational methodology. Due to this, one must go beyond the data and gather information and data from other sources that demonstrate a resoluteness of

purpose. Simply because the quantitative data that has been gathered does not provide evidence of progress after an intervention period marked by curricular interruptions, the teacher-researchers do not feel as though positive, significant accomplishments are lacking. If the educational program is believed to be taking students in the right direction, the program should be continued for an extended period, until sufficient time has been allotted for the conveyance of more conclusive results. It is the teacher-researchers' determination that sufficient time has not been given to the multiple intelligences in math at the targeted school.

For a better depiction of just how the multiple intelligences can benefit students in mathematics, at least one academic year should be devoted to its use. As previously mentioned in this section, the original intervention period was hurried at times and occurred during a period of great flux within the targeted school. Like most educational methods, the multiple intelligences approach to mathematics might be carried out in a more settled environment, with more time for student preparation and understanding of the program. Because of the time constraints and frequent curricular interruptions that occurred during the intervention, the teacher-researchers think that a longer introductory period and instructional phase would benefit students to a greater degree. This sole change, however, is not the universal remedy to bridge the ever-increasing gap between White and African American students at the targeted school. More could be done, including the stabilization of mathematics teaching assignments.

Teacher continuity within the mathematics teaching ranks ought to be sustained from year to year to produce consistent test scores and bridge any achievement gaps among diverse student populations. Under the current arrangement, mathematics

teaching assignments vary from year to year. One of the teacher-researchers has been assigned to two different levels during the last four years, while the other has received three different assignments during the same period of time. By stabilizing teaching assignments, teachers could possibly achieve a greater level of comfort and integrate grade-specific lessons and activities, while mastering the difficulty of teaching and covering all mandatory state goals. The current scenario of unsettled assignments necessitates that teachers hastily familiarize themselves with the newly-assigned curriculum and related materials, while never having the time to personalize their means of mathematics instruction. Once assignments are stabilized, a philosophy of teaching can be established so that students at each grade level will encounter a consistent method of instruction.

While the teacher-researchers consider the consistency with which teachers receive math class assignments, a necessary, if not crucial, aspect of mathematics instruction, the teacher-researchers also similarly advocate the adoption of a consistent method of teaching from grade level to grade level. By establishing a methodology that does not vary from grade level to grade level, students will have one less worry while entering a new grade. The approach that will be used in class often takes more time to become accustomed to than the actual material being presented. By removing this variable, students will already be familiar with the framework in which they will be instructed, consequently allowing them to concentrate more on the material and less on the presentation. This is not to say that all math teachers at the targeted school will employ identical teaching styles; rather, they will operate within the same framework, the

multiple intelligences, and use their creativity to sculpt interesting lessons that fit within their personal teaching style.

The multiple intelligences method of instruction can prove beneficial for both students and teachers. With eight different intelligences, teachers enjoy a variety of presentation, while students, unquestionably, receive instruction that zeroes in on their ideal style of learning. Instead of relying on one intelligence, for instance, the logical/mathematical intelligence in math, teaching with the multiple intelligences causes educators to think "outside the box" when planning math lessons, in turn maximizing instructional creativity.

It is the teacher-researchers' recommendation that the practice of teaching with the multiple intelligences be integrated into the other core areas. During the two focus groups that were conducted at the conclusion of the intervention, all of the participating students strongly suggested the integration of the multiple intelligences in all other curricular areas. Their reasoning, in effect, is that we all learn differently, so why not diversify teaching styles to meet the variety of needs found within learning preferences. The multiple intelligences lends itself very well to other curricular areas. In fact, during planning sessions for math lessons, the teacher-researchers often found themselves discussing and generating ideas that would utilize the multiple intelligences in the other classes they teach. While integrating the multiple intelligences into other curricular areas is important, the way in which it is done must be handled with great care.

The teacher-researchers recommend that when the multiple intelligences are integrated into other curricular areas, teachers responsible for those subjects should practice an important precept that the teacher-researchers followed while devising their

program. Before teaching with the multiple intelligences, great care should be given to the pairing of the intelligences that will be used in lessons, if more than one of the intelligences will be utilized. Pairing intelligences that aren't compatible could adversely affect the impact of a lesson.

