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ABSTRACT

This paper discusses the results of questionnaires sent to principals and teachers on the subject of manipulatives, computer, and calculator availability and use in the classroom. The study was done in order to develop a better understanding of teachers' inservice needs. Results of the study include: (1) most teachers have at least some manipulatives available to them; (2) on average, students use manipulatives about once a week; (3) the most common use of computers is for drill and practice; and (4) the most common use of calculators is for checking paper-and-pencil work. An introduction is followed by a literature review, and by brief descriptions of the methodology, instruments, sample, and procedure. A discussion of the results precedes the general conclusions. Tables listing percentages of availability of manipulatives and student usage time with manipulatives, computers, and calculators are appended. (KR)

THE USE OF MANIPULATIVES, CALCULATORS, AND COMPUTERS IN SELECTED KANSAN THIRD, FOURTH, AND FIFTH GRADE CLASSROOMS

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ABSTRACT

In January of 1990, questionnaires on the use of manipulatives, calculators, and computers were mailed to elementary principals, third, fourth, and fifth grade teachers in selected school districts in Kansas. The first questionnaire, completed by 54% of the principals, concerned principals' perceived usage of manipulatives, calculators, and computers in mathematics teaching by the elementary teachers in their schools. The second questionnaire, completed by 56% of the teachers, contained questions about the availability and use of manipulatives, calculators, and computers for their mathematics teaching. Results of the study include findings that: (1) Most teachers have at least some manipulatives available to them; (2) on average, students use manipulatives about once a week; (3) the most common use of computers is for drill and practice; and (4) the most common use of calculators is for checking paper-and-pencil work. Teachers are interested in having more manipulatives and want inservice in the appropriate use of the manipulatives.. This study was funded by the Dean's Faculty Research and Creativity Fund of The Teachers College at Emporia State University.

INTRODUCTION

In August of 1989, Jean Morrow joined the faculty of The Teachers College at Emporia State University as the elementary mathematics educator. In order to develop a better understanding of teachers' inservice needs, and finding little data available on the use of manipulatives, calculators, and computers, particularly by teachers of the intermediate grades, Morrow spoke with Dean Jack Skillett of The Teachers College, Kaye Tague, elementary education supervisor of USD 253, and Dr. Diane Richards, Director of the Flint Hills Education Research and Development Association (FHERDA). Based on those discussions, Morrow submitted a research proposal to the Dean's Faculty Research and Creativity Fund in October of 1989. The proposal was funded in November of 1989. In January of 1990 the questionnaires were mailed out to all principals, third, fourth, and fifth grade teachers belonging to FHERDA. Data was collected and analyzed during the spring. This report was written during the summer.

LITERATURE REVIEW

MANIPULATIVES

About one hundred fifty years ago, Friedrich Froebel invented the term "kindergarten" and provided his students with wooden geometric shapes with which to play. The shapes were also used for exploration, and as models for drawing from different perspectives. To this day, the use of manipulatives by young school children is advocated and commonly accepted (Fennema, 1972; Suydam and Higgins, 1977; Post, 1980; Parham, 1983; and Herbert, 1985). Piaget has proposed a comprehensive theory of cognitive development that suggests, among other things, that children of seven through eleven years of age need to experience through hands-on, concrete actions, the ideas which symbols represent. Yet, Kloosterman and

Harty (1987) found that manipulatives were used in the teaching of mathematics more often in grades K-2 than in grades 3-5, at least in the state of Indiana. Personal experience in Nebraska, Michigan, Iowa, and Massachusetts indicated to the author that Kloosterman and Harty's findings were not limited to Indiana alone.

This study directed attention to the use of manipulatives in grades three, four, and five, typically students aged nine through eleven ... who need, but often do not experience, concrete materials to help develop symbolic understanding. Types of manipulatives available, and the amount of time they were used, were two of the questions addressed.

