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The aftermath of implementing a standards-based curriculum in a K-8 district: Is there a correlation between hands-on instruction and math scores?

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The Aftermath of Implementing a Standards-Based Curriculum in a K-8 District: Is There a Correlation Between Hands-On Instruction and Math Scores?

by
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ABSTRACT

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The Aftermath of Implementing a Standards-Based Curriculum in a K-8 District:
Is There a Correlation Between Hands-On Instruction and Math Scores?
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The purpose of this study was to evaluate the effectiveness of the Upper Deerfield Township School District's new math programs to determine if the standards-based curriculum purchased three years ago has had an impact on standardized test scores. The district's ESPA/NJ ASK and GEPA standardized test scores in math from 2002, 2003, and 2004 were analyzed and six teachers were interviewed to determine if there was a correlation between hands-on instruction and higher student achievement on standardized tests. While the number of students who were proficient/advanced proficient in mathematics gradually increased for both grade levels during the specified testing years for this study, a closer look revealed the district's fourth grade students scored below the state mean in all the clusters whereas the eighth graders improved significantly during the three testing years used for this study.

ACKNOWLEDGEMENTS

I would like to thank my former teachers at Rowan University for the background in Educational Leadership that served as a foundation while I was working towards my master's degree. I am also grateful to my family and friends for their ongoing support during the last four years. I would like to thank my parents, Joseph and Marcia Washko, for always believing in me and encouraging me to reach for the stars. I am deeply indebted to my mother-in-law, Evelyn Triantos, who unselfishly watched our son, Connor, while I was at school. Most of all I want to thank my loving husband, Wayne, a devoted father and role model whose endless encouragement and support inspired me as I pursued my lifelong dream of making a difference in the lives of children.

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CHAPTER 1

Introduction

Focus of the Study

Prior to the state-mandated proficiency tests (ESPA now called NJ ASK and GEPA) the students' math test scores in the Upper Deerfield Township School District were average to above average. Since administering the ESPA/ NJ ASK and GEPA, students' math test scores have dropped dramatically. Using an eight-year-old mathematics textbook has contributed to the problem.

Cognizant of a need for change, the intern spearheaded a mathematics committee in the district three years ago. After a yearlong study, the district purchased new mathematics materials for teachers in grades K-8. The materials purchased included two National Science Foundation funded programs: *Investigations in Number, Data and Space* for students in Kindergarten through fifth grade and *The Connected Mathematics Project* for students in grades six through eight. Teachers in Kindergarten through fifth grade were also given the *Scott Foresman-Addison Wesley Math* textbook to supplement the program. *Middle School Math - Course 3* was the textbook used to supplement the eighth grade program.

The new standards-based curriculum was more hands-on and inquiry-based. After two full years of implementing the programs, the intern is now conducting a study to determine if the new mathematics materials and teaching practices have resulted in higher student achievement on standardized tests.

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of the district's math programs on student achievement using a community-based action research design. The study will result in a feasibility study to inform educators, administrators and Board members as to whether the new hands-on math programs have had an impact on student achievement.

Definitions

Core Curriculum Content Standards (CCCC) - Outline of specific benchmarks for student achievement in New Jersey.

District Factor Grouping (DFG) - a means of ranking school districts in New Jersey by their socioeconomic status.

Elementary School Proficiency Assessment (ESPA) - New Jersey's former fourth-grade state proficiency test.

Grade Eight Proficiency Assessment (GEPA) - New Jersey's eighth-grade state proficiency test.

Interstate Leaders Licensure Consortium (ISLLC) - national standards developed specifically for school leaders.

Manipulatives - Objects used during math instruction to facilitate student learning.

New Jersey Assessment of Skills and Knowledge (NJ ASK) - New Jersey's current state proficiency test administered in third and fourth grades.

Limitations of the Study

This study will focus on fourth and eighth grade mathematics instruction in the Upper Deerfield Township School District. The limitations include small and fluctuating sample size ranging between 75-110 students and multiple year test analysis. The intern will look at ESPA/NJ ASK and GEPA test scores from three years: 2002, 2003, and 2004.

Setting of the Study

The Upper Deerfield Township School District encompasses 31.8 square miles and is located approximately 36 miles south of Philadelphia and 50 miles west of Atlantic City. It is the fourth largest municipality in terms of population in Cumberland County. Cumberland County has the lowest median family income in the State.

