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Factors Associated with the Utilization of Mathematics Manipulatives in Grades Kindergarten Through Four

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Factors Associated With the Utilization of Mathematics

Manipulatives in Grades Kindergarten Through Four

(TITLE)

BY

Debra J. Bandy

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FIELD STUDY

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Abstract

Since the publication of “Curriculum and Evaluation Standards for School Mathematics” by the National Council of Teachers of Mathematics in 1989, mathematics pedagogy has shifted from the standard memorization of facts and processes to concept development and application. Teachers have been encouraged to utilize manipulatives to help students bridge the gap between concrete and abstract mathematical concepts. This study was conducted to determine if grade level impacted the frequency with which manipulatives were used, to examine teacher perceptions of eleven factors associated with the frequency of utilization of math manipulatives, and to assess the perceived effect of teaching with manipulatives on the mathematics achievement of public school students in grades kindergarten through four.

The study took place during the 1997-98 school year, using a survey of kindergarten through fourth grade teachers whose schools were located in Area IV of the Regional Offices of Education, which covers east-central Illinois. Of 187 teachers who were sent a survey, 113 returned it for a response rate of 60%.

Kindergarten and first grade teachers reported using manipulatives more frequently than teachers in grades two, three, and four. Every respondent in grades kindergarten, one, and two reported using manipulatives at least once a week. Frequency of usage fell dramatically after second grade. Ninety-eight percent of teachers indicated that the use of math manipulatives had a positive impact on increasing student achievement, while 97% indicated they believed the use of manipulatives was vital to student understanding. Of the eleven factors examined, teachers perceived the following to impact the frequency with which they utilized manipulatives: the amount of time involved in teaching the lesson, the amount of time in planning the lesson, class size, classroom

management issues, and the need for additional assistance during manipulative-based instruction. Seventy-five percent of teachers perceived that manipulatives were integrated into their current curriculum. Fifty-seven percent of teachers indicated that their districts provided all of the manipulatives they needed, while 54% indicated that the personal expense of providing manipulative materials did not limit their use. Ninety-two percent of administrators and 75% of parents were perceived by teachers as being supportive. Eighty-five percent of teachers indicated their level of training in using manipulatives was adequate.

Recommendations as a result of the study included establishing teacher committees to determine a minimum level of manipulatives required at each grade level, and a district commitment to provide financial resources for the basic supply; enlisting parent volunteers to assist during manipulative-based instruction; and establishing a procedure in each district by which teachers could choose to utilize a manipulative-based approach in place of the district textbook adoption. It was also recommended that further research be conducted to assess the impact of class size on the frequency of utilization, and that a study be undertaken which compares academic achievement of students who receive mathematics instruction through a manipulative-based approach to that of students instructed through the traditional, textbook driven curriculum.

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Chapter 1

Overview

Background

Historically, mathematics in the elementary school was synonymous with “arithmetic.” Before the “modern math” era of the 1960s, elementary topics were generally “limited to counting, arithmetic operations with whole numbers, common fractions and decimals, and applications involving percent and measurement” (Campbell & Fey, 1988, p. 53). During that time, the emphasis began to shift from memorization of facts and procedures toward the development of underlying concepts. For various reasons, including the lack of adequate staff development for teachers, the “new math” movement never was generally embraced by teachers; however, the inclusion of estimation, measurement, and problem solving became part of the elementary curriculum (Campbell & Fey, 1988).

The current reform movement in mathematics began with the publication of Curriculum and Evaluation Standards for School Mathematics in 1989, by the National Council of Teachers of Mathematics. The subsequent publication of its companion document, Professional Standards for Teaching Mathematics, in 1991, not only reemphasized the necessity of reform, but also reinforced the concept that mathematics education faced major shifts in instructional goals and processes. This work was based, in part, on data from the National Assessment of Educational Progress and from college entrance exams which indicated a lack of achievement in problem-solving and higher-order thinking skills. Emphasis on instruction began to be directed away from finding one correct answer, from student memorization of facts and procedures, and from teaching mathematics as a body of specific and isolated concepts. In addition to reforming the curriculum, teachers were being asked to instruct students in a

totally different manner than the one in which they received instruction when they were students (Battista, 1994). Teachers were being asked to establish a classroom environment in which students were free to construct mathematical knowledge with an emphasis on understanding, problem solving, reasoning, and application (Frye, 1991).

One option for teachers seeking to restructure their classrooms has been to incorporate the use of math manipulatives into math lessons. While many experts and teachers agree that the use of manipulatives is an important instructional tool to help students bridge the gap from the concrete to the abstract level, studies have found that manipulatives are infrequently used in actual classrooms. A study by Gilbert and Bush (1988) found that 74.7% of the teachers did not believe that they should allocate additional time to the use of manipulatives. Concerns regarding the amount of time needed to teach lessons involving manipulative-based instruction, classroom management, administrative support, and the accountability movement all caused teachers to question whether a heavy reliance on the use of manipulatives was an effective way of covering the content of their math curricula and if student achievement would be improved by their use.

Statement of the Problem

Battista (1994) has argued that the key to the success of the current reform movement in mathematics lies in the willingness of teachers to embrace the reform philosophies and carry them out in the classroom. One major instructional strategy which was recommended as a means of helping students construct their own mathematical reasoning was the use of manipulative materials. The number of teachers actually utilizing manipulatives remained unclear and worthy of further investigation. Whether or not the use of manipulatives has had an effect on increasing student achievement also has

been debated. As school districts update their mathematics curricula and go through the textbook selection process, information on manipulative-based approaches will be needed before the most effective curriculum can be selected.

One goal of this study was to answer questions pertaining to the perceived effectiveness of using math manipulatives on increasing student achievement. Another goal was to examine various factors which could influence the frequency with which teachers utilize manipulatives during mathematics instruction. The results of this study might be used by districts throughout the state that are faced with similar questions and decisions regarding the most effective way in which to select curricula while addressing the reform standards.

Research Questions

The purpose of this study was to examine factors associated with the frequency of the utilization of manipulative-based mathematics instruction in the classroom and its perceived effect on the mathematics achievement of public school students in grades kindergarten through four.

This study utilized a survey to gather data which addressed the following research questions:

1. To what degree, if any, does grade level impact the frequency with which math manipulatives are used by kindergarten through fourth grade teachers?
2. According to teacher perceptions, what effect, if any, does the use of a manipulative-based approach have on student achievement in mathematics?
 - a. Is the utilization of math manipulatives vital to a student's understanding of mathematical concepts?
 - b. Is the academic achievement level of students impacted

positively when math manipulatives are used?

3. According to teacher perceptions, to what degree do selected factors influence the frequency of their use of math manipulatives in terms of:

- a. Integration of manipulatives into the current curriculum
- b. Amount of time involved in teaching the lesson
- c. Amount of time involved in planning the lesson
- d. Training
- e. Adequacy of materials
- f. Desire for assistance during instruction
- g. Expense of providing supplemental materials
- h. Administrative support
- i. Parental support
- j. Classroom management issues
- k. Class size

Assumptions

Following were assumptions made concerning the study:

1. Survey respondents were educationally knowledgeable about the mathematics curriculum used in their districts.
2. Respondents were familiar with the term “manipulatives.”
3. Respondents would answer the survey in an honest and professional manner.
4. The number of responses would be sufficient to consider the results valid.

Limitations

Following were limitations of the study:

1. Participants were limited to public school teachers in kindergarten through grade four whose districts are located in the counties served by Area IV of the Illinois Regional Offices of Education.

2. Due to time constraints, this study did not examine test scores of students who received mathematics instruction through a manipulative-based approach.
3. Due to monetary constraints, student perceptions of the effectiveness of manipulative-based instruction were not included in this study.
4. Due to time constraints, the long-term effects of manipulative-based instruction were not examined.
5. Due to time and budgetary constraints, parent perceptions and possible concerns regarding a manipulative-based curriculum were not examined.
6. Due to time constraints, factors such as student socioeconomic level or the highest educational level attained by the parents of students were not examined.

Delimitations

Statistical analysis of student mathematics achievement scores was not completed as part of this study for three major reasons. First, comparing the scores of students who received mathematics instruction through a totally manipulative approach without the support of a textbook-driven curriculum is difficult because very few teachers have the ability to completely abandon the textbook. Second, there was not a sufficient amount of time to pretest students, apply a variable (using a manipulative-based pedagogy), and then post-test students following an adequate instructional period. Third, confidentiality laws have made it difficult to obtain individual student scores from school districts.

