Examining the Effects of Multiple intelligence Instruction on Math Performance

Monica L. Dillihunt
University of Alabama in Huntsville
Kenneth M. Tyler
University of Kentucky

The purpose of this study is to discern the effects of instruction type on minority students in urban schools, mathematics achievement. Two hundred thirteen third and fifth grade (136 African American and 77 Latino) students attending schools in low-income urban communities were provided mathematics instruction in one of two ways: multiple intelligence instruction (MI) or traditional instruction. Quasi-experimental results (Creswell, 2005) reveal that students exposed to multiple intelligence instruction score significantly higher on the mathematics posttest than students in the traditional instruction context. MI students also demonstrate significantly higher improvement from pre to post test than traditional instruction students do. Implications of these findings and future research directions are discussed.

Introduction

Many minority students from low-income urban backgrounds continue to experience considerable difficulty in mathematics performance (Bowman, 2004; Washington Update, 2004). To address this, many have suggested that teachers and teacher educators begin to build upon the cultural and intellectual capacities brought to school by the students who live in these urban communities (Boykin, 1983, 2002; Sternberg, 1997). The Multiple Intelligence (MI) Theory (Gardner, 1983) has provided a framework where such capacities are discussed. Specifically, his work has suggested that children's socialization experiences within their communities foster various forms of intellectual capacity. By maintaining similar experiences throughout children's formal learning activities and contexts, teachers and teacher educators can facilitate optimal performance outcomes (Kagan, 1997; Hickey, 2004).

While the Multiple Intelligence framework has been instrumental in the development of teacher and student-based instructional strategies that promote academic success (Kagan, 1997; Kagan & Kagan, 1998; Kallenback & Viens, 2004; Kornhaber, 2004), few studies have provided empirical data to support the notion that such strategies actually enhance student performance outcomes. Furthermore, the data suggesting that multiple intelligence instructional strategies are more beneficial to urban student academic performance than traditional classroom instructional strategies is scarce (Hoerr, 2004). Moreover, few studies have investigated the effects multiple intelligence instructional strategies have on performance in specific domains such as middle school mathematics. Finally, there is a need to more fully understand the role that multiple intelligence instructional strategies has in the academic performance of urban minority students placed at academic risk for failure. The following study seeks to address these issues.

Multiple Intelligences Theory

While some literature has attempted to define and critically discuss a one-dimensional conceptualization of intelligence (Neisser, et.al. 1996), particularly as it relates to academic outcomes, others have sought to describe intelligence by identifying and operationalizing its various forms. Particularly, the early research of Howard Gardner (1993a), who defines intelligence as "a biopsychological potential to process information in certain ways, in order to solve problems or fashion products that are valued in a culture or community." Shearer (2004) suggests that Gardner's theory clearly distinguishes the difference in the terms *intelligence* and *creativity*. He advocates that multiple intelligence theory indicates that people have intelligent originality that can be displayed in any of Gardner's eight intelligences, and that this originality is not only overlooked in the traditional academic setting, it is also overlooked. (Shearer 2004). Gardner (1983, 1993) identified eight forms of intellectual capacity. They include, but are not currently limited to, verbal/linguistic, visual/spatial, bodily/kinesthetic, intrapersonal, logical/mathematical, musical/rhythmic, interpersonal and naturalist.

Persons with verbal intelligence are thought to be able to learn by listening and are thought to possess strong written and oral skills. Persons with visual/spatial intellect typically learn best from visual presentations and stimuli such as movies, pictures and video demonstrations. They also have inclinations towards presenting knowledge through various art media including painting and sculpting. Persons with bodily/kinesthetic intellect are believed to process information through sensations felt in and throughout their bodies. Physical movement and contact with others is a central feature of this mode of intelligence. Intrapersonal intellectuals tend to have a heightened awareness of self that affords them the opportunity to be independent and self-motivated. Logical-mathematical intelligence is typically expressed by persons' orientation and use of critical thinking skills. These persons are believed to prefer learning that involves data-based patterns and relationships. Musical/rhythmic intelligence is manifested in persons' receptiveness to environmental as well as musical sounds. Persons with strong musical intelligence tend to sing, whistle or hum while engaging in other activities, including formal learning. Interpersonal intelligence becomes evident in the person who demonstrates strong preferences for intimate social interaction and engagement. It is believed that these individuals are more inclined towards working in groups and learning while interacting with others. Finally, naturalist intelligence is expressed in one's ability to observe and accurately discern elements of the natural world (Dunn et.al 2001, Denig (2004) & Shearer, 2004).