Utilizing the multiple intelligences theory when designing and implementing lessons plans is a worthwhile endeavor. It has been the teacher-researchers' experience that not only were they invigorated and more enthusiastic in their approach, but the students thoroughly enjoyed the experience as well. The adoption of a multiple intelligences-based program is best summarized by the words of one of the students who participated in the focus group, "I would recommend it [the multiple intelligences approach] because it's more fun. Everyone talks about how school is not fun because all they do is sit in their seats for five and one-half hours. If we got up and moved around and talked with our classmates, I think they would think it's more fun and they would actually look forward to coming to school."

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APPENDICES

Appendix A
Survey of Multiple Intelligences

Where Does Your True Intelligence Lie?

This quiz will help you identify your areas of strongest intelligence. Read each statement. If it expresses some characteristics of you and sounds true for the most part, jot down a "T." If it doesn't, mark an "F." If the statement is sometimes true or sometimes false, leave it blank. There are no right or wrong answers. Please answer honestly.

1. ____ I'd rather draw a map than give someone verbal directions.
2. ____ If I am angry or happy, I usually know exactly why.
3. ____ I can play (or used to play) a musical instrument.
4. ____ I can associate music with my moods.
5. ____ I can add or multiply quickly in my head.
6. ____ I can help a friend sort our strong feelings because I successfully dealt with similar feelings myself.
7. ____ I like to work with calculators and computers.
8. ____ I pick up new dance steps fast.
9. ____ It's easy for me to say what I think in an argument or debate.
10. ____ I enjoy a good lecture, speech, or sermon.
11. ____ I always know north form south no matter where I am.
12. ____ I like to gather together groups of people for parties or social events.
13. ____ Life seems empty without music.
14. ____ I always understand the drawings that come with new gadgets or appliances.
15. ____ I like to work puzzles and play games.
16. ____ Learning to ride a bike (or skates) was easy.
17. ____ I am irritated when I hear an argument or statement that sounds illogical.
18. ____ I can convince other people to follow my plans.
19. ____ My sense of balance and coordination is good.
20. ____ I often see patterns and relationships between numbers faster and easier than others.
21. ____ I enjoy building models (or sculpting).
22. ____ I'm good at finding the fine points of word meanings.
23. ____ I can look at an object one way and see it turned sideways or backward just as easily.
24. ____ I often connect a piece of music with some event in my life.
25. ____ I like to work with numbers and figures.
26. ____ I like to sit quietly and reflect on my inner feelings.
27. ____ Just looking at shapes of buildings and structures is pleasurable to me.
28. ____ I like to hum, whistle, and sing in the shower when I'm alone.
29. ____ I'm good at athletics.
30. ____ I enjoy writing detailed letters to friends.
31. ____ I'm usually aware of the expression on my face.
32. ____ I'm sensitive to the expressions on other people's faces.
33. ____ I stay "in touch" with my moods. I have no trouble identifying them.
34. ____ I am sensitive to the moods of others.
35. ____ I have a good sense of what others think of me.

Appendix B
Student Survey of Classroom/Learning Experiences

Think about the learning experiences you've had thus far this school year.

1. Without naming any teachers or students, list any activities or classroom experiences from which you feel you've learned the most academically.

2. Without naming any teachers or students, list any activities or classroom activities from which you feel you learned the least academically.