The school district is comprised of the William L. Morris Administration Building and three school buildings: the Charles F. Seabrook Elementary School (Pre-K to third), the Elizabeth Moore School (fourth and fifth), and the Woodruff School (sixth-eighth). The district maintains a fairly stable enrollment of approximately 900 students.

There are 171 employed in the district consisting of 97 certified teachers, counselors, and certified professionals, 17 full-time aides, 12 part-time aides, nine part-time cafeteria and playground aides, 14 maintenance and custodial, one full-time clerk, two part-time clerks, four full-time secretaries, three part-time secretaries, three principals, one child study team director, one information systems manager, two administrative secretaries, one payroll clerk, one treasurer of school monies, one school doctor, one school business administrator, and one chief school administrator.

Seventy-eight district personnel possess Bachelor of Arts or Science Degrees, 10 employees have Bachelor of Arts or Science Degrees plus 30 credits towards a Master's Degree, 13 have Master's Degrees, and three have Doctorate Degrees.

In 2004 the Upper Deerfield Township District faced its first defeated budget in its history. With that came a loss of jobs for an administrator, teachers, secretaries, and full and part-time aides. Although the district's factor group (DFG) is a "B," the school budgets have traditionally been approved by a township with a rich history of supporting the education for its children. In December 2000, the community passed a $13.1 million bond referendum by a two to one margin. The referendum included the addition of a state of the art language lab with 18 computers, a new media center, auditeria (auditorium/cafeteria), speech therapy facilities, administrative offices, nurse's and counseling suites, Fine Arts and Fitness Wing, additional classrooms, new HVAC systems, a new roof, numerous renovations and other district-wide improvements.

The district provides a full range of educational services appropriate to grade levels Pre-K through eighth. The district's curriculum is aligned to the New Jersey Core Curriculum Content Standards. Students are exposed to the basic core subjects of reading, math, social studies and science as well as specialized areas including Spanish, music, art, library, physical education, computer literacy, technology education/industrial arts and family and consumer science. The district also offers Advanced Curriculum Enrichment (A.C.E.) programs for students excelling in art, music, physical education and academics and Advanced Placement (AP) classes at the middle school.

The district's budget is $11,913,850 with a free lunch percentage of 37%. The cost per pupil was $10,577 in 2001-02 and $10,782 in 2002-03. The 2004-05 state aid

will be as follows: core curriculum aid - $2,500,367, supplemental core curriculum aid - $146,581, transportation aid - $275,998, special education aid - $663,441, early childhood program aid -$698,292, demonstrably effective program aid - $349,787, stabilization aid - $941,938, and other aids - $224,528 for a total of $5,800,932.

After graduating from eighth grade the students attend Cumberland Regional High School with six other elementary schools. The Upper Deerfield Township School District is the largest of the schools attending the Regional High School.

Adjacent to the school district is a section eight housing project encompassing more than 300 units. This brings many economic disadvantaged students to the schools. As stated, 37% percent of the district students are from low economic homes and receive free lunch and another five percent receive reduced lunch. The school family is racially diverse: 59% Caucasian, 29% Black, 10% Hispanic and 2% other.

Located in Cumberland County north of Bridgeton, Upper Deerfield Township has a population of 7,556 with approximately 2,800 households. Established in 1922, the rural community is 31.75 square miles. The 2004 municipal revenues include $5,143,392 of local tax levy, $524,028 of other local revenue, $5,800,932 of state revenue, and $625,536 of federal revenue.

Cumberland County's $17,376 per capita income is the lowest in the state. Upper Deerfield Township, however, has the fourth highest per capita income in the county with an average of $18,884. The median household income is $47,861; the median family income is $51,472; and the median non-family income is $20,000.

The Township has been historically agrarian. Agriculture and agricultural-related industries still play a vital role in this rural area's economy. Upper Deerfield Township's

development activity continues to be considerably slow and new development is modest. The community has seen the relocation of several businesses within its borders, which provide additional employment opportunities. Additionally, many area businesses have played major roles in the success of the schools including Shop Rite, Clement Pappas, *The Evening News*, and Brock Farms.

Upper Deerfield Township Schools continue to strive to be on the cutting edge of education, providing its diverse student population with the knowledge and skills needed to be successful in the 21st Century. With the No Child Left Behind Act (NCLB) of 2001 and mandated guidelines for Adequate Yearly Progress (AYP), the district will continue to strengthen an already strong educational platform.