Based on Gardner's theory, intelligence becomes more than a score received on the typical paper and pencil tests administered in schools. These tests do not measure the unique talents of an athlete, musician, artist, or chess player. Gardner (1999) orates that these individuals exhibit intelligences that cannot be measured by these standardized tests. Gardner (1999, as cited in Denig, 2004, p. 98-99) identifies eight criteria that must be met in order for a potential to be identified as intelligence:

1. It must be rooted in the brain, so that an injury to the brain could rob a person of that specific potential (e.g., a blow to the head causing loss of linguistic ability).
2. It must be rooted in our evolutionary history, such that our early ancestors exhibited that potential 9e.g., early humans has the naturalistic ability to discriminate among the different species of plants).
3. There has to be an identifiable core operation or set of operations associated with that potential (e.g., pitch, rhythm, etc. are core operations of musical ability).
4. It must be susceptible to being encoded in symbols (e.g., mathematical symbols).
5. It must possess a distinctive developmental path to become expert in that ability (e.g. trained clinicians with strong interpersonal skills).
6. It is exemplified by the existence of idiot savants, prodigies, and other exceptional people (e.g. Rainman's mathematical ability).
7. There is evidence from experimental psychology that the ability is distinct from other abilities (e.g., a person can walk and talk at the same time because the two abilities evidence different abilities – linguistic and kinesthetic).
8. It is supported by psychometric findings (e.g., a major league athlete might score high in ability hit a ball but low in the ability to hit a note).

While many postulate that the theory of multiple intelligence is not supported by much experimental research, Gardner (1993b, p. 33) states that, "While multiple Intelligences theory is consistent with much empirical evidence, it has not been subjected to strong experimental tests…. Within the area of education, the applications of the theory are currently being examined in many projects. Our hunches will have to be revised many times in light of actual classroom experience." Denig (2004, p.99-100) notes the existence of an acute amount of support for the concept of multiple intelligences. He also affords us with some strengths of the theory and it's relationship to the learning process:

- It serves as impetus of reform in our schools, "leading to a reevaluation of those subjects typically taught in school, with increased emphasis placed on the arts, nature, physical culture, and other topics traditionally limited to the periphery of the curriculum" (Armstrong, 2003, p. 4 as cited in Denig, 2004).
- It is child centered and develops children's innate potential rather than requiring them to master extraneous academic information.
- It encourages children to grow and to develop their potential as responsible human beings.
- It challenges educators to find "ways that will work for this student learning this topic" (Gardner, 1999, p. 154 as cited in Denig, 2004).

The theory of Multiple Intelligences provides a theoretical foundation for recognizing and acknowledging the unique talents and strengths of minority student in urban communities. This theory concedes that while all students may not be gifted in verbal or mathematical skills, they may be gifted in other areas, such as music, rhythm, art, spatial relations, or interpersonal knowledge. Affording opportunities for students to learn in these modes allows a broader spectrum of students to succeed in classroom learning.

Learning Styles Theory

Just as there are many proponents of multiple intelligences (Gardner 1993b, Shearer 2004, Kagan 1998) there are many proponents of learning styles (Denig, 2004, Snow, Corno and Jackson, 1996). The two terms are often used interchangeably, however they represent two different constructs. Ken and Rita Dunn have written several books and manuscripts describing the way in which individuals learn differently from each other and the other members of their families. Their research, conducted at the St. John's University's Center for the Study of Learning and Teaching Styles encompasses three decades of experimental research with the Dunn and Dunn Learning-Style Model. The data supports research on academic underachievers who were taught both new and difficult content utilizing instructional strategies that supported their learning style strengths. The results indicated statistically higher standardized achievement scores than they did when the approach did not reflect their learning style (Dunn & DeBello, 1999). These results support the notion of curriculum being taught differently to individuals who learn differently.

The Dunns (1993, 1999) define learning style as how a person deliberates on the process, internalize, and retain new and difficult academic content. The model addresses 21 unique elements that are classified into five variables: psychological, environmental, emotional, sociological, and physiological.