CALCULATORS AND COMPUTERS

In 1983, Winner and Holloway suggested that "instead of merely adding calculator and computer games, CAI drill and practice exercises to an already misdirected and overcrowded 'hodge podge' of learning activities, it is appropriate now to rethink and revise our whole approach to the learning of mathematics at the primary and intermediate levels." (p. 30) Indeed, the National Council of Teachers of Mathematics has for many years urged this rethinking and revising of our approach to the learning and the teaching of mathematics In the Standards, a strong recommendation is made that "appropriate calculators should be available to students at all times." (p. 8) In the NCTM's Executive Summary the point is made that "The effects of technological innovation on business, government, and industry are paralleled by dramatic changes in the physical, social, and life sciences. More than many other areas of study and application, mathematics is being taken in a new direction. Modern technology has caused a shift in what mathematics a person needs to know. At the same time, as computers open frontiers of ideas once beyond exploration, new mathematics is being created

as technological applications emerge. Mathematics now offers unprecedented potential for helping people understand the world. Yet in the midst of change, the teaching of mathematics has remained relatively unchanged. As it has for centuries, learning mathematics has often relied on rote memorization of rules. Many teachers view success in mathematics as immediate mastery of facts and rules." (p. 3)

A review of research (Long, 1985; Seidman, 1986; Dickey & Kherlopian. 1987) quickly reveals that the potential and actual uses of computers for computers vary widely. Computer software has been developed in the areas of drill and practice, tutorials, simulations, problem-solving, and games. Nevertheless, the majority of teachers seem to rely upon drill and practice programs.

Similarly, calculators provide an opportunity to explore a host of mathematical concepts and problems that may involve computational skills beyond their present knowledge. Yet many teachers hesitate to let young children use calculators for fear that it will inhibit their learning of basic skills (Driscoll, 1981). Or, if calculators are used, they are used to check assignments already completed with paper and pencil (Reys, Bestgen, Rybolt, & Wyatt, 1980).

A second area then, that this study proposed to examine, was the extent to which calculators and computers were used and the purposes for which they were used.

METHOD

To determine the extent to which manipulatives, calculators, and computers were available and used in third, fourth, and fifth grade classrooms, two questionnaires were designed and validated before they

were mailed to all elementary principals and all third, fourth, and fifth grade teachers in the FHERDA consortium.

INSTRUMENT

The questionnaires were adapted from previously validated ones (Klooster man & Harty, 1987) and the adaptations were reviewed by university mathematics educators and public school practitioners (Kerlinger, 1979). Minor revisions were made in the instrument based upon their comments.

SAMPLE

As stated previously, the teachers and principals surveyed were members of the FHERDA consortium. This particular group was chosen a) to keep the survey manageable and b) because of the relationship between the university and FHERDA. Principals were asked to respond to the questions in the subcategories of grades K-2, 3-5, and 6-8 (if those grades were housed in the elementary building). Teachers responded only for their own classroom.

PROCEDURE

A cover letter, questionnaire, and postage-paid return envelope were mailed in mid-January, 1990. Recipients were asked to respond by early February, 1990. Instructions for completing the questionnaire were contained in the cover letter and on the instrument itself. Confidentiality was assured.

It is important to note that instructions for manipulatives stipulated that pupil use, not teacher demonstration, was the criteria to be used when responding. To all intents and purposes, if only the teacher used a manipulative, i.e., to introduce or demonstrate a concept, that was not considered "using manipulatives." The manipulatives used, and the amount

of time they were used, by the students themselves, were to be the focus of the study.

RESULTS AND DISCUSSION

The question of availability of manipulatives was addressed by asking teachers what percent of their classroom manipulatives were commercially made and what percent were teacher-made. Forty-one percent of the teachers responding said that over half of the manipulatives used in their classrooms were commercially made and twenty-one percent reported that over half of the manipulatives were teacher-made. One third grade teacher noted that "there's no money and no storage place available to me for more teaching aids". A fourth grade teacher commented that "We just got our new math series. The series is good but we still haven't gotten all the manipulatives I'd like to have. More tangrams, geoboards, cuisenaire rods, base ten blocks (enough for everyone in the room at once)." While one fifth grade teacher wanted to see commercially made manipulatives available within the district, another noted that "discipline problems tend to develop when manipulatives are used". The written comments seem to be indicative of Fay's (1979) finding that the most serious problem mentioned by teachers of elementary mathematics is the lack of monies to purchase equipment and supplies. Thus it would seem that while teachers have some manipulatives available to them, additional quantities and varieties would be beneficial.

The question of amount of time students spent using manipulatives was addressed in two ways. First, teachers were asked about how many days per year manipulatives were used. Eighty-eight percent reported that the students used manipulatives less than 50 school days a year, that is, less than twice a week. There was a significant difference between the amount of time third-graders and fifth graders used the manipulatives, with the

third grade teachers reporting more usage ($p < .05$). Then, later, teachers were asked, on the average, how many minutes per week were spent with hands-on manipulative activities. Ninety-four percent reported using manipulatives less than two hours per week. This is consistent with the previous question. An interesting point here is that the principals reported greater usage of manipulatives in third, fourth, and fifth grade classrooms than did the teachers themselves.