Due to the organizational structure of many districts which involved grades five and six often being housed in middle schools, these grades were not included in this study.

Definitions of Terms

Area IV. Includes school districts located in the following Illinois Regions and Counties: Region 9 - Champaign/Ford; Region 11 -Clark/Coles/

Cumberland/Douglas/Edgar/Moultrie/Shelby; Region 17 - Dewitt/ Livingston/ McLean; Region 32 - Iroquois/Kankakee; Region 39 - Macon/Piatt; and Region 54 - Vermillion.

Low-income students. Students who receive free or reduced lunch based on published federal guidelines.

Manipulatives. Real objects which can be touched, handled, and moved by students.

Manipulative-based instruction. A mathematics curriculum which stresses active participation on the part of the students and one which includes opportunities for students to develop an understanding of mathematics concepts with real objects.

Math Task Force. A group consisting of teachers representing each grade level in the district, administrators, and community members whose purpose is to make curricular recommendations in the area of mathematics.

Math Their Way. A developmental, manipulative-based approach to the teaching of mathematics popularized by Mary Baratta-Lorton in 1976. Since her death, Math Their Way has been under the direction of the Center for Innovation in Education. Mathematics Their Way (1976) is widely recognized as the basic text for manipulative-based instruction.

Mathematics materials. Any real, concrete items which can be handled by students. (A synonym for manipulatives.)

Uniqueness of Study

The results of this study will be presented to the Math Task Force of Decatur Public Schools District #61, Decatur, Illinois, during the 1998-99 school year. The task force will be evaluating new curriculum materials which will be recommended for adoption for the 1999-2000 school year. One option which may be considered is allowing primary teachers to cover grade level

content through a manipulative-based approach. The effectiveness of manipulative-based instruction must clearly be understood. Consensus on the criteria for allowing teachers to use this approach must also be reached.

With the increasing emphasis on site-based decision making at the individual school level, the most effective way to present mathematics instruction will continue to be debated. The results of this study could be used by schools examining pedagogical issues relating to primary mathematics instruction. As alternatives to traditional textbook-driven mathematics curricula are evaluated, the possibility of implementing a manipulative-based curriculum, or the importance of providing teachers with manipulatives to complement a textbook-driven curriculum, could be supported with the results of this study.

Chapter 2

Rationale, Research, and Related Literature

Rationale

The issue of manipulative-based instruction has been in the forefront of early elementary education pedagogy debate for the past several years. As a classroom teacher, the author developed and utilized a kindergarten mathematics program based on Mathematics Their Way materials and philosophy (Baratta-Lorton, 1976). While the results, in terms of student achievement, were overwhelmingly positive, a statistical research base was lacking. This study was undertaken to provide a wide base of data for schools to use when contemplating whether or not to allow teachers to teach the mathematical concepts contained in the district's selected text through alternative methods. The results should also prove useful for schools faced with the decision of selecting mathematics materials at the site level.

As a result of this study, the current level of utilization of manipulative-based instruction was examined, as well as teacher perceptions regarding factors which affect its utilization and effectiveness.

Review of Related Research

Two comprehensive reviews of activity-based learning are cited by Grouws in a handbook which focuses on "classroom practices that research has shown to result in higher student achievement" (1995, p. 1). A study conducted by Suydam and Higgins in 1977, concluded that student achievement gains increased more among students using manipulatives than among those who did not. In a meta-analysis of 60 studies which compared the effects of using concrete objects with abstract approaches, Sowell (1989) concluded that when manipulatives were used on a long-term basis by teachers knowledgeable in their use with the purpose of helping students to develop their own ideas rather

than for an aid in memorization of facts, both the areas of student achievement and positive attitude toward mathematics increased. Grouws (1995) concluded that research results suggested teachers should use manipulatives on a regular basis, and that providing students with concrete materials helped them construct meaning for the ideas they were learning.

Karp (1990) conducted a study that compared achievement differences between students who received instruction in one of three mathematics programs ranging from a strict manipulative focus to an abstract non-manipulative approach. The study took place in five elementary schools in Long Island, New York. Eighteen first grade teachers with heterogeneously grouped students (N = 21 average class size) were randomly selected to participate. Students were given a pretest, then instructed through one of three approaches: (a) Explorations, a manipulative-based approach; (b) Silver Burdett, a traditional approach; and (c) Comprehensive School Mathematics Program (CSMP), a non-traditional program with an emphasis on conceptual understanding and application. Following six months of instruction, students were post-tested and a sample of participating teachers and administrators was interviewed. It was concluded that the CSMP program was the most effective at maintaining or increasing student achievement levels, with Explorations being the next most effective. Findings based on the correlations for individual scores and teacher experience also indicated that student achievement on the post-test was not related to teacher experience. The author noted that a longitudinal study would be needed to more thoroughly evaluate the long-term impact of a manipulative-based approach. The program showing the lowest gain in student achievement was the traditional, textbook-driven approach.

In a ten-week study conducted by Llovet (1990), kindergarten students (N = 24) were instructed through direct instruction, modeling, role playing,

manipulatives, and cooperative grouping strategies with the goal being to improve problem-solving ability. Paper and pencil activities were kept to a minimum. A criterion level of 80% was established. Pre-tests and post-tests were administered. While the criterion level of 80% was not met at the end of the ten week period, growth was demonstrated. It was also concluded that students demonstrated a positive attitude toward math at the end of the study.

A project to provide opportunities for rural teachers in low-income districts in New Mexico to improve hands-on science and mathematics instruction was conducted by Hadfield and Lillibridge (1991). Thirty-nine teachers participated in a six-day workshop focusing on minority participation, hands-on activities, and improvement of attitudes toward the teaching of mathematics and science. Manipulatives were made available to participants. Pre-tests and post-tests were administered to participants to assess their knowledge, confidence, and anxiety regarding teaching in both disciplines. Following the in-service, significant increases were found in the areas of knowledge and confidence. A significant decrease was noted in anxiety measures for both math and science. Participants were visited several weeks following the in-service. It was found that the majority had utilized their new methods "and materials and were enthusiastic about the incorporation of a hands-on method of instruction" (p. 2).

Chester, and others (1991), conducted a control group design study to examine the effects of emphasizing the use of manipulatives on the achievement of third grade students. A two-week geometry unit was presented to two groups of third grade students from western Iredell County, North Carolina. A pretest was administered. One group (N = 26) received instruction during a two-week geometry unit from a teacher who used math manipulatives to teach the concepts, while the other group (N = 24) received instruction

through only drawings and diagrams. An analysis of covariance revealed that the students who received instruction through manipulatives scored significantly higher on the post-test scores than the group using drawings and diagrams.

The impact on student achievement of third grade students (N = 26 schools, N = 1885 students), who received instruction through a reform curriculum based on the Illinois Goal Assessment Program (IGAP), was studied by Carroll (1997). IGAP scores of third grade students who received instruction through the Everyday Mathematics Curriculum, developed at the University of Chicago School Mathematics Project (UCSMP), were compared to the scores from suburban Cook County along with state scores. Students in 14 of the 26 schools in the study had been using this method since kindergarten. Students in the remaining 12 districts received either one or two years of instruction. In the UCSMP curriculum, students worked in cooperative groups, explored mathematical concepts in real-life situations, and used calculators and manipulatives. Students were encouraged “to ‘invent’ their own computational algorithms to solve problems” which were shared with classmates (p. 237). Paper and pencil computation was given a small role in this curriculum. Results indicated that all 26 UCSMP schools scored well above the state mean, with only three scoring below the suburban Cook County mean score. When the results of the 14 schools using the method since kindergarten were reviewed, the scores averaged 75 points above the state score. It was concluded that the curriculum had a positive longitudinal effect on achievement, including two schools with low-income populations of 45% and 27%. Results also indicated that reform in mathematics, including alternative instructional methods and materials, did not result in a decline in test scores.

Review of Related Literature

In a resource citing frequently asked questions regarding mathematics

instruction which was directed at parents and the community, Kober (1991) addressed the issue of the importance of using concrete materials when teaching young children. Kober indicated that children need to develop an understanding at the concrete level before they can understand symbols and abstract concepts. "According to research, manipulatives are a good way - and a highly recommended way in the early grades - of providing this experience" (p. 30). Kober stated that manipulatives met the needs of visual, auditory, and/or kinesthetic learners and indicated that students who learn with manipulatives were more capable of applying mathematical concepts to real life situations. Success with the use of manipulatives depended on the teacher selecting appropriate materials and connecting them with the concept under investigation. Kober indicated that while most teachers had access to manipulatives, the frequency of their use varied and declined from grade two on. In contrasting activity-based instruction to the reliance on mathematics texts, she stated that some experts believed that mathematics texts contributed to a passive mode of learning, placed an emphasis on low-level skills, and misled students into thinking that accuracy and speed of computation were more important than developing conceptual understanding.