Persons that are characterized as having a psychological learning style process academic information analytically, globally or as an integrated learner. They prefer to learn in a step-by-step sequence, through and understanding of the relationship of the content to themselves, or by having an interest in the topic. Those individuals preferring the environmental style focus on the type of lighting, sound, temperature, and physical seating while focusing on academic content. Emotional style learners are either persistent in completing a given task or rely on specific directives from teachers or peers to provide structure. Sociological learners are characterized as those that prefer to study alone, some with peers and others need an authority figure. Physiological learners are described as learners who prefer auditory stimuli, while others prefer visual cues, and still others prefer tactile constructs. Times of day, eating habits and movement from place to place are also characteristics of physiological learning styles (Dunn & Dunn, 1993). Each person can be taught how to study and concentrate on specific content structures by focusing on their unique learning style. (Denig, 2004). The Dunns have proposed Contract Activity Packages, Programmed Learning Sequences, Tactile and Kinesthetic Resources and Multisensory Instructional Packages that can be used by a variety of learners to capitalize on their particular strength.

Learning styles theory indicates that all learners not only have a primary learning style, they have a secondary style that is employed to emphasize initial learning (Denig, 2004). These learning styles are determined through various age appropriate instruments (www.learningstyles.net). According to Dunn et.al (2001) "the Dunn model focuses on identifying individuals' preferences for specific instructional environments, strategies, and resources, and the extent to which each approach either fosters or inhibits academic achievement." Learning styles theory emphasizes the importance of employing teaching strategies to accommodate the varied learning styles of the students they teach. This is an intricate charge that requires one to respond to 20-30 or more individuals with different learning styles.

Both Gardner and the Dunns suggest that educators should change the way they teach. Gardner stresses the importance of capitalizing on students' abilities or the product, while Dunn advocates for focusing on students learning styles or the process in which they are taught (Denig, 2004). Multiple intelligences researchers advocate that methodology that effectively supports the intuitive way in which individuals learn during classroom instruction needs reform. Learning styles proponents concur, though suggesting that teachers use different instructional resources that support the various ways each individual learns best.

Multiple Intelligence Research

Research indicates that the theory of multiple intelligences has inspired hundreds of reform efforts that sought to infuse MI instructional strategies into elementary students' classroom learning structures and experiences (Campbell & Campbell, 1999). Much of this work was summarized in a special issue of Teachers College Record Journal (January 2004). Presented were several teacher/educator based initiatives that sought to expose students of varying developmental levels to multiple intelligence instruction. The papers contained brief descriptions of the multiple intelligence strategies used throughout the initiative. Also presented were descriptive and anecdotal results that were linked to the presence and demonstrated utility of multiple intelligences instructional strategies. For example, Hoerr (2004) explains that a large majority of students in his school "average many years above grade level on standardized tests". He goes on to report that many of the students exposed to multiple intelligence instruction throughout their elementary school years enjoy academic success at the secondary level as well. Additional work has shown how multiple intelligences were successfully incorporated into another school's organizational infrastructure (Shearer, 2004). The reported findings suggested that all educational stakeholders-students, teachers and parents-benefit from the use of multiple intelligence instructional and organizational strategies. Similar findings have been submitted in additional work (Diaz-LeFebvre, 2004; Kornhaber, 2004).

Several methodological issues are present throughout these works. A major concern is the ability to replicate the procedures used in incorporating multiple intelligence strategies in classroom instruction. In particular, it is not clear from these reports whether one or all forms of intelligence were used throughout MI based instruction. Also, the authors do not discuss teachers' training or experience using multiple intelligence instruction nor is there a discussion of how these instructional strategies were maintained throughout different class activities and with different academic subjects. Another major issue in those papers was the absence of empirical data to support the stated academic performance gains yielded by students exposed to multiple intelligence strategies. For instance, Kallenbach and Viens (2004) wrote that the presence and utilization of MI instructional strategies helped to “make learning more meaningful or relevant to students.” Similarly, Kornhaber (2004), in her report of a larger, longitudinal study of MI instruction, found that nearly 80% of the schools (in the study) reported improvements in student standardized test performance. Only half of the school personnel attributed change in test performance to students’ exposure to MI instruction.

