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ABSTRACT

A large-scale summative, comparative evaluation of "Patterns in Arithmetic" (PIA), a modern televised arithmetic curriculum for grades 1-6 was carried out in grades 1-4 in both rural and urban schools during the 1970-71 school year. This report deals with the results of monitoring procedures carried out, and student achievement as measured by pre- and posttesting using standardized instruments. Implementation data were gathered by interviews with teachers and principals, teacher questionnaire, examination of records, and direct observation. In four of the five sites and implementation requisites were judged to have been satisfactorily fulfilled. Achievement data were gathered on three components (concepts, computation, problem solving) and analyzed using multivariate analysis of variance. Results indicated that the achievement of students in the control group was about equal to that of students in the experimental group. The results did not vary by sex, grade level, or site. (Author/SD)

Technical Report No. 302

EVALUATION OF PATTERNS IN ARITHMETIC IN GRADES 1-4, 1970-71: EFFECTS ON STUDENTS

Report from the Quality
Verification Program

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STATEMENT OF FOCUS

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints--financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

ACKNOWLEDGMENTS

We gratefully recognize the contributions to the 1970-71 Patterns in Arithmetic field test of hundreds of students, teachers, and administrative personnel in the Catholic Archdiocese of New York City Schools; the Chicago Public Schools; the Portland (Oregon) Public Schools; the schools of Franklin, Montgomery, and Pulaski Counties, Virginia; and the schools represented by the Association of School Superintendents, Vermont. Particular thanks are due the instructional television staffs of the New York Archdiocese, the Chicago, and the Portland schools; WBRA-TV (Roanoke, Virginia); and the Vermont ETV network. We also are grateful to the cooperating staff of the Northwest Regional Educational Laboratory, Portland, Oregon.

Many Center personnel offered invaluable assitance throughout the field test, but the contributions of Mary Quilling who wrote the original proposal for the study and supervised its implementation and Ed Haertel who struggled with massive and complex amounts of data must be particularly noted.

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ABSTRACT

A large-scale summative, comparative evaluation of Patterns in Arithmetic (PIA), a modern televised arithmetic curriculum for Grades 1-6, was carried out in Grades 1-4 in 92 rural and urban schools in five sites during the 1970-71 school year. About 5,000 pupils in the experimental schools received PIA as their basic mathematics course while another 5,000 students in control schools continued to use conventional arithmetic programs. Achievement was measured by standardized tests of mathematics concepts, computation, and applications in problem-solving. Results indicated that achievement of control school pupils was about equal to that of students in the experimental group. The results did not vary by sex, grade level, or site.

I

INTRODUCTION

Background

Patterns in Arithmetic (PIA), a comprehensive elementary mathematics program for Grades 1-6, was originated in 1959 and developed over the next decade under the leadership of Professor Henry Van Engen with the support of the Ford Foundation and, starting in 1964, the Wisconsin Research and Development Center for Cognitive Learning. The components of PIA are video-taped lessons which are usually presented via broadcast television, teacher suggestion manuals, and pupil exercise books. Unlike many curricula which employ television, PIA is designed to be a complete program of elementary mathematics rather than a supplementary or enrichment series. When PIA is used as a basic instructional program, a class watches a 15-minute telecast once or twice a week (the schedule varies at different grade levels) and the teacher then develops the lesson content by using the student exercise books and activities from the manual. The normal sequence of events would be (1) a few minutes of pre-telecast orientation, as suggested in the teacher's manual; (2) the telecast, during which the TV teacher may ask the pupils to manipulate various objects or work a few problems; (3) post-telecast activities, also suggested in the manual, which enlarge upon or review the important concepts presented in the telecast; and (4) over the next few days, supplementary activities from the manual and exercises in the pupil exercise books, some of which are related to material in the telecast and some of which are review of concepts presented in previous telecasts. Short tests are also given a few times a semester so that teachers can assess pupil progress.

PIA was designed to be utilized in the period of transition from a traditional mathematics program to a modern mathematics program at the elementary level. To quote Professor Van Engen,

> Remember that the telecasts are not intended to replace the classroom teacher. They are intended to help introduce and demonstrate new mathematical ideas. You, the teacher, are still the most important element in the development of a sound and meaningful mathematics program in your school....PIA is one answer to a new program in mathematics, but after having used PIA for a year or two, you will be ready to find other answers for your school. Whatever happens, remember that change is inevitable. You must help determine the direction of that change [1967, p. vi].