A framework for teaching mathematical content through a student-centered approach aligned with the National Council of Teachers of Mathematics standards was presented by Burtz and Marshall in 1996. In describing their perspective of what mathematics education should encompass, the authors stated, ". . .students must be actively involved in exploration, investigation, and experimentation with models, concrete materials, and everyday objects in order to develop conceptual understanding of mathematical ideas" (p. 11). Recommendations for the kindergarten through grade five curriculum included establishing a classroom atmosphere which fosters

problem solving; giving students opportunities for exploration, investigation, and discovery; emphasizing relationships among skills and concepts; using computers, calculators, and other forms of technology; and having students use concrete materials regularly in various activities.

In a government publication which reported on a 1992 conference on mathematics and science teaching, the two topics addressed were improving professional development opportunities for teachers and the creation of better instructional materials for the classroom. Specifically, textbook publishers were urged to adapt and reflect the “new national content standards through improved instructional practices such as problem solving activities, creative student leaning tasks, and cooperative learning. The curriculum should promote active learning, inquiry, problem solving, cooperative learning, and other instructional methods that motivate students” (McKinney, 1992, p. 29).

According to Sgroi, Groper, and Semonile (1995), a young child’s mathematical experience is influenced by the nature of the child and three variables: the learning environment, the curriculum, and the type of assessment. In order to align assessment with a more open learning environment, it was recommended that teachers incorporate assessment into everyday routines, and that the child’s reasoning and thinking be taken into account when judging the correctness of an answer. The need for allowing students to actively participate in activities was noted. Teachers who used this approach questioned the use of paper and pencil tests. “The classroom organization that permits primary-grade teachers to observe individual youngsters at work and to assess them in an informal and formal manner is a critical feature of the mathematics program” (p. 277).

Subtraction can be successfully mastered by first grade students if a link is created between the child’s experience and mathematics (Page, 1994).

Problems begin when children are expected to make the transition from experiences to numerical representation. Page suggested that students who explore subtraction through problem solving with manipulatives will “begin to discover the symbolic nature of manipulatives and, by extension, of number” (p. 141). It was concluded that students used this sense of number to learn the language for talking about the manipulative-based situations which, in turn, gave meaning to the algorithm of subtraction.

Concerns about how textbooks have adapted to the National Council of Teachers of Mathematics standards were discussed by Mokros (1994). Mokros compared learning math from a textbook to learning to read by reading only romance novels. Mokros also indicated a belief that students who only use texts spend too much time on formulaic learning, memorizing rules for each chunk of material taught instead of developing their own understanding of mathematics strategies. Mokros concluded that even though many teachers are beginning to understand the limitations of traditional math texts, they continue to use them. Reasons cited for their continued use include the inability of teachers to find more meaningful materials, teachers not being allowed to try something different by their schools, and parental resistance to innovative instructional methods.

The National Council of Teachers of Mathematics standards has remained the driving force behind the mathematics reform movement since 1989. Clearly, new instructional approaches, classroom organizations and structures, instructional methods, and alternative assessments have been integral components of this reform. As indicated previously, the literature consistently supported the use of manipulatives in mathematics instruction for students in grades kindergarten through three in order to connect math to the real world and to enable students to develop their own scheme of

understanding of an abstract discipline. Despite the evidence that this link is needed, whether teachers actually implement alternative instructional methods, specifically the use of manipulatives, remained in question. This study sought to provide data from teachers about the frequency of using this teaching strategy, as well as their perceptions about its effectiveness.

Chapter 3

Design of the Study

General Design of the Study

This study utilized a survey to gather data which addressed the following research questions:

1. To what degree, if any, does grade level impact the frequency with which math manipulatives are used by kindergarten through fourth grade teachers?
2. According to teacher perceptions, what effect, if any, does the use of a manipulative-based approach have on student achievement in mathematics?
 - a. Is the utilization of math manipulatives vital to a student's understanding of mathematical concepts?
 - b. Is the academic achievement level of students impacted positively when math manipulatives are used?
3. According to teacher perceptions, to what degree do selected factors influence the frequency of their use of math manipulatives in terms of:
 - a. Integration of manipulatives into the current curriculum
 - b. Amount of time involved in teaching the lesson
 - c. Amount of time involved in planning the lesson
 - d. Training
 - e. Adequacy of materials
 - f. Desire for assistance during instruction
 - g. Expense of providing supplemental materials
 - h. Administrative support
 - i. Parental support
 - j. Classroom management issues
 - k. Class size

Surveys were constructed and mailed to 187 teachers in grades kindergarten through four, using a random sampling technique. Results were collected from 113 respondents, for a return rate of 60%.

Sample and Population

In September, an introductory letter which included a request for a regional directory was faxed to each Regional Superintendent located in Area IV of the State of Illinois Regional Offices of Education. Area IV was selected due to the diverse populations and sizes of school districts served by this area (see Appendix A). Two directories were received immediately. The fax was followed three weeks later by a telephone request for directories from the remaining regions. Directories were received from all with the exception of Region 9, which published no directory. Region 9 teachers were not included in the study.

Upon receipt of the directories, a data base of teachers in grades kindergarten through four was established. Each public school located within Regions 11, 17, 32, 39, and 54 was represented by one teacher. Beginning with kindergarten, a teacher was randomly selected in the first school in each directory. A first grade teacher was then selected from the next school. This procedure continued with grades two, three, and four; then the cycle was repeated. If a school did not house the grade level next in the cycle, a rotating list was established, so that as equal a representation as possible was maintained from among those schools.

The total number of teachers selected from each region depended upon the number of schools located within that region. The number of teachers surveyed, by region, was as follows: Region 11 by 37 teachers, Region 17 by 55 teachers, Region 32 by 40 teachers, Region 39 by 33 teachers, and Region 54 by 22 teachers.

Data Collection and Instrumentation

A preliminary survey instrument was field tested in October, 1997, with 74 kindergarten through fourth grade teachers in Decatur Public Schools, District 61, where the author is employed as a principal. Responses from the field test survey were used to determine which factors to include in the study. The "Teacher Survey on Math Manipulatives" (see Appendix B) utilized in the study, was then developed with the assistance of Mr. Rich Buckler, Director of Research for Decatur Public Schools.

Included in each mailing was a copy of the survey instrument (see Appendix B), a cover letter (see Appendix C), a scantron sheet (see Appendix D), a stamped, self-addressed return envelope, and a blank address label. The address label was provided for those who expressed interest in receiving a copy of the results of the survey. Fifty-eight respondents expressed interest in receiving results of the study. Participants were assured that their individual responses would be confidential. Surveys were numbered for tracking purposes only.

Grade levels were reported only if the teacher taught a single grade. Class size was reported as one of three designated ranges. Teachers indicated their agreement/disagreement with statements 2-14 using a modified Likert scale with the following response opportunities: A = Strongly agree, B = Agree, C = Disagree, D = Strongly Disagree, and E = No opinion. Teachers were asked to provide feedback in two comment boxes in the following areas: 1. training which they believed had a significant impact on their ability to utilize manipulatives, and 2. comments regarding the importance/lack of importance using manipulatives.

Data Analysis

Descriptive statistics were utilized to analyze the data collected from

each survey question and its corresponding research question. Data analyses were presented through tables which included the number and the percentages of each response choice.

One hundred thirteen scantron sheets were returned. One respondent, who taught only language arts, completed only Section I. One respondent returned a blank survey, indicating that she had been reassigned to fifth grade this year. For questions 2 -14, 111 responses were included in the study.