While the results of these studies show promise for many educators and practitioners, educational researchers are limited in their ability to draw favorable conclusions because of several statistical and internal validity concerns. For instance, in both research studies, there is no indicated performance baseline or control group to which performance under multiple intelligences instruction is compared. Without knowing-by way of quantitative measurement-students’ conceptualizations of learning before they are exposed to MI instruction, researchers have no way of determining-with certainty-whether students’ attitudes towards and conceptualizations of learning were a function of multiple intelligence instructional reform. Furthermore, that 80% of participating schools found improvement in student standardized performance does not allow one to confidently conclude that this was a function of exposure to MI instructional strategies. The fact that only half of the participating schools themselves attributed improvements to MI strategies suggests that other elements may have equally produced the said findings. Finally, it would be interesting to determine whether MI instructional strategies produced stronger academic performance effects among ethnic-, gender- and grade-heterogeneous student participants.

In all, the effects of multiple intelligence instructional strategies on student performance have been found across a variety of research investigations. Yet, researchers need to exercise more standardization and other control procedures in order to more accurately assess the effects produced by such instructional practices. That is, there is a need to employ rigorous methodological controls so that error variability will be minimized and a more reliable assessment of MI instructional effects on academic performance can be made. To address these issues, the present study uses a fully randomized, experimental design.

The present research study sought to discern any differences in mathematics performance resulting from two forms of classroom instruction. We expected participants to endorse multiple intelligence strategies significantly more than direct instruction. The transformation of multiple intelligence concepts to operationalize instructional strategies and learning tools in formal learning settings has already been made (Kagan, 2000).

Methodology

Sample

Two hundred and thirteen (N=213) low-income African American (N=136) and Latino (N= 77) students participated in the study. Ninety-four students were in the third grades and 119 in fifth grades. There were 108 female and 105 male students. Students were sampled from three elementary schools located in urban, low-income, communities in the Northeastern portion of the United States. Each of the schools was randomly selected for participation in the study. Ninety-five percent of the students across the three schools received free or reduced lunch and 70% were at or below basic in mathematics achievement standards. Two 3rd grade classrooms and two 5th grade classrooms (in each school) were randomly selected from a pool of four 3rd grade and four 5th grade classrooms. Each classroom in the study had approximately 17-25 students. Classrooms were randomly assigned to one of two instructional types, traditional instruction and multiple intelligence instruction.

To carry out instruction, twelve teachers (four at each school) were asked by school leadership to participate in the study. Teachers participating in the study were drawn from staffs that were 95% African American at both schools. There were ten female teachers and two male teachers. Ten of the teachers were African Americans, one was European American and one, Asian American. Eight of the teachers had less than three years of teaching experience, while four of them had ten years of experience in classroom teaching.

Instrumentation

A grade-level appropriate multiplication test was used to assess the effects of the type of instruction on student math performance. Items on the instrument were adapted from the Enright Computation Series (2002), which has been used by 3rd through 5th grade math teachers at the sites. Two independent, 20-item multiple-choice tests were created to examine performance before and after the intervention. Scores on both tests ranged from 0-20, with higher scores indicating more items correctly responded to. Content validity was established by administering the pre and post-test exams to two certified mathematics instructors. These teachers, who were not participants in the study, scored the items on both tests to determine if they were appropriate for third and fifth grade students. Inter-rater reliability for the measure was .89. Pilot testing of each grade level pre and posttest yielded internal homogeneity averages of .85 (3rd grade pretest) and .89 (5th grade pretest).

Procedures

The researchers teams obtained a letter of agreement to conduct research from the principal and bilingual consent forms were then sent to the parents of students whose classroom teachers were identified as participants in the intervention. Teachers had no previous experience with multiple intelligence instructional strategies.