Significance of the Study

The intern is conducting this study to enhance teaching techniques of the faculty to meet the diverse needs of the students in fourth and eighth grade. The intern would like to determine if the Upper Deerfield Township School District's decision to spend thousands of dollars to purchase new math materials district-wide has had an impact on student test scores on state mandated proficiency tests in fourth and eighth grade.

Relationship of the Study to the ISLLC

This study will give the intern an opportunity to develop leadership skills in light of ISLLC. As indicated in ISLLC Standard 2, a school administrator is an educational leader who promotes the success of all students by advocating, nurturing and sustaining a school culture and instructional program conducive to student learning and staff professional growth. This study will give the intern an opportunity to enhance her skills in the following areas: student growth and development, effective teaching principles,

multiple ways of learning, having high expectations for student and staff performance, and ensuring all programs are designed to meet student needs. These areas fall within the student learning and staff professional growth component of the ISLLC standards.

Organization of the Study

The remainder of this study was organized into chapters. The review of the literature was included in Chapter 2. Chapter 3 outlines the design of the study. The presentation of research findings is Chapter 4. Chapter 5 contains the intern's conclusions, implications of the study and recommendations for further study.

CHAPTER 2

Review of the Literature

In two studies conducted eight years apart, researchers set out to determine if using math manipulatives would enable students to better learn math concepts. Surprisingly, the statistical evidence for one study differed from the results of the other one.

Chester, Davis and Reglin's (1991) study involved third grade geometry lessons with 52 randomly selected students. During the two-week study, the 26 students in each group were given a pretest and a posttest. There were three hypotheses. The first two hypotheses stated there would be a significant difference between the pretest and posttest scores of each group. The third hypothesis stated there would be a significant difference between the posttest scores of the control group and the experimental group. The control group used a textbook, drawings and diagrams and at no time during the study were the students allowed to use manipulatives. The teacher of the experimental group used math manipulatives to reinforce concepts taught and make learning math more real to the students.

A similar study (Rust, 1999) focused on the benefits of math manipulatives versus standard curriculum in understanding math concepts. Unlike the study mentioned above, Rust (1999) used one classroom consisting of 21 students. The eight-week study centered on teaching four math concepts: addition, subtraction, measurement and

fractions. Teachers assessed the students using The Knox County Math Skills Test and a Teacher Checklist Manipulative Evaluation.

Chester et al. (1991) concluded, "the use of math manipulatives will increase the achievement of third grade students." On the other hand, Rust (1999) concluded that students learned more from the textbook than from teaching with manipulatives. This was based on statistical evidence gathered from the two forms of assessment. She went on to say, however, "a well-balanced classroom where both methods are used equally would benefit the students along both the level of learning as well as the level of interest" (Rust, 1999).

In reviewing the information presented in both studies, which were quantitative in design, there are many unanswered questions. Both studies had small samples and brief evaluation times. A larger sample with research conducted over a longer period of time may have produced more conclusive results. Despite this, it is apparent that hands-on instruction increases student understanding of mathematics at all ability levels.

While there appears to be a necessity for alternative teaching practices including inquiry-based learning and real-world applications which the National Council of Teachers of Mathematics supported in 1988, some research on math instruction has focused on alternative teaching strategies such as cooperative learning. Two such studies (Xin, 1999) and (Stuart, 2000) concluded that student achievement increased when the students participated in cooperative learning groups.

Xin (1999) investigated the effects of computer-assisted cooperative learning in mathematics instruction within a classroom for students with and without disabilities. One-hundred-eighteen students participated in the study, 25 of who had learning

disabilities. The third grade students were grouped in either cooperative or whole-class learning groups. The whole-class learning group received the same instruction as the cooperative learning group except that work in the computer lab was completed individually rather than in cooperative groups. The results demonstrated that students in the cooperative group, regardless of ability, statistically outperformed students, regardless of ability, in the whole-class instruction group.

Similarly Stuart's (2000) results supported a cooperative learning environment. She developed a questionnaire that she gave to her fifth grade students. Her research was both quantitative and qualitative in design. Based on the student responses, she determined cooperative groups were effective in helping students understand math concepts. Many students also noted that sometimes a peer would be able to explain a concept better than the teacher would. Incidentally, Stuart also concluded that students believed manipulatives were helpful learning tools. Only one-fourth of the students surveyed stated using manipulatives was confusing. This latter idea supports the findings of Chester et al. (1991) and further confirms that manipulatives are beneficial in a math classroom when used properly.