Data were collected on the “Teacher Survey on Math Manipulatives” to measure teacher perceptions of each of the corresponding research questions:

1. To what degree, if any, does grade level impact the frequency with which math manipulatives are used by kindergarten through fourth grade teachers? (Survey Section 1, Column A and Survey Question 1)

2. According to teacher perceptions, what effect, if any, does the use of a manipulative-based approach have on student achievement in mathematics?

a. Is the utilization of math manipulatives vital to a student’s understanding of mathematical concepts? (Survey Section 1, Comment Box 2, and Survey Question 1)

b. Is the academic achievement level of students impacted positively when math manipulatives are used? (Survey Section 1, Comment Box 2 and Survey Question 3)

3. According to teacher perceptions, to what degree do selected factors influence the frequency of their use of math manipulatives in terms of:

a. Integration of manipulatives into the current curriculum (Survey Question 4)

b. Amount of time involved in teaching the lesson (Survey Question 5)

c. Amount of time involved in planning the lesson (Survey

Question 6)

- d. Training (Survey Section 1, Comment Box 1 and Survey Question 7)
- e. Adequacy of materials (Survey Question 8)
- f. Desire for assistance during instruction (Survey Question 9)
- g. Expense of providing supplemental materials (Survey Question 10)
- h. Administrative support (Survey Question 11)
- i. Parental support (Survey Question 12)
- j. Classroom management issues (Survey Question 13)
- k. Class size (Survey Section 1, Column B and Survey Question 14)

The results were analyzed with the assistance of scantron technology with four treatments being conducted. One set of responses was analyzed according to grade level and class size. One set was analyzed according to total grade level. A third analysis was applied to all grade levels according to the three class size ranges. The final analysis was completed for the total group. Data for research question 1 were disaggregated by grade level. Total group responses were used for the remaining research questions.

Chapter 4

Results of the Study

Overview

The purpose of this study was to examine factors associated with the utilization of manipulative-based mathematics instruction in the classroom and its perceived effect on the mathematics achievement of public school students in grades kindergarten through four.

This study utilized a survey to gather data which addressed the following research questions:

1. To what degree, if any, does grade level impact the frequency with which math manipulatives are used by kindergarten through fourth grade teachers?
2. According to teacher perceptions, what effect, if any, does the use of a manipulative-based approach have on student achievement in mathematics?
 - a. Is the utilization of math manipulatives vital to a student's understanding of mathematical concepts?
 - b. Is the academic achievement level of students impacted positively when math manipulatives are used?
3. According to teacher perceptions, to what degree do selected factors influence the frequency of their use of math manipulatives in terms of:
 - a. Integration of manipulatives into the current curriculum
 - b. Amount of time involved in teaching the lesson
 - c. Amount of time involved in planning the lesson
 - d. Training
 - e. Adequacy of materials
 - f. Desire for assistance during instruction
 - g. Expense of providing supplemental materials

- h. Administrative support
- i. Parental support
- j. Classroom management issues
- k. Class size

The tables present teacher perceptions to the research questions in terms of number (n), and percentage (%) rounded to the nearest whole number, in each rating category. For research question 1, teachers were asked to indicate their grade level within specified bands, and the frequency with which they used manipulatives in their classroom on the following scale: A = Daily, B = four times a week, C = three times a week, D = two times a week, E = one time a week, and no response = less than once a week. For research questions 2 and 3, teachers were asked to rate their agreement/disagreement with statements relating to utilization factors using the rating scale of A = Strongly Agree, B = Agree, C = Disagree, D = Strongly Disagree, and E = No Opinion. Teachers were also asked to list training they had received which they felt had a significant impact on their ability to utilize math manipulatives, and to supply comments regarding the importance/lack of importance regarding using manipulatives.

Results for Research Question 1

Research question 1 examined the relationship of grade level and frequency of utilization of math manipulatives. As indicated in Table 1, data analysis clearly indicated that as the grade level increased, from kindergarten through grade four, the frequency with which manipulatives were utilized daily decreased. At the kindergarten level, 52% of the respondents utilized manipulatives either daily or four times a week, as compared to 56% at grade one, 11% at grade two, 20% at grade three, and 12% at grade four. The number of respondents indicating utilization at the rate of once a week or less

Table 1

Grade Level and Frequency of Utilization of Math Manipulatives

<u>Grade</u>	<u>Frequency</u>					
	A	B	C	D	E	NR
Kindergarten						
<u>n</u>	6	6	6	4	1	0
percentage	26%	26%	26%	17%	4%	0%
One						
<u>n</u>	5	10	9	1	2	0
percentage	19%	37%	33%	4%	7%	0%
Two						
<u>n</u>	0	2	9	3	4	0
percentage	0%	11%	50%	17%	22%	0%
Three						
<u>n</u>	2	3	6	4	6	4
percentage	8%	12%	24%	16%	24%	16%
Four						
<u>n</u>	1	1	4	4	1	6
percentage	6%	6%	24%	24%	6%	35%

Note. Frequency codes are as follows: A = daily, B = four times a week, C = three times a week, D = two times a week, E = one time a week, and NR = less than once a week.

increased with each grade level. It should be noted that 0% reported using manipulatives less than once a week at grades kindergarten through two, while the percentage grew to 16% at grade three and to 35% at grade four.

Results for Research Question 2

Tables 2 and 3 present data relating to research question 2 which sought to determine teacher perception regarding the effect of using math manipulatives on student achievement. As indicated in Table 2, 97% of the respondents indicated they strongly agreed or agreed that the utilization of math manipulatives during math instruction was vital to a student's understanding of mathematical concepts. It should be noted that only 3% disagreed with the statement, and 0% strongly disagreed that manipulatives were vital.

Table 3 presents data regarding teacher perceptions of whether or not student achievement is positively impacted when math manipulatives are utilized. As indicated in Table 3, 98% of the teachers either strongly agreed or agreed that manipulatives had a positive impact on student achievement.

Teachers were asked to supply comments relative to the importance or lack of importance regarding the use of math manipulatives. Seventy-six teachers offered responses in comment box 2. Among the 76 responses, 68 teachers expressed beliefs that the use of manipulatives was "very important," "essential," and/or "vital" to their students' understanding of math concepts, with many citing manipulatives as being useful in bridging the gap between concrete and abstract concepts. Two responses indicated difficulty with keeping students on task; one stated that manipulatives should not take the place of memorization; one reported not having access to manipulatives; two reported using them randomly or according to the topic; one had recently changed from teaching second grade to fourth and was having difficulty using them as often this year; and one indicated trying to use them with 19 students last year was easier than with the current class of 27 students. A complete list of responses can be found in Appendix E.

Table 2

Teacher Perception that the Use of Math Manipulatives Is Vital to Student Understanding

Rating	<u>n</u>	Percentage
Strongly Agree	67	60%
Agree	41	37%
Disagree	3	3%
Strongly Disagree	0	0%
No Opinion	0	0%

Table 3

Teacher Perception of Positive Impact of Math Manipulatives on Student Achievement

Rating	<u>n</u>	Percentage
Strongly Agree	60	54%
Agree	49	44%
Disagree	1	1%
Strongly Disagree	0	0%
No Opinion	1	1%

Results for Research Question 3

Tables 4 through 15 present the results related to research question 3, which examined teacher perceptions regarding 11 factors which might influence the frequency with which manipulatives are utilized in the classroom.

Each factor in research question 3 will be addressed individually.

Table 4 presents results relating to the factor of integration of manipulatives into the math curriculum currently being used by each respondent. Results indicated that 75% of teachers agreed or strongly agreed that the use of manipulatives was fully integrated into the math curriculum adopted by their school/district, while 19% either disagreed or strongly disagreed. It should be noted that 6% of the teachers offered no opinion.

According to results indicated in Table 5, 66% of the respondents perceived that the amount of time involved in teaching a manipulative-based lesson was a factor they considered when deciding how often to utilize manipulatives in mathematics instruction. The time factor did not appear to be a concern to the 31% who disagreed or strongly disagreed with the statement.

Data regarding the factor of time involved in the planning and preparation of manipulative-based lessons are presented in Table 6. As indicated in that table, 58% of the respondents strongly agreed or agreed that planning and preparation time was a factor they considered when planning instruction involving the use of manipulatives. It should be noted that 40% either disagreed or strongly disagreed with the statement relating to this factor.

Table 7 represents responses to the statement, "It is my perception that my degree of knowledge/training has adequately prepared me to be able to integrate manipulatives into my math curriculum". As indicated in Table 7, 60% of the teachers expressed agreement, while 25% strongly agreed that they had adequate training. It should be noted that 11% indicated the need for additional training, while 4% expressed no opinion.