Intervention

The intervention was conducted over a seven-week period. Mathematics lessons were instructed daily using MI strategies or traditional instruction. Multiple intelligence lessons included the use of a variety of manipulatives, co-operative student simulations of mathematics scenarios, creating diagrams and illustrations of arrays and patterns, playing multiplication memory games, development of rhythms, songs, raps and chants that were implemented in the teaching of the mathematics content. Students were responsible for using these strategies to comprehend the content instead of being directed by the teacher (see Appendix A for sample lesson). Traditional direct instruction lessons included only teacher lead discussions, demonstrations and student practice using a variety of workbooks and worksheets. Individually, students were allowed to use manipulatives to assist with solving worksheet activities. Prior to the intervention, the researcher visited each classroom to become familiar with the students and the class routine. Classroom instruction was carried out in the manner that teachers would normally conduct class for a period of two weeks. In this two-week period, the researcher observed teachers' baseline instructional practices to ensure that they were not using MI strategies prior to the study. A checklist on multiple intelligence instruction was used to ensure that the researcher's judgments about the observed instructional practice were correct.

In addition, an outside trainer conducted a one-hour Multiple Intelligence workshop at each school and a 30-minute weekly follow-up training for the teachers implementing MI instructional strategies. During these sessions the teachers shared their lessons for the next week and were provided suggestions of additional MI activities that they could implement if needed. The lessons were written based on the mathematics curriculum as assigned by the school district and specifically covered the multiplication content to be covered during a three-week period. Discussions on effectiveness of activities were also discussed during this time. The trainer also met with the traditional instruction teachers for a 30-minute time period each week to discuss their lessons and verify that they were not using any other method of instruction outside to direct teaching. Three units on multiplying one digit by one and two digits with and without regrouping were taught by the third grade teachers, while the fifth grade teachers taught units on multiplying one digit by one, two and three digits as well as multiplying two digits by two and three digits.

Training of Observers

The researcher recruited and trained six graduate students (two at each school) to perform classroom observations. The purpose of the observations was to ensure that multiple intelligence instructional strategies were carried out in the same way during the intervention period. The observation training was a 2-hour training period, which consisted of viewing videotapes of classrooms and writing observations. The observers were trained on what to look for in the classroom and how to write the observation reports. Observers observed classrooms for 40-45 minute intervals daily. To assist with gathering information from the classrooms, observers also used audio tape recordings with the permission of teachers and parents. An inter-observer coefficient of .95 between observers indicated more confidence in reliable observations among the observers.

Week One. Both 3rd and 5th grade teachers were randomly assigned to a teaching condition, multiple intelligence or traditional instruction. The trainer conducted a one-hour workshop on Multiple Intelligence instructional strategies for the MI group. Concept specific mathematics lessons were created using either MI or traditional teaching methods.

Week Two. The teachers administered the mathematics pretest in each of their classrooms for a forty-five minute timed period.

Weeks Three – Five. Implementation of 3rd and 5th grade mathematics lessons in MI classrooms included using a variety of music, bodily / kinesthetic, visual / spatial, and inter and intrapersonal techniques demonstrated through visual drawings, simulated demonstrations, raps, chants, games and manipulatives. Third and 5th grade mathematics lessons in the traditional instruction classrooms included teacher lecture, demonstration, and student individual worksheet practice with the use of manipulatives if needed. Follow-up sessions by the trainer were conducted with each group on a weekly basis during this time as well.

Week Six. The teachers administered the mathematics posttest in each of their classrooms for a forty-five minute timed period.

Week Seven. At the conclusion of the study, the researcher conducted individual interviews with each of the teachers participating in the study, in an effort to gain in-sight of their perspectives of students' performance, participation and academic outcome. The researcher also hoped to gain insight on the teachers' ideals with regard to using multiple intelligences strategies in the future.

Results

A five-way repeated measure analysis of variance (ANOVA) was conducted to determine the effects of grade (3rd and 5th), gender (male and female), test (pre and post-test), ethnicity (African American and Latino) and instructional strategy (multiple intelligence and traditional) on math performance. Test served as the repeated measure in the analysis. A significant effect for test emerged F (1,197) = 353.03, p <. 01, eta squared = .64 with post-test performance being significantly higher (X=12.13) than pre-test performance (X=6.47). This effect was qualified by several interactions emerging from the data analysis. To begin, there was significant two-way interaction between time and instruction F (1,197) = 138.56, p<. 01, eta squared = .41. In an effort to understand why the ANOVA yielded a significant F, a Scheffe post hoc analysis was conducted. Huck (2000) describes the Scheffe post hoc analysis as a pairwise comparison, which makes adjustments in size of the critical values used to determine whether an observed difference between two means is significant. This analysis is the most robust post hoc analysis available. Scheffe post hoc analyses revealed no significant difference in performance between multiple intelligence and direct instruction experimental conditions at pre-test (X=5.41 and X=7.51, respectively). A significant difference, however, did emerge between student performance means at post test, with students in the multiple intelligence conditions scoring significantly higher than students in the direct instruction condition (X=14.56 and X=9.77, respectively). Further, a three-way interaction between test, ethnicity and instruction type emerged F (1,197) = 7.48, p<. 01, eta squared = .04.