The dual aims of PIA are to provide a sound program in mathematics for the elementary school child and to provide inservice education for the elementary school teacher. Television was chosen as the medium by which to accomplish these aims; it was noted that televised programs are particularly effective for pupils and teachers in rural areas and in the centers of large cities. The attribute of a rural setting that makes televised education promising is that without it, rural teachers may not have opportunities to update their skills and, consequently, students may not receive modern mathematics instruction. Used properly--with the teachers viewing the program as their pupils see it--PIA thus becomes an inservice program in the concepts and pedagogy of modern mathematics. Both teachers and pupils learn the new ideas through the medium of television from qualified teachers presenting contemporary mathematics content.

Urban settings are often characterized by high transiency of pupils, and even teachers, within the school district. A televised program, in addition to being a familiar and appealing medium, provides for continuity in the basic skills program and is an educational touchstone for the transient pupils. Moreover, since urban children are frequently deficient in the reading skills required for efficient learning from mathematics textbooks, a program such as PIA which features video-taped lessons, activities with stress on the manipulation of concrete materials, and exercise books with minimal reading may be a particularly effective means of presenting new concepts for these children.

There are some factors, of course, which are important in both types of demographic situations--television's appeal to children and its efficiency and economy as an inservice course.

For more complete information on the history, mathematical content, behavioral objectives, and pedagogical principles of PIA, see Braswell and Romberg (1969). For an overview of the key mathematical ideas in PIA, see Appendix A.

Previous Evaluations

As part of the research and development effort of PIA, a summative, non-comparative evaluation of the program in Grades 1 and 3 was carried out during the 1966-67 school year (Braswell & Romberg, 1969). Several hundred first- and third-grade classrooms in communities of four different sizes in Alabama and Wisconsin took part in the study; the two largest communities were broken down into three socioeconomic levels. The results of that study indicated that most of the PIA program objectives were being accomplished. In addition, further analysis revealed no relationship between performance and community size or socioeconomic level. The only difference appeared to be between the two states, and then only on the standardized computation test.

A field test for Grade 2 was carried out in the 1967-68 school year

(Braswell, 1969b). Again, the results indicated that PIA was accomplishing most of its goals. At the end of the school year, the children in the 30 classes in the study scored significantly higher than the test norms on a standardized test of concepts for that grade level, even though they had scored lower than the test norms at the beginning of the year.

A formative evaluation of the PIA program for Grade 5 was also carried out in 1967-68 (Braswell, 1969a); about 80 classes participated. Results indicated that children learned traditional computation skills and important concepts in arithmetic commensurate with their stage of development. Computation problems tended to be easier at the end of the school year than they were shortly after the skills were presented, which is good evidence that skills learned early in the year are not forgotten but are reinforced by the structure of the PIA pupil exercise books.

In the 1968-69 school year, the PIA staff at the Wisconsin Research and Development Center for Cognitive Learning conducted a formative evaluation of the PIA program for Grade 6 (Braswell, 1970). The study successfully used the techniques of item sampling to evaluate the year's curriculum and to engender several specific improvements in the telecasts.

Reasons for the Present Study

One of the original aims in developing PIA was to provide inservice education for elementary school teachers, but none of the evaluations mentioned heretofore had investigated the effectiveness of PIA in this respect. In addition, partially as a result of questions from prospective consumers regarding utilization of PIA in various settings, a need to ascertain the effectiveness of PIA in rural and urban sites, especially among children of lower socioeconomic background and achievement, was recognized. None of the previous studies had focused on this particular question. Moreover, there had never been an evaluation of the Grade 4 program and the Grade 1-3 materials had not been evaluated following a 1970 revision. Thus, a large-scale summative, comparative evaluation, focusing both on the inservice effect on teachers and on the achievement of rural and urban pupils in Grades 1-4, was proposed and funded for the 1970-71 school year.