Teachers were also asked to supply, in comment box 1 on the survey, the types of staff development/training in which they had participated. Of the 111 surveys included in the study, 21 teachers listed no training in using math

Table 4

Teacher Perception of the Total Integration of Math Manipulatives into Current Curriculum

Rating	<u>n</u>	Percentage
Strongly Agree	21	19%
Agree	62	56%
Disagree	19	17%
Strongly Disagree	2	2%
No Opinion	7	6%

Table 5

Amount of Time Involved in Teaching the Lesson Is a Factor in Frequency of Utilization of Math Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	26	23%
Agree	48	43%
Disagree	24	22%
Strongly Disagree	10	9%
No Opinion	3	3%

manipulatives. Among teachers reporting using manipulatives less than once a week, 10 reported no training. Many teachers listed multiple opportunities. The most common responses were as follows: "Math Their Way" (50), local staff development (36), "Activities Integrating Math and Science" (28), college course work (15), regional conferences (15), state conferences (7), "Math - A

Table 6

Amount of Time Involved in Planning and Preparing Manipulative-Based Lessons as a Factor in Frequency of Utilization

Rating	<u>n</u>	Percentage
Strongly Agree	17	15%
Agree	48	43%
Disagree	33	30%
Strongly Disagree	11	10%
No Opinion	2	2%

Table 7

Self-perception of Adequacy of Teacher Knowledge and Training In the Use of Math Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	28	25%
Agree	67	60%
Disagree	10	9%
Strongly Disagree	2	2%
No Opinion	4	4%

Way of Thinking” (4), and “Box It and Bag It” (3).

In order to assess factors relating to the adequacy of materials, statements were rated dealing with the adequacy of manipulative materials provided by the local district (Table 8) and if the expense involved in providing manipulatives limited the frequency of utilization (Table 9). As reported in

Table 8

Adequacy of Math Manipulatives Provided by District

Rating	<u>n</u>	Percentage
Strongly Agree	14	13%
Agree	49	44%
Disagree	28	25%
Strongly Disagree	15	14%
No Opinion	5	5%

Table 9

Personal Expense in Providing Math Manipulatives as a Limiting Factor

Rating	<u>n</u>	Percentage
Strongly Agree	11	10%
Agree	35	32%
Disagree	42	38%
Strongly Disagree	18	16%
No Opinion	5	5%

Table 8, 57% of the teachers either strongly agreed or agreed that their districts provided all of the manipulatives they felt they needed. Thirty-nine percent perceived that their districts did not provide the manipulatives they believe they needed. According to data reported in Table 9, 42% either agreed or strongly agreed that their ability to use manipulatives was limited by the expense involved in paying for their own manipulatives. Fifty-four percent indicated that the personal expense of providing manipulatives for their classrooms was not a

limiting factor.

Table 10 presents teacher responses regarding their perceptions of whether or not they would use manipulatives more frequently if they had a teaching assistant or parent volunteer to assist during math instruction. As reported in Table 10, 55% reported they either strongly agreed or agreed they would use manipulatives more often if assistance was available during instruction. It should also be noted that only 38% disagreed or strongly disagreed that they would use manipulatives more often if assistance was available.

Teacher perception of administrative support is presented in Table 11. Clearly, respondents perceived support from their administrators. As reported in Table 11, 92% of the respondents assigned a rating of either agree or strongly agree to the level of support their administrators provided for their use of math manipulatives. It should be noted that 7% of the respondents had no opinion on this issue.

Teacher perception of parental support, reported in Table 12, indicated that 75% agreed or strongly agreed they had parental support, while only 4% indicated they disagreed or strongly disagreed. It should be noted that 22% of the respondents had no opinion of how their parents felt about the use of manipulatives.

Table 13 presents the perceptions of teachers concerning whether classroom management issues were factors to consider when deciding whether or not to utilize manipulatives. As reported in Table 13, 80% of the teachers strongly agreed or agreed that classroom management was a factor to be considered. Twenty percent disagreed or strongly disagreed that they took this factor into consideration when planning for instruction with manipulatives.

Table 14 presents data regarding teacher perception that class size is a

Table 10

Teacher Perception of the Need for Teaching Assistance During Manipulative Based Mathematics Instruction

Rating	<u>n</u>	Percentage
Strongly Agree	22	20%
Agree	39	35%
Disagree	36	32%
Strongly Disagree	7	6%
No Opinion	7	6%

Table 11

Teacher Perception of Administrative Support for The Use of Math Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	42	38%
Agree	59	54%
Disagree	1	1%
Strongly Disagree	0	0%
No Opinion	8	7%

factor to be considered when determining whether or not to use manipulatives. As indicated in that table, 61% agreed or strongly agreed that they considered class size when planning manipulative-based instruction. It should be noted that 38% disagreed or strongly disagreed that class size was a factor to consider.

Table 12

Teacher Perception of Parental Support for the Use of Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	22	20%
Agree	61	55%
Disagree	3	3%
Strongly Disagree	1	1%
No Opinion	24	22%

Table 13

Teacher Perception Regarding the Impact of Classroom Management Issues of the Frequency of the Utilization of Math Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	32	29%
Agree	56	51%
Disagree	20	18%
Strongly Disagree	2	2%
No Opinion	1	1%

The factor of class size impacting the frequency of utilization is not clear when data are compared regarding class size bands and frequency of utilization as reported by classroom teachers (Table 15). As indicated in Table 15, among teachers with 20 or fewer students, 24% reported using manipulatives daily, while only 5% with 21-26 students reported the same frequency. (Due to the small number of respondents with more than 27

Table 14

Teacher Perception Regarding the Impact of Class Size on Frequency of Utilization of Manipulatives

Rating	<u>n</u>	Percentage
Strongly Agree	21	19%
Agree	45	42%
Disagree	32	30%
Strongly Disagree	9	8%
No Opinion	1	1%

Table 15

Class Size as Compared to Frequency of Utilization of Math Manipulatives

Frequency	<u>Class Size Bands</u>					
	20 or fewer students		21-26		27 or more	
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>
Daily	9	24%	3	5%	2	18%
4 times a week	3	8%	18	30%	1	9%
3 times a week	14	37%	18	30%	1	9%
2 times a week	5	13%	8	13%	3	27%
1 time a week	4	11%	9	15%	2	18%
Less than once a week	3	8%	5	8%	2	18%

students, these data were not interpreted.) However, when those teachers who reported using manipulatives three or more times a week were compared between the two class size bands, little variation was observed. In classes with

20 or fewer students, 69% used manipulatives at least three times a week, while 65% reported doing so with class sizes ranging from 21-26. The potential impact grade level had on class size, as compared to frequency of utilization, was not examined as a part of this study.

Chapter 5

Summary, Findings, Conclusions and Recommendations

Summary

The purpose of this study was to examine factors associated with the utilization of manipulative-based mathematics instruction in the classroom and its perceived effect on the mathematics achievement of public school students in grades kindergarten through four. Participants, randomly selected teachers in kindergarten through grade from Illinois Regional Offices of Education located in Area IV, completed a survey instrument designed to reveal their perceptions on various factors relating to the utilization of math manipulatives. Data from 111 surveys were included in the study.

Specific research questions examined by this study included:

1. To what degree, if any, does grade level impact the frequency with which math manipulatives are used by kindergarten through fourth grade teachers?
2. According to teacher perceptions, what effect, if any, does the use of a manipulative-based approach have on student achievement in mathematics?
 - a. Is the utilization of math manipulatives vital to a student's understanding of mathematical concepts?
 - b. Is the academic achievement level of students impacted positively when math manipulatives are used?
3. According to teacher perceptions, to what degree do selected factors influence the frequency of their use of math manipulatives in terms of:
 - a. Integration of manipulatives into the current curriculum
 - b. Amount of time involved in teaching the lesson
 - c. Amount of time involved in planning the lesson
 - d. Training

- e. Adequacy of materials
- f. Desire for assistance during instruction
- g. Expense of providing supplemental materials
- h. Administrative support
- i. Parental support
- j. Classroom management issues
- k. Class size

Findings

The data collected for each research question were presented in tables containing the number of responses and their corresponding percentages in each rating category on the survey instrument. Total responses received from teachers in specific grade levels were as follows: kindergarten = 23, first = 27, second = 18, third = 25, and fourth = 17.

Data from survey questions asking teachers to indicate their grade level and the frequency with which they utilized math manipulatives were presented to answer research question 1. Twenty-six percent of the kindergarten teachers reported using manipulatives daily, while first grade teachers reported a daily utilization rate of 19%. Daily utilization fell to 0% at grade two, 2% at grade three and 1% at grade four. No kindergarten, first, or second grade teacher reported using manipulatives less than at least once weekly, while 16% of third grade teachers and 35% of fourth grade teachers reported using manipulatives less than once a week.

Data from survey questions 2 and 3 were presented to determine teacher perceptions regarding the effect of a manipulative-based approach on student achievement. Ninety-seven percent of the respondents indicated that they believed the utilization of manipulatives during math instruction was vital to a student's understanding of mathematical concepts. Ninety-eight percent of

respondents indicated their belief that the academic achievement level of students was impacted positively when math manipulatives were used. Sixty-eight of the 77 teachers expressing thoughts on the importance/lack of importance of using manipulatives, indicated they believed that the use of manipulatives was very important and/or vital to their students' understanding of mathematical concepts (see Appendix E).