The questions directed toward the use of computers revealed that, in general, computers were seldom used by the students, either alone or in small groups, for more than a half hour per week. The most frequent use of computers was for drill and practice. Only seven percent of the teachers reported "not at all" on the use of the computer for drill and practice. Twenty-nine percent reported not using the computer at all for tutorial work (learning new information or subject matter); nearly forty-four percent said they never used simulation programs (operating a lemonade stand, running a store, etc.); and twenty-seven percent said they did not use the computer for developing either problem solving or higher order thinking skills. There were no significant differences among the grade levels. In general, the findings here are in keeping with other recent studies of computer usage in elementary schools (Kloosterman & Harty, 1987).

Fifty percent of the teachers responding stated that they did not have students use calculators at all for checking answers to paper-and-pencil computation; forty percent did not have students use calculators for doing computation involved in problem solving; and nearly fifty-seven percent reported not having students use the calculator at all to explore or discover patterns not yet taught. There were significant differences at the .05 level in between the amount of time third graders and fifth graders spent using

calculators for checking paper-and-pencil work. The fifth graders were reported to be using calculators more frequently for checking answers. Several respondents commented that the school, or several rooms in a school, shared one class set of calculators. The indictment made at the conference that developed the recommendations found in School Mathematics: Options for the 1990s, still seems appropriate: "Two-thirds of all elementary school mathematics is taught in order to make calculators and microprocessors obsolete" (p. 27).

Lastly the teachers were asked how often inservice was available in the use of manipulatives, their interest in having additional inservice, and the need for more manipulatives. Sixty percent of the teachers reported that such inservices were available once every couple of years. The same percentage stated that they would like to have more manipulatives in their classrooms and would like to have inservice on how to use the manipulatives in their teaching. A number of teachers added a written comment that they would like to have more manipulatives if they also received training in how to use them, or similarly they would like the inservice if the manipulatives were available for them to use.

GENERAL CONCLUSIONS

It is important to remember that the interpretation of the results of this study have several limitations: the sample is a limited one; the data gathered for this report are intended as general guidelines or indicators of trends in the use of manipulatives, calculators, and computers, and the need for inservice, particularly in the area of manipulatives.

Data also indicate that most teachers do have access to at least some manipulatives and do use them one or more times a week. An unanswered question is whether the manipulatives are appropriate ones and/or available

in sufficient quantities. A related, and also unanswered question, is whether teachers use the available materials in the way they were intended to be used.

Calculator and computer findings were about as expected. Using calculators to check paper-and-pencil algorithms and computers for drill and practice predominate but there is some indication that other, more creative uses, are being practiced in some classrooms. Perhaps the emphasis on appropriate uses of technology to enhance mathematics instruction is beginning to impact teachers in the field as well as the preservice preparation of teachers. Finally, the survey results have been beneficial for us as we continue to address the need for inservice education, and the mathematical areas in which teachers want input.

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APPENDIX

TABLE 1. PERCENT OF TEACHERS REPORTING

	Availability of Commercial Manipulatives	Availability of Teacher-Made Manipulatives
Less than 10%	21%	18%
10% to 25%	13%	35%
26% to 50%	25%	26%
51% to 75%	22%	12%
76% to 100%	19%	9%

TABLE 2. PERCENT OF TIME STUDENTS USE MANIPULATIVES

Number of days per week manipulatives used		No. of minutes per day manipulatives used	
less than 10	12%	None	3%
10 to 25	37%	1 to 59 minutes	75%
26 to 50	39%	60 to 119 min.	17%
51 to 75	5%	120 to 240 min.	4%
76 to 100	7%	more than 240	1%

TABLE 3. PERCENT OF TIME SPENT WEEKLY IN COMPUTER USAGE FOR

	Drill & Prac.	Tutorial	Simulation	Prob. Solving
Not at all	7%	29%	43.9%	27.3%
1 to 30 min.	65%	59%	49%	59.6%
31 to 60 min.	21%	8%	5.1%	7.1%
61 to 119 mi	3%	2%	2%	5%
more than 120 min	4%	2%	0%	1%

TABLE 4. PERCENT OF TIME SPENT WEEKLY USING CALCULATORS FOR

	Checking work	Pr. Solv. Comput.	Exploration
Not at all	50%	40.4%	56.5%
1 to 30 min.	46%	53.5%	40.5%
31 to 60 min.	4%	4.1%	3%
61 to 119 min.	0%	0%	0%
more than 120 min.	0%	0%	0%