3. What types of classroom activities do you enjoy most?

Appendix C
Sample Intervention Lesson Plans

Subject	Activities	Highlighted Intelligences
Math (10:30 – 11:20)	➢ Background music playing ➢ Energizer – I like all of my friends…especially… ➢ Journal Check ➢ Present rap to answer the problem of the weekend (from 2-9) ➢ Correct lessons 7-1 through 7-3: The students will physically demonstrate mathematical movements for the slide model for subtraction (lesson 7-2) ➢ Students will review lesson 7-4 (solving x-a=b) and lesson 7-5 (equivalent sentences and formulas).	➢ Musical/Rhythmic ➢ Bodily/Kinesthetic
	➢ Solving Proportions; pp. 274-275 ➢ Basic skills quiz: Addition of fractions ➢ Mental math practice with easier proportions in the quiz of the day, in addition to basic skills timed quiz. ➢ Use of chain of events to demonstrate the proper procedures of how to set up and solve proportions by using cross-multiplication. After putting word problems using proportions on the board, students will break into groups to find the significance of the key terms and how they dictate where the mathematical terms go in the proportion.	➢ Logical/Mathematical ➢ Visual/Spatial
	➢ Making a Mini-Water Filtration Plant ➢ Students will be put into groups of 3 and asked to turn the following materials into a water filtration system using: swamp water, 3-two liter plastic pop bottles, 1-1500 mL beaker, 20 g of alum, 800 mL of fine sand, 800 mL of coarse sand, 400 mL of pebbles, 1-500 mL beaker, 1-coffee filter, 1-rubber band, 1-tablespoon, and 1-clock. ➢ Following the lesson, students will be asked to develop 2-3 pertinent questions for the field trip based on their experiences with this exercise. ➢ Homework: PMI reflection of the day's activity	➢ Naturalistic ➢ Intrapersonal
	➢ "What Number Am I?" game to reinforce mathematical vocabulary (rational, irrational, integer, whole, or natural) ➢ ISAT practice problems ➢ TGT cooperative group activity: Students will compete (in two groups of three) using all problems on pages 16 and 17 of book 7. ➢ The teacher circulates to make sure proper social skills are being utilized.	➢ Verbal/Linguistic ➢ Interpersonal

Appendix D
Transcripts of Two Focus Groups
Conducted May 31, 2001

Focus Group 1

Me Of the multiple intelligences that were used during your math classes in the last 14 weeks, which do you feel helped you the most with math and why?

CS Well, I think bodily/kinesthetics because I just kinda getting tired of sitting in our seats all the time, and then I'm kinda bored. I like when we got to get up and do projects and stuff like that.

SW I agree with Courtney because when we did the one with math properties, it was kind of cool to be able to get up and move around. I kinda understood the properties we were doing a little better. I also liked musical/rhythmic because I like to listen to music.

KT I like visual because I saw how to work out the problem or how to figure it out, and I learned how to do it by…..(pause)

Me It helps to draw a diagram?

KT Yes. Drawing diagrams and pictures helped me on some word problems that we were doing in geometry.

RR I like verbal/linguistic because I like talking and working in groups. If somebody didn't know something then other people can talk and help them.

Me What is that called when you're engaged back and forth with other people?

RR Interpersonal

(interruption of intercom)

Me So, you like verbal/linguistic as well as interpersonal?

BA I like visual because I like to see problems and visualize them before I try to solve them. I like to read, so I like to make a movie in my head and imagine the characters. I think it's a lot like this.

Me Did you discover through the class that one of the intelligences was a strength that you didn't know existed before?

SW Naturalistic. When we were doing naturalistic it wasn't as fun as doing our other work. We found volume and mass of rocks and leaves.

Me So, clearly, the naturalistic intelligence is not a strength for you. In which of the intelligences did you find you had a strength?

SW I think bodily/kinesthetic or musical were the ones that I really liked the most because I think I do my homework better when I have music playing in the background.

BA I think visual is my strength because I like to read, and when I visualize things, I can picture them better than I can actually see them.

Me You like to have a diagram?

BA I think. Or, I'm not really sure what you mean.

Me Does having a diagram or a picture help you understand problems more readily?

BA Yeah! Because when I'm able to see things, I usually get the right answer. I can also see what I don't need to use in the problem.

SW Yeah. When you just read about it or hear people talking about it you don't understand it as well as when you can see it.

KT I would pick musical/rhythmic because I didn't think I was musically inclined. When we got into groups and we had to make up songs, we thought of some pretty good rhymes..it wasn't the best, but we had fun.

Me Now do you think you remember things better through music?

KT Yes, I didn't know I had that strength before.