Teachers were asked to indicate their agreement/disagreement with survey questions 4 through 14 which were statements associated with various factors which could impact the frequency with which teachers utilized manipulatives in their classrooms.

The first factor examined was the integration of the use of manipulatives into the current math curriculum. Seventy-five percent of the respondents indicated they perceived that the use of manipulatives was fully integrated into the curriculum adopted by their district.

Sixty-six percent of the respondents indicated the amount of time involved in teaching a manipulative-based lesson was taken into consideration when determining how often they utilized manipulatives.

When asked if the amount of time involved in planning and preparing a manipulative-based lesson was a factor in how often they utilized manipulatives, 58% of the teachers indicated it was. It should be noted that 40% indicated that preparation time was not a factor.

Eighty-five percent of the teachers indicated they agreed or strongly agreed that their knowledge/training had adequately prepared them to integrate manipulatives into their curriculum, while 11% indicated disagreement or strong disagreement. It should be noted that of the 85% indicating their training was sufficient, only 25% strongly agreed that it was. It should also be noted that of 111 surveys returned, 103 teachers supplied the type of staff development they

felt had a significant impact on their ability to utilize manipulatives.

When asked their perceptions of the adequacy of manipulative materials provided by the district, 57% of the respondents indicated they agreed or strongly agreed that their district provided all the manipulatives they needed. It should be noted that 39% disagreed or strongly disagreed that their needs were met through their district.

Fifty-five percent of the respondents indicated that they would utilize manipulatives more frequently if a teaching assistant or parent volunteer were available during math instruction. Thirty-eight percent indicated that the availability of a teaching assistant or parent volunteer would make no difference in their use of manipulatives.

Forty-two percent of teachers either agreed or strongly agreed that the personal expense involved in providing math manipulatives was a limiting factor in the frequency of usage. Fifty-four percent indicated that they did not believe that the personal expense involved in paying for manipulatives was a factor which limited their use.

Ninety-two percent of the teachers indicated they strongly agreed or agreed that their administrator supported their use of math manipulatives. Only 1% indicated that their administrators did not support their use of math manipulatives, while 7% offered no opinion.

Seventy-five percent of teachers indicated that they believed that parents supported the use of math manipulatives. It should be noted that 22% of the respondents had no opinion concerning parental support for the use of manipulatives.

Eighty percent of the teachers either agreed or strongly agreed that classroom management issues were factors they considered when deciding whether or not to utilize manipulatives during instruction. Twenty percent

indicated that classroom management issues did not affect the extent of their use of manipulatives.

Sixty-one percent of teachers indicated that class size was a factor to consider when determining whether or not to use manipulatives, while 38% disagreed or strongly disagreed that class size was a factor.

Conclusions

Results indicated that grade level does impact the frequency with which math manipulatives are utilized. Manipulatives are used on a daily basis with a greater percentage of kindergarten teachers than any other grade level. Fifty-two percent of kindergarten teachers and 56% of first grade teachers reported using manipulatives at least four times a week. Percentages of teachers reporting using manipulatives four or more times a week for second grade teachers dropped to 11%, third to 20% and fourth to 12%, indicating a significant drop between first and second grade. Every respondent at kindergarten, first, and second grades reported using manipulatives at least once a week. Sixteen percent of third grade teachers and 35% of fourth grade teachers reported using them less than once a week.

Teachers overwhelmingly perceived that the use of manipulatives was important to students' understanding of mathematical concepts, and that the use of manipulatives had a positive effect on student achievement. Ninety-seven percent of the respondents agreed or strongly agreed that the use of math manipulatives was vital to student understanding, while 93% indicated that math manipulatives had a positive impact on student achievement. On the comment section of the survey, teachers repeatedly cited the importance manipulatives played in increasing student achievement and understanding in math.

Teacher perceptions of eleven factors which might impact the use of

manipulatives were examined. Teachers clearly perceived that manipulatives were integrated into their current curriculum, as evidenced by 75% of teachers who reported agreement or strong agreement that manipulatives were fully integrated.

Using manipulatives is often more time consuming than paper and pencil tasks. Teachers (66% of the respondents) indicated that the amount of class time required to teach a manipulative-based lesson was a factor they took into consideration when planning how often they could incorporate manipulatives into their math lessons.

A majority of teachers perceived that the preparation time involved in planning a manipulative-based lesson was a factor they considered when determining whether or not to utilize manipulatives during math instruction, as indicated by 58% of the respondents.

Training does not appear to be a negative factor, but room for improvement was indicated among 75% of the respondents. In assessing self-perception of the adequacy of teacher knowledge and training in the use of manipulatives, 25% reported they strongly agreed their training was adequate while 60% agreed that their training was adequate.

In order to use math manipulatives, an adequate supply must be available. While 57% of teachers indicated that their district provided them with an adequate supply, a large group (39%) did not believe they were provided with enough manipulatives. Although an adequate supply of manipulatives can not be considered a negative factor, there appeared to be wide variations of availability among the schools included in the study.

The factor of personal expense was a divided issue for the respondents. Forty-five percent of teachers reported that the expense involved in providing their own manipulatives limited the frequency with which manipulatives were

utilized. Fifty-four percent of teachers did not believe that personal expense in providing manipulatives affected their use. The expense factor must be taken into consideration, since it was a concern to 45% of respondents.

Teachers indicated they would use math manipulatives more frequently if they had help during periods of instruction, either in the form of a teaching assistant or parent volunteer. Fifty-five percent of respondents indicated a desire for assistance. A desire for assistance during manipulative-based lessons was also mentioned as a factor in the comment section of the survey.

Teachers clearly perceived that they had administrative support for using manipulatives as evidenced by the 92% of respondents who agreed or strongly agreed that they had the support of their administrators. Seven percent indicated they had no opinion, which leads the researcher to question if this lack of an opinion was due to the teachers not using manipulatives, or to the administrator not voicing an opinion.

Having parental support when using manipulatives was not a concern among respondents. Seventy-five percent of teachers believed they had the support of their parents to use manipulatives. However, 22% reported having no opinion, indicating that many teachers do not know how their parents feel about the use of manipulatives as an instructional strategy.

Classroom management issues were factors teachers considered when deciding whether or not to use manipulatives, as evidenced by 80% of the respondents. Concerns about classroom management and the less structured atmosphere during manipulative-based lessons were also cited by teachers in the comment section of the survey.

Teachers perceived class size as being a limiting factor in how often they utilized math manipulatives. Sixty-one percent of teachers indicated that class size was a factor in determining how often they used manipulatives. Class size

was mentioned in the comment section as being a concern for two teachers. However, when analyzing the number of times teachers reported using manipulatives, little variance of frequency was noted among teachers reporting using them three or more times a week in class sizes of less than 20 or between 21 and 26 students. Due to the small percentage of respondents with class sizes over 26, the issue of class size could not be completely determined. The factor of whether or not class size impacts frequency is worthy of further investigation.

In summary, of the eleven factors examined, teachers perceived the following five as having an impact on the frequency with which they utilized math manipulatives: the amount of time involved in teaching the lesson, the amount of time involved in planning the lesson, class size, classroom management issues, and the need for additional assistance during instruction.

Based upon survey results and teacher comments, kindergarten through fourth grade teachers in Area IV of the State of Illinois Regional Offices of Education, overwhelmingly supported the use of mathematics manipulatives, integrated the use of manipulatives into classroom instruction, and clearly perceived that the use of manipulatives was important to students' understanding of mathematical concepts.

Recommendations

It is apparent from the results of this study that an overwhelming percentage of teachers perceive the use of manipulatives as being very important to student success in mathematics. It is recommended that a study be undertaken which would involve comparing achievement test scores among students who receive math instruction with manipulatives on a regular basis to scores of students who receive instruction through a lecture and paper/pencil approach. Teachers indicated they perceived the use of manipulatives as

having a positive impact on student achievement. Test score analysis between two such groups might provide support for this perception.

It is clear that the frequency with which manipulatives are utilized depends on many factors. In order to fully utilize manipulatives, teachers must have an adequate supply. Thirty-nine percent of teachers reported that their district did not provide an adequate supply of manipulatives, and 45% reported that having to provide manipulatives at their own expense limited the frequency with which they were utilized. It is recommended that districts allow a teacher committee to determine minimum needs for each grade level and that a monetary commitment be made to provide teachers with this basic supply. In addition, a system of providing for the needs of individual teachers could be established.