In reviewing Xin (1999) and Stuart's (2000) studies, there are many questions about their research design. For example, as previously mentioned, Xin's (1999) research lasted one semester and involved 118 third grade elementary students, 25 who had learning disabilities. She concluded cooperative learning is a useful strategy and facilitates learning in mathematics when working with diverse learners, specifically those with learning disabilities. Using a wider range of disabled students from various regions could have clarified and produced more definitive results regarding how effective

computer-assisted cooperative learning environments are with these learners. If this was the case, then an even broader sample of fifth graders or even any elementary or middle school students would have been necessary for Stuart's (2000) study to further determine ways to reduce or even eliminate math anxiety among students. Furthermore, Stuart's (2000) research was based on her interpretations of her students' responses to the questionnaire and her objectivity could be questioned.

Nevertheless, Stuart's (2000) research had similarities with another study that focused on the effects of curriculum practices on first graders' attitudes, activity preferences and achievements in mathematics. Pearce, Lungren and Wince (1998) set out to answer four questions: Are the attitudes of first grade students toward mathematics positive? Does curriculum used in teacher mathematics affect attitudes differently? Do positive attitudes reflect higher achievement in mathematics? What are learning activity preferences of first graders when studying mathematics? A classroom teacher, a special education teacher and a university professor joined forces for this study to determine if positive attitudes in math influenced student learning.

The researchers created and verbally administered a survey to 163 first graders in the Spearfish Public Schools in Spearfish, South Dakota. Utilizing Mathematics Their Way and Silver Burdette & Ginn Mathematics as curriculum, data was collected. The results indicated the first graders' attitudes toward mathematics were positive regardless of the curriculum used. Similar to other studies, they also concluded students enjoyed and benefited from using math manipulatives and also learned more from working in cooperative groups.

Again, the sample for this research was small and somewhat limited. Additionally, the method of conducting the research could be questioned because the students may not have understood the questions and therefore did not answer honestly.

Nevertheless, Shaughnessy, Halandyna and Shaughnessy (1983) ideas support the need for this research. They reported that in order to improve attitudes in mathematics, teachers should routinely give attitude assessments. By doing so, educators can change the factors that appear to predict positive attitudes by altering the instructional techniques, learning environments or curriculum used.

Research in mathematics instruction has indicated there are a lot of factors that should be taken into consideration when analyzing student learning. Yet another area that is driving instructional methods in classrooms across the nation is student performance on state-mandated proficiency tests. With the No Child Left Behind (NCLB) legislation of 2001, all students, including those with disabilities, must reach proficiency in mathematics and reading by 2014. Since schools are required to achieve Adequate Yearly Progress (AYP) goals on state assessments as set forth by each state, the performance of children with special needs will be critical to meeting these goals. In 2003, each state developed an accountability plan of performance goals spanning 11 years. Schools not meeting the AYP performance goals for two consecutive years will result in district interventions, supplemental services and possibly state takeovers. Already there is evidence that districts are struggling to keep up with the NCLB benchmarks.

According to an article in *RBS Currents* (2004), only 60 percent of the 1,696 schools in Pennsylvania made AYP in 2002-2003. The percentage was much lower in

the School District of Philadelphia. Of its 263 schools, only 58 school reached AYP in 2003.

For many, this data is not surprising. According to the 1999 TIMSS (Third International Mathematics and Science Study) Video Study, students in other countries such as Japan, Switzerland and Australia performed significantly higher than students in the United States, especially in the area of mathematics achievement at the eighth grade level. Two additional studies were conducted in 1995 and 2003 with similar results. One of the reasons could be that U.S. eighth graders rarely spend time engaged in serious study of mathematical concepts, according to an article in *Educational Leadership* (2004). As a matter of fact, 86% of eighth graders participating in the study in 1999 indicated they used worksheets and textbooks regularly during mathematics lessons. The international average that year was only 59%, according to TIMSS (2004).

Decades of poor performance have done little to improve student achievement in the area of mathematics instruction in the United States. While many efforts have been implemented to improve student learning, the ultimate responsibility for learning is the students. Teachers are responsible for providing opportunities to learn. Included in those opportunities are motivation, encouragement, and guidance. These are resources necessary for learning, but acceptance of the resources is the responsibility of the student. Teachers and administrators cannot be responsible for actual learning. There are too many uncontrollable variables that appear outside the school such as a student's willingness to learn and the impact of the family, peers, and the media.