TABLE 1
Descriptive Statistics for Three-Way Interaction (Instruction Type, Ethnicity, and Test)

Type of Instruction	Ethnicity	Pre	Post
Multiple Intelligence (MI)	*Total*	*5.04*	*14.56*
	African American	5.77	14.11
	Latino	4.83	15.30
Traditional Instruction (TI)	*Total*	*8.24*	*9.77*
	African American	6.98	9.42
	Latino	8.51	10.43

Scheffe post hoc analyses revealed that African American and Latino students in the MI instruction conditions performed significantly better on the math posttest (X=14.11 and X=15.3, respectively) than on the pretest (X=5.77 and 4.82, respectively). No significant differences between pre and post, test performance emerged for those students in the direct instruction condition. Significant differences also emerged between MI instruction and direct instruction posttest performance for students in each ethnic group. Here, African American students in the MI instructional condition significantly outperformed African American students in the direct instruction condition. Similarly, Latino MI students significantly outperformed Latino students in the direct instruction condition. Posttest performance differences between African American and Latino MI students were negligible as were those between African American and Latino direct instruction students. Equally noteworthy is the finding that Latino students in the MI instruction condition demonstrated the strongest performance gains from pre to posttest. Specifically, posttest scores yielded for Latino students were almost four times higher than their pretest scores. African American students in the MI instruction condition also showed significant gains, although they were not as strong as those for Latino MI students.

Correlation analyses were also computed to determine the relationship between the identified student factors and performance on the math posttest. Although significant correlations did not emerge between posttest and ethnicity, they did emerge between posttest and instructional type ($r = -.46$, $p < .01$). These correlations reveal that the students obtained higher scores on the math posttest. Also, students in the traditional instruction yielded lower scores on the posttest. Table 1 presents the descriptive statistics; Table 2 presents the correlation coefficients and Figure 1 depicts the interaction.

TABLE 2

Correlation Matrix for Grade, Gender, Ethnicity, Instruction Type and Post-Test: All students

	Grade	Gender	Ethnicity	Instruction Type	Post-Test
Grade	-	-.08	-.02	-.04	-.01
Gender		-	.02	.01	.02
Ethnicity			-	-.04	.12
Instruction Type				-	-.46**
Post-Test					-

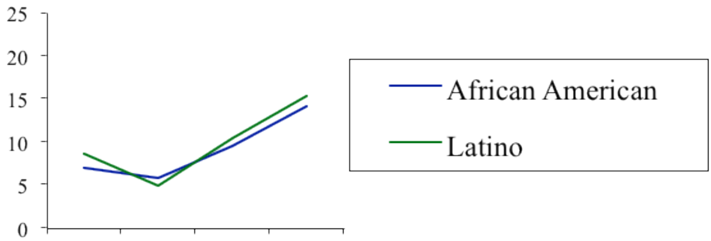
* = significant at .05; = **significant at .01

Discussion

The results of the present study suggest that students placed at-risk for academic failure greatly benefit from the multiple intelligence teaching strategies (Gardner, 1991). The performance findings mirror those obtained in other studies (Campbell, 1997; Hoerr, 2004; Kornbaker, 2004). For instance, Campbell (1997) found that students who were able to use multiple intelligences had little difficulty learning geometric concepts. Other research has produced similar findings (Clements, 2001). In the current study, students taught multiplication through multiple intelligence instruction significantly increased their posttest mathematics scores by the end of the seven-week intervention period. The strength of this finding, yielded by the reported effect size of .41, also suggests that the interaction effect between these two variables was robust. The finding that students in the MI condition had the highest performance average on the posttest suggests the power of multiple intelligence instruction. The absence of gender or grade effects illustrates the utility of MI instruction for students of all grades.