The reported frequency of usage rate of math manipulatives dropped after first grade. This could be due to the increasing pressure to complete paper and pencil tasks, a lack of teacher knowledge on how to incorporate manipulatives into higher grades, or a combination the two. It is recommended that training and in-service opportunities become an ongoing part of a district's staff development plan. It is also recommended that an emphasis on manipulative-based instruction be an integral part of undergraduate mathematics methods courses.

Twenty-two percent of teachers marked no opinion when asked to rate parental support, while 55% indicated they would use manipulatives more frequently if they had assistance during instruction. It is recommended that teachers attempt to enlist parents to assist during math instruction. Not only would this be beneficial during instruction by having an extra set of hands available to help, it would also allow parents to become familiar with manipulative-based instruction. Enlisting parent volunteers could also help with

classroom management concerns.

Sixty-one percent of teachers perceived that class size was a factor which limited their ability to use manipulatives. Due to the limited number of teachers with class sizes above 27 who returned surveys, the impact of class size on the frequency with which manipulatives were utilized could not be definitely determined. It is recommended that the impact of class size on the use of math manipulatives be an area of further research.

Based upon the findings of this study, it is recommended that districts establish a procedure by which teachers could choose to utilize a manipulative-based approach in grades kindergarten, one, two, three and four in place of the paper and pencil format of the district adoption. Areas to be considered in such a proposal include: criteria regarding acceptable levels of teacher training, a requirement to follow the curriculum presented in the district adoption, a monetary stipend equivalent to the cost of student workbooks to be used for manipulatives, the development of a support system for teachers attempting this approach, and an alternative assessment program for students.

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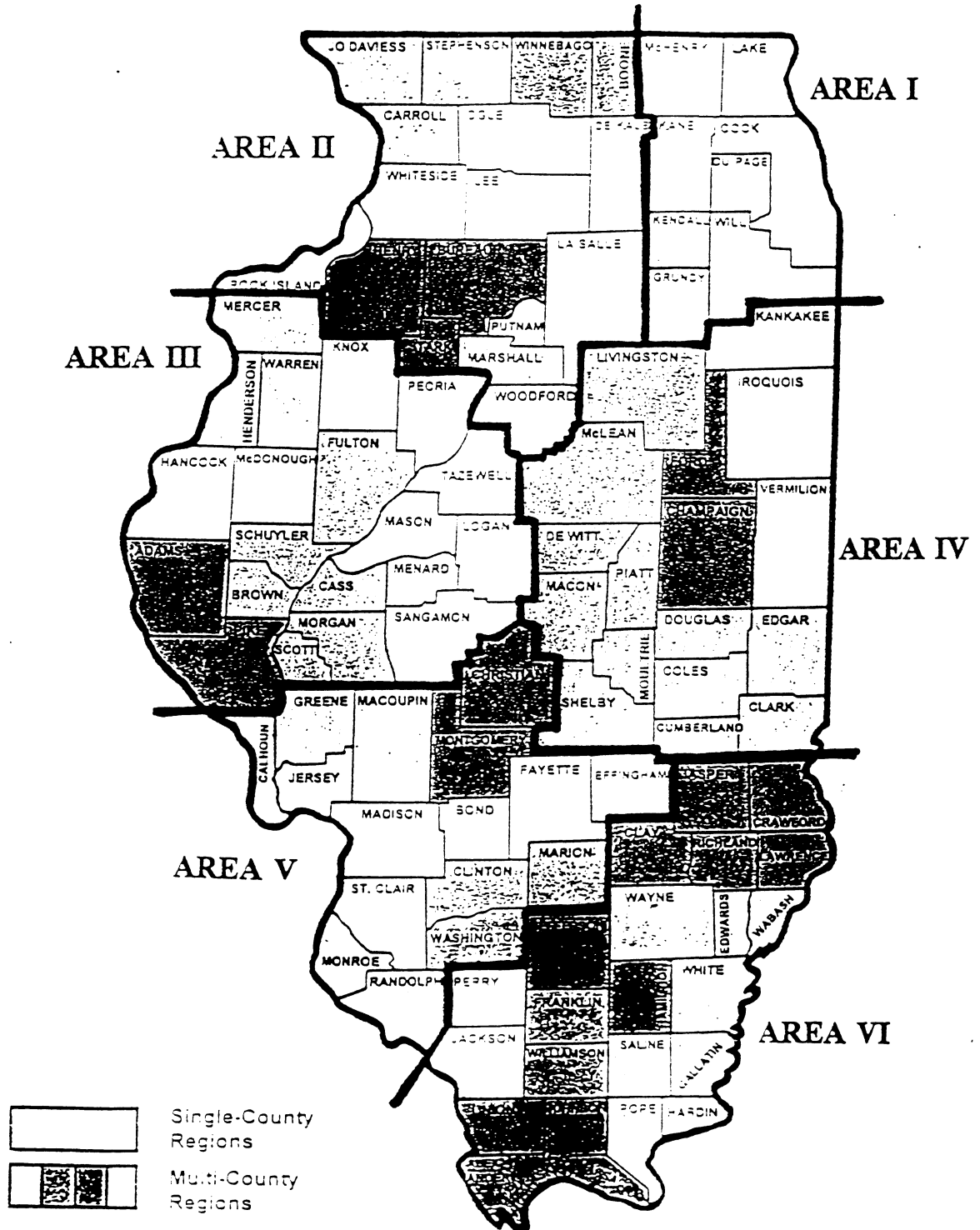
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Appendix A

Map of Regional Offices of Education

REGIONAL OFFICES OF EDUCATION



Appendix B

Teacher Survey on Math Manipulatives .

Section I - Background Information

SPECIAL CODES Instructions

Column A Instructions - Please indicate your current grade level by filling in the corresponding numbered bubble under the "A" column in the SPECIAL CODES section of the scantron sheet.

(Column A) What grade level are you currently teaching?

- | | | | |
|---|--------------|---|--------|
| 0 | kindergarten | 3 | third |
| 1 | first | 4 | Fourth |
| 2 | second | | |

Column B Instructions - Please indicate your current class size by filling in the corresponding bubble under the "B" Column according to the ranges listed below.

(Column B) In which range does your current class size fall?

- | | |
|---|---------------------|
| 0 | 20 students or less |
| 1 | 21 to 26 students |
| 2 | 27 students or more |

--In comment box #1, please list any training you have received which you feel had a significant impact on your ability to utilize math manipulatives. (Possible training might include, but is not limited to the following: Math Their Way, Box It and Bag It, AIMS, local staff development, regional, state or national conferences.)

--In comment box #2, please add any comments you have regarding the importance/lack of importance regarding the use of manipulatives.

Section II - Teacher Perceptions Regarding the Use of Math Manipulatives.

Please mark the bubble (A - E) which best completes the following numbered item.

1. How frequently do you utilize manipulatives for mathematics instruction, on average, each week. If you use manipulatives less than once a week, please do not mark a response.
 - A. daily
 - B. four times a week
 - C. three times a week
 - D. two times a week
 - E. once a week

(Please continue by answering questions on the following page.)

Please use the following five response choices to indicate the extent of your agreement/disagreement with each of the following statements (2 - 14). Mark your answer sheet accordingly.

- A. Strongly agree
- B. Agree
- C. Disagree
- D. Strongly Disagree
- E. No opinion

2. It is my perception that the utilization of math manipulatives during math instruction is vital to a student's understanding of mathematical concepts.
3. It is my perception that the academic achievement level of my students is impacted positively when math manipulatives are used.
4. It is my perception that the use of math manipulatives is fully integrated into the math curriculum adopted by my school//district.
5. It is my perception that the amount of time involved in teaching a manipulative based lesson is a factor in how often I utilize math manipulatives.
6. It is my perception that the amount of time involved in planning and preparing manipulative based lessons is a factor in how often I utilize math manipulatives.
7. It is my perception that my degree of knowledge/training has adequately prepared me to be able to integrate manipulatives into my math curriculum.
8. It is my perception that my district provides all of the manipulatives I need.
9. It is my perception that I would utilize manipulatives more frequently if I had a teaching assistant or parent volunteer during math instruction.
10. It is my perception that the expense involved in providing manipulatives limits the frequency with which I utilize them.
11. It is my perception that my administrator supports the use of math manipulatives.
12. It is my perception that my parents support the use of math manipulatives.
13. It is my perception that classroom management issues are factors to consider when deciding whether or not to utilize manipulatives during instruction.
14. It is my perception that class size is a factor to consider when determining whether or not to use manipulatives.