SW I agree with Kristen. When we did that Problem of the Weekend, I did a rap to tell about the number of heart beats in a day. I had a lot of fun, and I never thought I could make up a rap for a simple math problem.

Me OK, on a scale of 1to 10, 1 being the worst and 10 being the best, how would you rate the multiple intelligences as they've been used in your math class?

SW 9 because I liked everything except naturalistic.

CS I'd give it a 10 because I liked all of them even though some of the multiple intelligences were boring for me. It was better than just sitting in your seats. I liked it a lot.

Me Do you think you learned more using them?

CS Yes, I think so. It's hard to explain.

RR I'd give it a ten too. Mostly for the same reasons as Courtney. Sometimes class was just boring and you wanted to do something else, and with the multiple intelligences, things were fun.

Me Better than being talked to.

BA I'd give it a ten too. I liked visual a lot and bodily/kinesthetic.

KT I'd give it a 9 because it was fun. I liked getting up and talking and working with our friends and making graphs and drawing pictures instead of sitting in our seats all day long. It was fun working with other people that I don't really know too well.

Me OK. Try and think of one lesson that you found particularly interesting. Tell me what it was and which of the intelligences did it employ?

SW I really liked the "What Number am I?" game. It used verbal/linguistic because you had to listen to comments and questions other people said in order to get the right answer. It used all oral language. It also used interpersonal because you worked with other people.

CS I like when Mr. K-C set out numbers on the floor like a number line and it helped us when we were adding, subtracting, multiplying and dividing integers. We used bodily/kinesthetic to help get the answer. I'm not sure what its called, but we also had to talk to people and work with them.

Me What is it called when you're interacting with others?

CS Interpersonal

KT I liked the rap. It used interpersonal, musical/rhythmic, and it really helped to put words into a catchy song.

Me Do you feel that you discovered a learning style that you didn't know was a strength in you that you'll now use in the future?

SW I'll use musical/rhythmic more because I like it, like listening to it, and feel comfortable using it.

RR I'll use bodily/kinesthetic because I think it's easier and more fun and it's interesting, sometimes it's interesting.

CS I agree with Roxanne because bodily/kinesthetic is a lot of fun and it helped us learn.

Me It is nice to get out of your seat.

BA I'd say bodily/kinesthetic because with the profession I'd want to do, I could really use it.

Me Would you care to share what that is?

student got very flustered and could hardly understand what he was saying so we moved on

Me Did you learn more or less with the multiple intelligences? Would you recommend it for other subjects?

CS I think we learned more. It was more fun and we learned about what we were doing and I'd recommend it in classes that are kinda boring-I'm not gonna mention those classes.

Me Do you think you could do it in all your subjects?

CS Yeah, and it would be fun.

BA I agree with Courtney. I learned more than if I had just been reading from a book because it made me want to pay more attention and I kinda learned quicker than I would have.

RR I agree with Courtney because I don't like listening to the teacher lecture. I like working in groups and doing things by myself. And it's fun so I would recommend it.

KT I would recommend it because it's more fun. Everyone talks about how school is not fun because all they do is sit in their seats for 5 and one half hours. And if we got up and moved around and talked with our classmates, I think they would think it's more fun and they would actually look forward to coming to school.

SW I would because I liked everything, except naturalistic.

Focus Group 2

Me Of the multiple intelligences that were used during the past 14 weeks of instruction, which do you feel helped you the most with math and why?

CR I think visual because I feel

Tape cut off

Me On a scale of 1-10, with 1 being the worst and 10 being the best, how would you rate the multiple intelligences as they have been used in your math class?

CR I'd give it a 7 because I think I learned more this year, and I really enjoyed it more. I really don't like math books at all. When we did the multiple intelligences, we didn't use the books a whole lot.

CS I would say a ten. I really liked how the activities spiced up the class. It was really cool to work with my friends and play different games and have fun.

NT I say a 7 too because I really didn't like some of the activities...it wasn't so much that it was disorderly, it just didn't seem like it worked for me...it took so long. It took so much longer to complete a lesson than when we just went out of the book.