Goals of the Study

Plans for the study call for the data to be evaluated from three approaches: the effects of PIA on pupils, the effects of PIA on teachers, and the interaction between the two. This report will concern itself only with the first question: in what ways, if any, is student achievement affected by PIA? The second question, regarding the effects of PIA on teachers, is discussed elsewhere (Marshall & Fischbach, 1972); in summary, the results of that study indicated that with respect to PIA-specific content, but not to general basic mathematics, PIA is clearly an effective inservice course for teachers, particularly for teachers with relatively low initial knowledge of the basic mathematics underlying a contemporary program. Discussion of the third question, dealing with interaction between teacher and pupil effects, will appear in a third report if the data are of sufficient interest.

The specific questions to be dealt with in this report are:

1. Do students who use PIA increase their achievement on standardized measures in any one or more of the following areas of mathematics?

    a. computation

    b. concepts

    c. applications/problem-solving

2. Do students who use PIA increase their achievement on program-related objectives in any one or more of the following areas of mathematics?

   a. computation

   b. concepts

   c. applications/problem-solving

3. Do the effects, if any, of PIA on pupil achievement vary with any one or more of the following?

   a. demographic characteristics

   b. grade level

   c. sex

Also included in this report is descriptive information concerning the field test sites and the mathematics program implementation in each. This information was gathered to secure a more comprehensive description of the participating schools and to verify that the PIA program was carried out according to the recommendations of the developers. It was also used as a basis on which to exclude data from the final analysis and to develop teacher implementation and program appropriateness scores which were correlated with achievement in the schools using PIA.

II

THE EVALUATION PLAN

Subjects

The evaluation was designed to be carried out in urban and rural sites in which the teachers and/or students reflected in varying degrees and combinations the characteristics (e.g., student lack of reading skills) discussed in Chapter I. Site selection was somewhat restricted by the availability of broadcast facilities and, of course, by the unwillingness of some school systems to commit large numbers of schools to an extensive one-year field test. However, enough distinctive sites were secured to enable potential consumers to generalize the results of the study to a variety of local situations. A Memorandum of Agreement between the Center and each site was prepared specifying their respective contributions to the field test (see Appendix B).

Urban sites selected were the Catholic Archdiocese of New York City Schools, the Chicago Public Schools, and the Portland (Oregon) Public Schools. Rural sites were located in the state of Vermont and in three rural counties near Roanoke, Virginia. In all sites except Vermont, most or all participating schools had qualified for Title I funds, indicating that a substantial number of the students were from impoverished homes and were below grade level in achievement. In four of the five sites, schools willing to participate were identified and were randomly assigned to the experimental (PIA) group or the control (non-PIA) group. In the fifth site (referred to later in this paper as urban site 2) randomization was not possible due to technical constraints caused by the geographic location of the schools with broadcasting facilities; thus, selection of schools for the control group was of necessity done through the cooperation of the central office personnel by matching a school district with the experimental group in parental socioeconomic status, standardized test scores, etc.

Approximately 10,600 children and 390 teachers in 92 schools took part in the study. Because of unforeseen causes this sample was reduced somewhat in the data analysis and one site (urban site 3) was dropped from the study entirely, but the numbers in the analysis are still of the same order of magnitude. Table 1 indicates by grade level the approximate numbers of children, teachers, and schools in each site. Within each site there were approximately equal numbers of experimental and control schools. In those sites where more than one grade level participated, there were approximately equal numbers of classes in each grade. It is important to point out that all four grade levels are not represented in each site; however, each grade level appears in at least one urban and one rural site.

Method

Classes in the experimental schools used the PIA programs as the sole or major component in the mathematics curriculum. This included utilization of the television programs, pupil exercise books, and the teacher's manuals according to the developers' recommendations incorporated in the requisites for implementation, to be described later in this chapter. Classrooms in the control schools proceeded as usual with whatever mathematics curriculum they chose to use. Although teachers in control school classrooms were encouraged not to use the PIA telecasts, they were not prevented from doing so if they chose; in fact, some of these teachers did use the PIA telecasts as a supplement to their basic curriculum.

TABLE 1

APPROXIMATE NUMBER OF PARTICIPANTS IN THE STUDY

Site	Grade Level 1	2	3	4	Schools	Teachers	Pupils
Urban site 1			X	X	46	150	4,700
Urban site 2	X	X			9	90	2,350
Urban site 3[a]	X	X			9	40	850
Rural site 1	X	X	X		10	70	1,650
Rural site 2				X	18	40	1,050
	TOTAL				92	390	10,600

[a]Data were not used in analyses.