Appendix C

Cover Letter

November 9, 1997

Dear Colleague,

I am conducting a field study as part of the Specialist in Educational Administration degree program through Eastern Illinois University. My study seeks to examine teacher perceptions of various factors which might impact the frequency with which math manipulatives are utilized in the classroom.

You were selected as a participant among kindergarten, first, second, third, and fourth grade teachers from schools located within Area IV of Illinois Regional Offices of Education. I am requesting that you complete the survey on the enclosed scantron sheet and return it by November 21, 1997. A stamped, self-addressed envelope is included for your convenience. The surveys are numbered for tracking purposes only. Information you provide will remain confidential, and your responses will be used solely for research purposes. Total research results and recommendations will be shared during the 1998-1999 school year with the Math Task Force, Decatur Public Schools.

If you would like to receive a copy of the final results, please write your name and address on the enclosed label. Leave it attached to its backing, and slip it into the return envelope.

Thank you in advance for assisting in this study.

In Education,

Debbie Bandy
Principal, Durfee Magnet School

Appendix D
Scantron Sheet

**GENERAL PURPOSE
DATA SHEET III
form no. 19541**

USE NO. 2 PENCIL ONLY

SPECIAL CODES

A	B	C	D	E	F	G	H	I	J
0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9

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- 19 (A) (B) (C) (D) (E)
- 20 (A) (B) (C) (D) (E)
- 21 (A) (B) (C) (D) (E)
- 22 (A) (B) (C) (D) (E)
- 23 (A) (B) (C) (D) (E)
- 24 (A) (B) (C) (D) (E)
- 25 (A) (B) (C) (D) (E)
- 26 (A) (B) (C) (D) (E)
- 27 (A) (B) (C) (D) (E)
- 28 (A) (B) (C) (D) (E)
- 29 (A) (B) (C) (D) (E)
- 30 (A) (B) (C) (D) (E)
- 31 (A) (B) (C) (D) (E)
- 32 (A) (B) (C) (D) (E)
- 33 (A) (B) (C) (D) (E)
- 34 (A) (B) (C) (D) (E)
- 35 (A) (B) (C) (D) (E)
- 36 (A) (B) (C) (D) (E)

- 1 (A) (B) (C) (D) (E)
- 2 (A) (B) (C) (D) (E)
- 3 (A) (B) (C) (D) (E)
- 4 (A) (B) (C) (D) (E)
- 5 (A) (B) (C) (D) (E)
- 6 (A) (B) (C) (D) (E)
- 7 (A) (B) (C) (D) (E)
- 8 (A) (B) (C) (D) (E)
- 9 (A) (B) (C) (D) (E)
- 10 (A) (B) (C) (D) (E)
- 11 (A) (B) (C) (D) (E)
- 12 (A) (B) (C) (D) (E)
- 13 (A) (B) (C) (D) (E)
- 14 (A) (B) (C) (D) (E)
- 15 (A) (B) (C) (D) (E)
- 16 (A) (B) (C) (D) (E)
- 17 (A) (B) (C) (D) (E)
- 18 (A) (B) (C) (D) (E)

COMMENT 1

COMMENT 2

FOR OFFICE USE ONLY

37 (A) (B) (C) (D) (E)

38 (A) (B) (C) (D) (E)

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Appendix E

Survey Comments Regarding the Importance/Lack of Importance of
Using Math Manipulatives

The following list represents teacher responses located in comment box #2 of the Teacher Survey on Math Manipulatives:

- Academic achievement is higher when manipulatives are used.
- I wish I had more manipulatives.
- At my level (K) manipulatives are very important. With the use of hands on materials, subject matter is better understood.
- I believe at this level (2) manipulative are a must! We use them throughout he whole year.
- Manipulatives are very helpful when teaching things such as money, time, etc. They are very time consuming and it is a less structured atmosphere. It is hard with some classes.
- Manipulatives make it easier for the children to comprehend concepts.
- Student use of manipulatives is vital to understanding.
- Our district uses the Saxon program at the primary level and manipulatives were purchased. We LOVE it!
- First and second grade teachers say students come in with strong math skills.
- I feel their use is important at the kindergarten level.
- Very beneficial for hands on experiences.
- Manipulatives are very important.
- They are an integral part of my instruction. We do not use a math workbook.
- Manipulatives are vital to an understanding of concepts in math instruction.
- Only way to make learning meaningful and fun.
- There are always a few children in every class who do so much better if they can be taught “hands on”.
- Saxon Math is manipulative strong at Kdg. = excellent program.
- I use manipulatives almost exclusively.
- Manipulatives are very important; help children visualize math concepts

in a hands on method.

- Very important, especially in lower grades.
- Some kids catch on easily, but for those who don't, I think hands-on activities help a lot.
- Very important.
- Manipulatives very useful-I use milk bottle caps, number lines, rulers, etc.
- I feel manipulatives are vital to our math instruction. Very important.
- Important to use manipulatives.
- Very important!
- I feel manipulatives extremely important at my grade level- going from concrete to abstract- fosters understanding.
- Manipulatives should be an essential part of teaching in all grades.
- Very important in K-2nd only used occasionally in my 3rd grade classroom, with my lower students.
- Very important for teaching some concepts.
- Hands on gives meaning to all students.
- Very important.
- Many children learn but using manipulatives first and then going to more abstract procedures.
- Big importance on using manipulatives - especially for Chapter math students, slow learners, and L.D. students!
- I feel it is essential. It makes "sense" of abstract ideas.
- I think hands-on materials are important in all subject area, esp. for elementary students.
- Math manipulatives are essential for children to understand math concepts.
- Manipulatives seem to help most children.
- Manipulatives are a valuable resource for building concepts.
- Manipulatives are very important, esp. at first grade level - using hands and objects makes math more "real" and more fun - esp. for slower learners.
- Manipulatives are very important for first graders for exploration as well as concept development and reinforcement.
- Classes with who I now use manipulatives progress faster than those

classes in the past when I did not have manipulatives.

- Manipulatives are VERY important in kindergarten.
- Easy to see and understand but very time consuming. Some children become too dependent on manipulatives.
- I feel that using manipulatives is helpful to all who use them - no matter the ability level.
- Manipulatives are extremely important and meaningful in teaching math.
- Manipulatives are the foundation of my math instruction. Couldn't live without them.
- I feel that some students need to use manipulatives to understand math concepts, however not all students really need them.
- During the beginning of the year I tend to use manipulatives more.
- Some students need the "hands-on" examples to learn the concepts.
- I try to use a multi-sensory approach. Manipulatives are part of that.
- Extremely important at grade 1 - helps concept become more "real" and concrete.
- Lower ability students definitely need manipulatives and so do the hand on visual learners.
- Manipulatives have helped my students understand in a concrete way the math problems at hand.
- I think it's very important and especially at the kindergarten level.
- Use of manipulatives in the math classroom is essential to insure that the students internalize the concepts.
- Extremely important.
- Using manipulatives is very important. It gives student another way to help students understand the concept being taught.
- Essential in primary grades.
- Manipulatives have made it much easier for my student to grasp math concepts.
- I place great importance on manipulatives - best way to teach kdg.
- Extremely important at my grade level.
- Manipulatives are very important in my math teaching! The children can see & use!
- Hands on are very important, especially for the slow learner.

- Manipulatives are important to the understanding of math concepts.
- A large percentage of students must perform, hands-on, to truly understand. (I am one!)
- Math Manipulatives help children visualize abstract concepts. Many children can work through to bring understanding with manipulatives.
- I offer several different types and allow child to choose favorite. Usually prefer number line by Jan. of first grade.
- I find that manipulatives are an invaluable tool. They help to bridge the gap from the concrete to the abstract.
- I found it much easier to use manipulatives with 19 students (last yr) than the 26-27 I've had this current year. Stock, storage, ease of passing things out are really major factors especially storing them with no room!
- I have 21 yrs. experience in grade K-2 and used manipulatives often.. As a first yr. fourth grade teacher, I'm finding it difficult to find appropriate ways to use manipulatives for the skills taught so far.
- The topic we are working on determines how often or how much I use manipulatives.
- Random basis.
- We do not have many manipulatives. I feel they are quite important, yet I am limited.
- Use of manipulatives should not replace much needed memorization of facts. I see "knowing" facts on the decline.
- Some children use them to play and do not do work.
- It is hard to keep kids on task. Need extra help with manipulatives.