Figure 1

Three Way Interaction Between Test, Ethnicity and Instruction Type



One reason for this enhanced performance is that the multiple intelligence math instruction provided students with an opportunity to use manipulatives, create diagrams and illustrations, play games, write and sing a variety of songs, and use their bodies to act out situations and mathematical scenarios. Students in this condition were also given an opportunity to work with partners and in small group settings where they could share ideas and learn with or from each other. By incorporating and building upon students' multiple intelligences-which are consistent with the cultural values this population of students are socialized to accept-a deeper and richer understanding of mathematical concepts emerged. Some researchers have even linked conceptually the various modes of Gardner's multiple intelligence to the specific cultural themes extant in African American students' home environment (Ford, 2004). For instance, Table 3 presents a comparison of Howard Gardner's multiple intelligences with A. Wade Boykin's conceptualization of the cultural value orientations permeating the out-of-school socialization experiences of many African American youth (see Boykin, 1986 for a discussion of the cultural themes). As Kagan (1998) and several others purport, academic motivation is enhanced when teachers begin to build on students' intellectual and cultural strengths during academic instruction. This can eventually lead to increased academic and personal self-esteem and heightened academic success.

TABLE 3

Culturally Responsive Teaching Strategies: Comparison between Gardner & Boykin adopted by Ford (2004)

Gardner	**Boykin**

Multiple Intelligences	*Afro-Centric Expression*	**Teaching Strategies and Products**
Bodily Kinesthetic	Movement Harmony Verve Expressive Individualism	• Creative movement (mime, drama, dance, tableau techniques—body used to communicate) • Hands-on thinking; manipulative (i.e. sculpting) • Role plays, simulations theatre • Field trips • Physical activity • Sports and games • Learning centers
Musical	Movement Harmony Verve Expressive individualism	• Singing, humming, whistling, chanting • Curriculum songs (creating melodies, songs, rap, cheers, jingles, etc.) • Background music • Playing instruments • Poetry/poems • Drama
Naturalist	Social time perspective Harmony	• Environmental issues • Social issues • Outdoor activities • Flexible assignments
Visual/ Spatial	Social time perspective Spirituality	• Graphic-rich environment (visuals and graphic organizers, pictures, posters, charts, graphs, diagrams) • Mind mapping (webbing) • Puzzles and games (i.e. Chess) • Patterns • Painting collages • Visual arts
Logical / Mathematical	Oral tradition	• Lectures • Socratic questioning • Scientific investigations & experiments • Logical-sequential assignments (reports, experiments, research) • Problem solving; problem-based lessons • Logical puzzles and games • Competitions • Analogies • Independent study projects
Verbal / Linguistic	Oral tradition Verve Expressive individualism	• Lectures • Seminars • Discussions/Dialogues • Oral presentations & speeches; speakers • Debates • Word games (i.e. idioms, jokes, puns, riddles, homonyms, anagrams, mnemonics) • Poetry • Storytelling • Drama • Reading (choral, peer, individual) • Journal writing • Visualizations
Intrapersonal	Spirituality Harmony	• Independent study • Self-paced, independent instructional assignments • Choices and options; interest-based assignments • Reflection time/opportunity (i.e. journals, poetry)
Interpersonal	Communalism Affective	• Social cooperative learning (i.e. clubs) • Service and community involvement • Conflict mediation • Opportunity to help others (i.e. tutoring, mentoring) • Simulations

Limitations and Future Directions

While the purpose of this study was to investigate the effects of multiple intelligence instruction on student math performance under quasi-experimentally (Creswell, 2005) controlled conditions, several observations limit the generalizability of the findings. For example, a history internal validity threat occurred where researchers were not able to control for the amount of practice students had with mathematics performance during the intervention period. It is possible that heightened performance on the MI posttest may have been produced by additional practice time, by way of homework assignments or even additional clarification with parents or other family members. Future research should look to more fully standardize the amount of exposure students have to completing experimental tasks. Limiting the amount of mathematics homework students have would address this issue.