Until teachers in the United States share this belief, the students' math scores most likely will continue to either stagnate or drop. Maybe the NCLB reform effort to

close the achievement gaps between disadvantaged and minority students will be the driving force the United States needs to catch up to the countries with successful mathematics programs and teaching strategies. While it is not a new thought that what works in one district, state or country may not work in another, the challenge administrators will face in the next decade and beyond will be to develop and implement programs where all students will find success, including the area of mathematics.

CHAPTER 3

The Design of the Study

The intern wanted to evaluate the effectiveness of the Upper Deerfield Township School District's new math programs to determine if the standards-based curriculum purchased three years ago and more hands-on instruction has had an impact on fourth graders ESPA/NJ ASK and eighth graders GEPA standardized test scores. To do this the intern utilized two methods to gather data. The intern reviewed the district's ESPA/NJ ASK and GEPA standardized test scores from 2002, 2003, and 2004. The intern also interviewed six teachers to determine if there was a correlation between hands-on instruction and higher student achievement on standardized tests.

This study involved five fourth grade teachers and an eighth grade teacher all who had a minimum of five years teaching experience. Three of the teachers had at least 20 years of experience while the other three teachers have been in the profession for less than 10 years. They are well-respected educators in the district who use a variety of techniques to engage students in learning math. They will be referred to in this study as Teacher A, B, C, D, E and F. The intern gathered data by reviewing the district's ESPA/NJ ASK and GEPA standardized test scores and interviewing teachers in fourth and eighth grade who teach math. Since this study focused on how students learn math and what teachers perceive as effective teaching practices in a diversified mathematics classroom, the intern believed interviewing these six teachers provided significant data for this study.

The data analysis was ongoing. The intern looked for patterns in student achievement in the seven content clusters for the fourth grade test in 2002 and the six content clusters tested the following two years. There were six content clusters for the eighth grade test for all three years. The intern also wanted to determine if there was a correlation between hands-on instruction and math scores.

The intern conducted the interviews during a three-week time frame. Each interview lasted 45-minutes and took place in a classroom setting. The instrument consisted of 11 questions (see Appendix A), ranging from how long have you been teaching and why did you want to become a teacher to how do students learn math and what constitutes a good math curriculum. The responses were as diverse as the teachers who were being interviewed for this study.

Nevertheless, upon completion of this study, the intern will have information to share with the superintendent, administrators and the Board of Education. Based on the findings, the intern may recommend additional materials be purchased and professional development workshops be set up to provide the teachers with the materials and knowledge needed to help students achieve success in mathematics.

CHAPTER 4

Presentation of Research Findings

From constant movement and what may appear to be chaos from an outsider looking into the classroom to sitting in desks and listening to the teacher present the lesson, the students in the Upper Deerfield Township Schools receive diversified instruction enriched with manipulatives in their mathematics classrooms. This was evident based on the data collected from six teachers in the district who hereafter will be referred to as Teacher A, Teacher B, Teacher C, Teacher D, Teacher E and Teacher F. Additionally, the district's ESPA/NJ ASK and GEPA standardized test scores in mathematics for 2002, 2003, and 2004 have been gradually increasing each year with the largest gains coming during the spring of 2003, the first year of implementation of the new math programs at both the fourth and eighth grade levels.

But in order to determine if there is a correlation between hands-on instruction and math scores it is important to take a look at the teaching practices of these six teachers and how they think students learn math. The length of time they have spent in field of education determined what techniques they believed worked best in their classrooms.

For example, the veteran teachers typically had more structured classrooms and tended to lecture more whereas the teachers with less than 10 years of teaching experience established more interactive environments with their students.

"I think students learn math by being shown the skills and then being asked to apply them in different situations," explained Teacher A, a veteran teacher. "I try to give them the tools they need to solve the problems, and I encourage them to come up with their own strategy."

Teacher B, who has been teaching less than 10 years, believes using manipulatives to introduce a new concept is invaluable.

"Manipulatives are very helpful to introduce a new concept because it gives the students something concrete that they can get their hands on," he said. "It is a good starting point because you can give them something concrete to explain an abstract concept."

All the teachers interviewed agreed students learn math through repetition of skills and some also believed using real life examples helps the students understand the concepts.