At the beginning of the 1970-71 school year, informational meetings were conducted by Center staff for both experimental and control school teachers in all sites to explain the field test. The meetings for the PIA teachers also provided inservice training in the utilization of the PIA program as specified in the teacher's manuals and elsewhere by the developers (Braswell & Romberg, 1969). Schedules for student and teacher data collection for the year were outlined, and pretest/questionnaire data were gathered from the participants for the teacher effect aspect of the field test (Marshall & Fischbach, 1972). In spring of 1970 a final brief meeting was held at all sites, primarily to gather posttest teacher data and review student posttesting procedures, but also to report some preliminary results, particularly monitoring information, from the field test. Representative agendas and materials for both the initial and final meetings with teachers appear in Appendix C.

During the year the Center provided no further inservice training and local school central office personnel offered no more consultant support either to PIA or to control schools than was typically given to other schools or during other academic years. However, Center staff members or field workers trained by the Center carried out monitoring visits in all sites to gather descriptive information and to ascertain whether the PIA program was implemented in the experimental groups according to recommendations detailed at the inservice meetings and in the teacher's manuals.

Requisites for Implementation of PIA

The recommended instructional procedures for PIA teachers as well as certain basic specifications for the field test were formalized in a statement of requisites for effective implementation. Judgments about satisfactory implementation and subsequent exclusion of data from certain sites or schools from the analysis, if necessary, could then be made on the basis of the requisites. Also, teacher implementation and program appropriateness scores to correlate with student achievement could be developed from the requisites. The requisites were as follows:

1. All PIA teachers should receive inservice training in PIA program utilization.

2. All or most of the televised lessons and exercise book activities should be completed by all or most students at each grade level.

3. Technical aspects of the PIA telecast presentation should be adequately fulfilled.

    a. Television reception should be consistently good.

    b. Telecasts should be broadcast according to the established schedule.

c. Repeat telecasts should be available to allow alternative viewing times as well as to provide for absentees and for students who need the reinforcement of a second presentation.

4. The recommended PIA instructional procedures should be followed, including:

    a. A substantial portion of the background segments of the teacher's manual (e.g., the behavioral objectives) should be read by the teacher <u>prior</u> to the telecast.

    b. Telecast lessons should be preceded by an orientation or pre-telecast activity directly related to the objectives of the lesson.

    c. Telecast lessons should be followed immediately by a concluding post-telecast activity directly related to the objectives of the lesson.

    d. At least one "Highly Recommended" activity specified in the manual should be used in conjunction with each lesson for all or most students.

    e. At least some of the exercise pages associated with each lesson should be completed by all or most students.

    f. Common mathematics manipulatives should be used in conjunction with the lessons when specified.

5. The PIA program should be deemed appropriate for students of varying ability levels throughout the school year as evidenced by student attitude and by teacher judgment, as follows:

    a. Students should exhibit a positive attitude towards the telecasts.

    b. The pace of the telecast presentation should maintain student attention.

    c. The level of difficulty of student exercises should be appropriate.

    d. Use of supplementary printed materials from other curricula should be largely unnecessary.

    e. The level of difficulty of the objectives of each lesson should be appropriate.

    f. The time intervals between telecasts should be adequate.

6. A minimum of one-half hour of instructional time per day should be devoted by each teacher to the PIA program for all children.