Another major limitation lies in the interpretation of the results. In addition to the rather negligible effect size for the time x ethnicity x instruction interaction, the average score for both African American and Latino students in the MI condition was not, by academic standards, optimal, even though they enjoyed significantly higher gains from pretest to posttest than their direct instruction counterparts. Specifically, the average number correct for posttest performance across student ethnic groups was 13 out of 20. When these numbers are converted into percentages, a score of 65 is produced. This, in most elementary school systems, equals a standard grade equivalent of a D (using a 10 point grade scale range). When the multiple intelligence performance scores are further disaggregated by student ethnicity, it is shown that African American students and Latino students did not fare well (14 out of 20 correct =70% =letter grade of C/D) and (15 out of 20 correct = 75% = letter grade of C). In the current study, one hour of in-class MI-instructed mathematics may not have been adequate time to produce academic success. More research is needed to understand how much exposure to MI instructional strategies is necessary in order to produce achievement gains that demonstrate mathematical proficiency and mastery. Additionally, math is but one of several academic subjects learned throughout the typical school day. It would be interesting to understand—through experimental means—the effects MI-based instruction has on additional school subject performance such as language arts, and the social and natural sciences. Finally, much like the Hoerr (2004) work, where the entire school curriculum was fused with MI instruction, future research needs to provide empirical evidence of the effects of such instruction on achievement, while observing a whole-day, experimentally controlled learning condition. Findings that emerge from this work will be able to more strongly speak to the effects of MI instruction on student performance.

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Appendix

Sample Lesson Plan

MULTIPLICATION FUN

Grade: 3rd

Time to complete lesson: 1 session (approx.1hr and 15 min)

Objectives:

The students will be able to:

- ❑ Identify and write products for factors of 6,7, and 9
- ❑ Express products using the order property of multiplication
- ❑ Write facts correctly

Multiple Intelligences

Verbal / Linguistic, Interpersonal, Mathematical / Logical, Visual / Spatial, Bodily / Kinesthetic, Intrapersonal

Materials:

Tag board, bean bags, cut out patterns of shirts, pants and skirts,

Warm – Up Activity

Place a cut out circle on the floor (use tag board to create) divide the circle in to equal sections labeling them from one to nine. Each student will take turns tossing a bean bag into the circle. The student has to say a fact that will equal the product of the number the bean bag landed on (i.e. the bean bag lands on 6; the student may say 2x3 or 1x6 etc). If the student is correct the game continues, if not the teacher guides the students to the correct response and then continues the game. The game continues until each student has had a least one chance.

Key Vocabulary:

Factor

Product

Order property of multiplication

Activities:

- ❑ Review vocabulary
- ❑ The teacher will model making arrays for various multiplication problems, discussing rows and columns (i.e. 3 rows by 4 columns = 12). She will write examples on the chalkboard and ask various students for their response.
- ❑ The teacher will also demonstrate how to find products of six by doubling products of three, asking various students to provide responses and she goes along.
- ❑ Divide the class into three groups according to ability (high, medium, and low).
- ❑ Group one: (low)
  - o Students will be given cut out patterns of pants, shirts, and skirts. They will organize the items of clothing in arrays (mixing and matching) to solve multiplication facts (three pants x three shirts) equal nine outfits.
  - o They will write their answers on notebook paper.

- o Next, this group must draw funny facts for 6, 7, and 9
- ❑ Group two:
- o Each group will be given a set of facts on sentence strips and a set of products on another; they are to match strips to find the answers to the problems, playing the game like concentration.
- o The checker will check answers by discussing with the group and if needed use a multiplication table.
- o Next, this group must create an "I am, who has" game using facts for 6, 7, and 9.
- ❑ Group three:
- o Using a number cube and counters, the students will take turns rolling the cube, whichever number comes up first is the first number in the problem, the next person (pair) rolls and their number is the second number, the group is to now multiply the two numbers together and solve the problem. (5-10 minutes)
- o Next, this group must create a song (to perform for the class) that explains how they solved the problems.
- ❑ Items that are not complete may be finished at the beginning of the lesson the next day or the teacher may assign various components for each person in each group to complete for homework.

Author's Note:
This research was supported by the Title IV Professional Development and Retention grant of the University of Alabama in Huntsville and the Walter and Theodora Daniel Endowed Research Grant of Howard University. The opinions expressed in this publication do not necessarily reflect the position or policy of the funding agencies, and no official endorsement should be inferred.