Me So don't you want to rate it lower than a 7?

NT No, because some of the stuff I did like. I like a lot of the different stuff we did.

PS I'd give it an 8 because I really liked the intrapersonal and interpersonal intelligences because I like working in groups as well as thinking on my own.

Me Describe one mathematics lesson that you found particularly interesting and the multiple intelligence(s) that was/were used during the lesson.

PS I say the "What Number am I?" game. It used logical and verbal and interpersonal and intrapersonal. It was really fun to me. I like competition. As if you didn't know that about me. laugh laugh

CS Activities that used the dry erase boards were good. Using the buzz boards was also fun because we got to see who was competitive.

Me Which intelligences were used in the activities that utilized the dry erase boards and the buzz boards?

CS We used the dry erase boards to do visual spatial stuff. The buzz boards were more bodily/kinesthetic, right? Oh, yeah, I loved having background music playing when we did lessons.

CR I liked the lessons when the eighth graders came over to teach us. They were fun and it was better than the usual way of learning.

NT I liked the circumference, area, volume lesson. I finally understood it all. When we made the prisms and other things, it really clicked in my head. Now I know what the different geometry words mean, which I didn't before.

Me Do you now know a learning style that is a strength for you that you can use in the future?

NT Verbal and intrapersonal were good. I liked talking with my partners. (long pause)

Me You also said intrapersonal. What did you like about using intrapersonal activities?

NT I liked thinking about what I did wrong on my math tests and doing redos. It's cool to get points back when you make dumb mistakes.

CR I think visual. I think it's easier to learn when you can see everything and picture it in your head...because when you forget something, it is right there for you to see and use it.

PS I'd say visual too. I used to not like visual because I thought it wasted time. But now, it helps me a lot more when I see it and plug it in to see that work. It helps me check to see if things are right.

CS I would probably use bodily/kinesthetic and musical. I don't really think I'm good at sports, but doing stuff with my body really helped me to understand more and it's fun.

Me Would you recommend teachers use the multiple intelligences not only for math, but for other classes?

All 4 Yes.

PS I find world studies classes boring. It would be a lot more fun, and I'd be able to pay attention and learn while having fun.

NT What he said.

CR It should be used in other subjects because I find it easier to remember if I have something along with it. If I can remember a certain activity that went along with learning a formula, I'll remember what I learned.

CS I think all teachers should use this kind of teaching because it's more fun and we're not so bored all the time. Especially in classes like social studies where we just get talked at all the time. I'd like school more if we could have some fun.

Me While using the multiple intelligences, did you discover that one of the intelligences was a strength that you didn't know existed?

NT Uh, yeah. I really like it when teachers lecture because time flies by. It doesn't seem so long.

Me And which intelligence uses lectures?

NT Uh, isn't it the verbal intelligence?

Me Affirmative nod

CR Interpersonal intelligence was the one that I didn't know I could be good in. When the eighth graders came to teach us lessons on Fridays, it was fun.

CS I really wasn't sure about logical mathematical when Mrs. Pajkos said it because that was intimidating. But I really like the chain of events, yeah the chain of events, when we needed to figure out the steps of a problem. I also liked graphing on the white boards.

PS I found out that visualizing things really was good. It was worth the little bit of extra time to get something correct.

Me Of the multiple intelligences that were used during the past 14 weeks of instruction, which do you feel helped you the most with mathematics?

CR I think visual helped me the most because I like need to see it instead of just trying to remember it.

NT I'd have to say verbal because I do my best when K-C gives us lectures.

Me You like more traditional teaching methods?

NT I'm not saying I think everything else is bad. I like them, but they take up more time. I don't like it when class goes slow.

CS Yeah, bodily/kinesthetic helped me learn the most. I really liked when we moved around with the different letters and signs to learn the math properties. I got it really well after that. We all got 100's on our quizzes too.

PS Interpersonal stuff was fun. When we got to work together as a group to find mistakes. Sometimes my classmates didn't like when we found their mistakes.

CR I also like bodily/kinesthetic because I find it funner and it helps to remember things. I enjoyed it instead of being bored.

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