"I find that if I give a relationship or use real life examples they are more apt to pay attention and respond," said Teacher C, a veteran teacher. "I try to relate it to something they will do."

Teacher D agreed.

"I integrate everything together and try to relate what they are doing to everyday life," explained the veteran teacher. "I try to make it real so the students can see the connections. This gives all kids an opportunity to be actively involved."

Establishing a fun but challenging and non-threatening environment is essential said Teacher E.

"I like the children to work and think hard without them really knowing that they are because of the activities they are doing," said the Teacher E, who has been teaching less than 10 years. "I like to vary the instruction and keep things moving along. This takes the monotony out of math instruction."

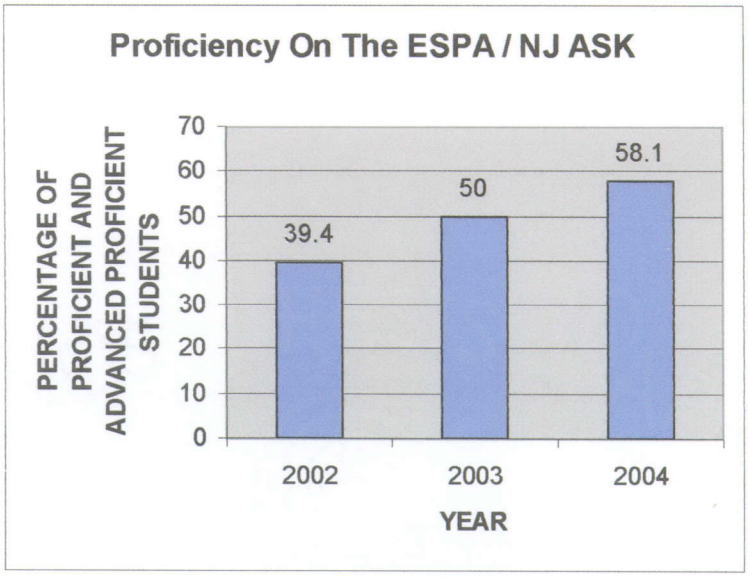
Teacher F, who has been teaching for less than 10 years, agrees hands-on activities keep the students interested and assist in the learning process.

"I try to make it fun for my students by using games and activities so they can move around the room," she said. "When students play a game, they do not realize it is like doing a worksheet.

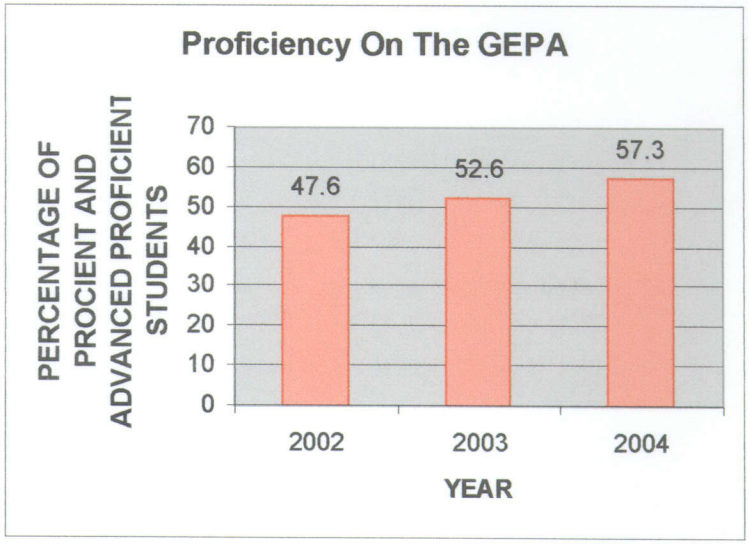
"The same is true for manipulatives. They can be very effective if you use them correctly because sometimes they help to reinforce a concept. Students can touch and feel them and it gives them a different way to look at something. They also respond to manipulatives more than to doing a worksheet," she added.

While it appears that math classes are fun because the students are engaged in more hands-on, inquiry-based learning than in the past, the true test lies in the standardized test scores. After carefully analyzing the district's standardized test scores from 2002, 2003, and 2004, it appears student achievement is on the rise.

As illustrated in the following chart, 39.4% of the fourth graders who took the ESPA were proficient or advanced proficient in math in 2002. That number rose significantly to 50% in 2003 when they took the NJ ASK. Incidentally, this was the first year of implementing the new math curriculum. In 2004 the number rose again to 58.1%.



Eighth grade students showed similar progress when they took the GEPA as illustrated in the chart below. In 2002 only 47.6% of the students were proficient or advanced proficient in math. The following year that number jumped to 52.6%. As previously mentioned, this was the first year of implementing the new math curriculum. In 2004 that number rose again to 57.3%.



One teacher thought the new math materials have helped increase student achievement.

"I think the students who participate in the new series have benefited greatly," Teacher E said. "I cannot say that all students do. I feel some teachers do not know or do not want to know how to use the new program. In this case the students cannot benefit."

Teacher C was not totally convinced the new math programs have been beneficial and was very candid about the reason why.

"I need to see someone do this so I feel more comfortable in my classroom," Teacher C said. "I am very frustrated because I do not feel confident with it."

Reaching out to her colleagues has helped.

"When we first started it, I did not know what I was doing so I went to a colleague for help," Teacher C recalled. "I watched her so I could figure it out. It did help."

Teacher D also had to make some changes with how she taught math but now feels more comfortable teaching and has developed a truly personalized approach to teaching the students.

"My kids have a hard time with the open-ended questions so I incorporate my own teaching style rather than from the books to make it easier to understand," said Teacher D. "Math should be a mix of drill and hands-on activities. Students need to learn the basic building blocks so I tend to drill a lot."

While there have been some gains in the overall test scores in fourth and eighth grade, it appears there is plenty of room for improvement, especially at the fourth grade level. For the last three years the school mean for each of the clusters that are tested by each test section on the ESPA/NJ ASK fell below the state mean. The school mean for

each of the clusters tested by each test section on the ESPA/NJ ASK also fell below the DFG mean, indicating our students scored lower that other students in districts throughout the state with similar socioeconomic status.

At the eighth grade level, however, the students have shown significant improvement. For example, the school mean for each of the clusters that are tested by each test section on the GEPA fell below the state mean in 2002. The school mean for all but one cluster (Patterns, Functions & Algebra) tested by each test section on the GEPA fell below the DFG mean. While the school mean fell below the state mean for all of the clusters that are tested by each test section on the GEPA in 2003, the school mean for all but one cluster (Spatial Sense & Geometry) was above the DFG mean. During 2004 the students showed significant improvement as compared to the previous two years. The school mean for two (Number Sense, Concepts & Applications and Spatial Sense & Geometry) of the six clusters was above the state mean in 2004. Additionally, the school mean for all the six clusters was above the DFG mean.

While the eighth graders have shown significant growth in their mathematics skills as compared to the fourth graders, all the teachers are optimistic. Some are even altering the way they teach to keep up with the trends in the field of mathematics.

"I added a lot more hands-on activities to my lessons. The new programs pushed me in this direction to go beyond the straight computation and problem solving," said Teacher F. "The students are also writing more in math class."

Teacher E agreed.

"I love the new series. Math is boring if you just drill from a text. But in the new series, math is more interesting to both the teacher and the student because it involves a

lot of tactile learning experiences," Teacher E said. "This is a very effective math series but the instructors must have an open mind when using it."

CHAPTER 5

Conclusions, Implications, and Further Study

This study provided a look into six teachers' math classrooms and examined their teaching strategies, techniques and use of manipulatives. The district's standardized test scores at the fourth and eighth grades were also analyzed. The goal was to determine if the new mathematics materials purchased three years ago and teaching practices have resulted in higher student achievement on the state mandated proficiency tests.

On the surface the answer is, yes, if the only element that was taken into consideration was the fact that the percentage of students who were proficient/advanced proficient in mathematics after taking the ESPA/NJ ASK and the GEPA gradually increased during the specified testing years for this study. The largest gains came during the first year the new materials were implemented in the district. Fourth graders went from 39.4% proficiency/advanced proficiency to 50% proficiency/advanced proficiency between 2002 and 2003. Eighth graders went from 47.6% proficiency/advanced proficiency to 52.6% proficiency/advanced proficiency between 2002 and 2003.

However, during the testing years used for this study, the student population enrolled in the district fluctuated. The number of fourth graders tested were as follows: 2002 – 109 students; 2003 – 86 students; and 2004 – 98 students. The number of eighth graders tested were as follows: 2002 – 103 students; 2003 – 76 students; and 2004 – 84 students. Since the number of students taking the tests was not consistent each year, this must be taken into consideration when drawing conclusions about the effectiveness of the

new math series in the district. Additionally, students' ability levels could have also varied each year and that must also be factored into the equation. Nevertheless, with the pressures of the No Child Left Behind Act (NCLB) of 2001 and mandated guidelines for Adequate Yearly Progress (AYP), these gains in student achievement in the district are worth pointing out.

Improvement in mathematics, however, is not limited to students in this district. Results of the Trends in International Mathematics and Science Study (TIMMS) released December 2004 indicated that the students in the United States showed slight improvement in math at both the fourth and eighth grade levels. Varied curriculums at the state and local levels and diverse student populations with families from many racial and economic backgrounds contribute to the achievement gap between the United States and other Asian nations according to several education reform groups. Without visiting the classrooms in these nations and interviewing the teachers, it would be difficult to determine why their students' math scores are higher than ours. But one thing is for certain. Using materials that are almost 10 years old is not recommended.

That was why a mathematics committee was formed during the 2001-2002 school year. The group faced the challenge of selecting new materials. After a yearlong study, the district purchased new mathematics materials for teachers in grades K-8. The materials purchased included two National Science Foundation funded programs: *Investigations in Number, Data and Space* for students in Kindergarten through fifth grade and *The Connected Mathematics Project* for students in grades six through eight. Teachers in Kindergarten through fifth grade were also given the *Scott Foresman-Addison Wesley Math* textbook to supplement the program. *Middle School Math* -

Course 3 was the textbook used to supplement the eighth grade program. The new standards-based curriculum was more hands-on and inquiry-based.

While the standardized tests at both the fourth and eighth grade levels indicate students are scoring higher, a closer look reveals that the district's fourth grade students scored below the state mean in all the clusters whereas the eighth graders improved significantly during the three testing years used for this study. It was difficult to take this a step further and make year-to-year comparisons for each of the tests because the total number points possible sometimes varied each testing year for each cluster. For example, during 2002 students taking the GEPA could achieve a maximum of 22 points in the Problem Solving Skills cluster. The following year that number increased to 32 and in 2004 that number rose to 38.

With a lot of factors to take into consideration, it is difficult to pinpoint exactly what led to higher test scores in the district. The hands-on and inquiry-based materials have mostly likely contributed to the student achievement as well as the diversified instruction presented in the math classrooms throughout the district. Additionally, a new certified middle school math teacher was hired to teach at the eighth grade level in 2003, replacing a teacher who had been in that position for more than 15 years. A multiple grade level study lasting a minimum of five years may provide clearer and more definitive results as to what is working in the classroom to help students of all abilities grasp and retain mathematical concepts. Looking at only two grade levels limits the study. Interviewing parents as well as students would broaden the study.

Nonetheless, the intern believes the district is heading in the right direction when it comes to math instruction. Students are being exposed to mathematical concepts in a

variety of ways so they can make real-world connections. According to the teachers interviewed, authentic lessons are necessary if students are going to grasp the concepts presented to them daily. Several said if students cannot make a connection, then they will not bother learning the material.

Another essential component to student success is ensuring each teacher feels comfortable and understands how to use the materials effectively. Some teachers interviewed said more training is necessary and hope more professional development opportunities in math are offered in the future. Others cited more materials would have to be purchased so all teachers have access at all times to the tools needed to teach math.

As a future educational leader, this intern would ensure that there would be professional development opportunities available to the teachers in order to address these needs and concerns, a concept supported by ISLLC Standard 2. It would be important to understand the principles of effective teaching and be cognizant that not everyone feels comfortable with change. Therefore, the process would take some time but the key would be to encourage the staff to believe in the district's vision and set high expectations for all the students while maintaining a safe and supportive learning environment.

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Appendix

Instrumentation

1. How long have you been teaching and why did you want to become a teacher?

2. How would you describe the learning environment you create in your math classroom?

3. How do you think students learn math?

4. What do you consider to be effective teaching practices in a math class?

5. Tell me what you think about manipulatives and how you use them.

6. How do students respond when you use manipulatives?

7. How do you use manipulatives for assessment?

8. The district three years ago selected a new math series. How do you think the students have benefited from the new programs?

9. In what ways did this change the way you taught math?

10. What in your opinion constitutes a good math curriculum?

11. Do you have the materials you need to be an effective math teacher? Please explain your answer.