Data Collection Schedule and Instrumentation

All students in both PIA and control schools were given pretests of arithmetic achievement in the fall of 1970 and posttests in the spring of 1971 according to the schedule shown in Table 2. With the exception of the pretest for Grade 1, which was developed at the Center, all of these instruments are well-known standardized tests: the California Achievement Tests--Mathematics (CAT), Levels 1 and 2, Forms A and B, 1970 edition, published by the California Test Bureau; the Comprehensive Tests of Basic Skills--Arithmetic (CTBS), Level 1, Forms Q and R, published in 1968 by the California Test Bureau; and the Cooperative Primary Test (Mathematics), Forms 12a, 23a, and 23b, published in 1965 by Educational Testing Service (ETS). The tests were selected with three considerations in mind. First, they reflect PIA objectives to a greater extent than other instruments examined. In particular, the Cooperative Primary Test and the PIA program both place emphasis on concept development. Second, they are quite widely accepted measures and thus, potential users of PIA would have confidence in them. Third, particularly in the case of the tests chosen for Grades 1-3, they require a minimum reliance on reading skills. Although more testing time was required, two tests were utilized in Grades 1-3 in order to adequately cover the range of PIA content. Analysis of the data was performed both for three subtests of the CAT and CTBS tests in their entirety--computation, concepts, and applications/problem-solving--and on several subscales developed for the PIA content valid items from the computation and concept subtests. (See Appendix D for a summary of the subscales formed from PIA content valid items.) It should be pointed out that the concepts and application/problem-solving sections of the CAT are usually treated as one

TABLE 2

SUMMARY OF INSTRUMENTATION AND SCHEDULE OF STUDENT TEST DATA COLLECTION

<table>
<tr><th>Grade</th><th colspan="2">Pretests, Fall 1970</th><th colspan="2">Posttests, Spring 1971</th></tr>
<tr><td>1</td><td colspan="2">R & D Center
Arithmetic Survey</td><td>California Achievement
Tests (1970 ed.)--Mathematics
Level 1, Form A</td><td>ETS Cooperative
Primary Test (Mathematics)
Form 12a</td></tr>
<tr><td>2</td><td>California Achievement
Tests (1970 ed.)--Mathematics
Level 1, Form A</td><td>ETS Cooperative
Primary Test (Mathematics)
Form 12a</td><td>California Achievement
Tests (1970 ed.)--Mathematics
Level 1, Form B</td><td>ETS Cooperative
Primary Test (Mathematics)
Form 23a</td></tr>
<tr><td>3</td><td>California Achievement
Tests (1970 ed.)--Mathematics
Level 2, Form A</td><td>ETS Cooperative
Primary Test (Mathematics)
Form 23a</td><td>California Achievement
Tests (1970 ed.)--Mathematics
Level 2, Form B</td><td>ETS Cooperative
Primary Test (Mathematics)
Form 23b</td></tr>
<tr><td>4</td><td colspan="2">Comprehensive Tests
of Basic Skills--Arithmetic
Level 1, Form Q</td><td colspan="2">Comprehensive Tests
of Basic Skills--Arithmetic
Level 1, Form R</td></tr>
</table>

subtest since the national norms were established on this basis. However, since the present analysis was performed on raw scores, separate subtests could be formed for these two areas.

The sources of descriptive and implementation data were interviews with principals and teachers, observations of teachers, and teacher questionnaires. Both the interviews and observations were held on a continuing basis throughout the school year, while the questionnaires were administered at the initial and end-of-year meetings of participants at each site. One interview was held with the principal from each experimental and control school and with each experimental (PIA) teacher; about one-half of the control group teachers were sampled for interviews. A random sample of teachers drawn from the interviewees in both groups were observed during their mathematics class instruction. Slightly less than one-half of the PIA teachers and one-third of the control group teachers were observed. All field test monitoring, summarized in Table 3, was carried out by Center staff or by field workers trained by the Center rather than by local school system personnel. Copies of monitoring instruments appear in Appendix E.

It will be noted that certain questions on the monitoring instruments deal with teacher and student attitudes toward PIA. Attitude data for both PIA teachers and students were collected primarily to reveal any trouble spots in the implementation program rather than to do a rigorous attitudinal study, since previous field tests had already provided substantial evidence that PIA was positively received by both teachers and students (Braswell & Romberg, 1969). Because in some sites teachers who had previously selected the math series for their students independently did not participate in the decision to use PIA, it was felt that possible negative attitudes affecting teacher cooperation and implementation might be evident and should be identified.

TABLE 3

SUMMARY OF MONITORING DATA COLLECTION

Instrument[a]	Schedule of Administration	Target Population	Sample Size[b]	
			PIA	Control
Principal interview	Held on a continuing basis from November 1970 through April 1971	All principals	43	37
Teacher interview		All PIA teachers 1/2 of control teachers	191	96
Teacher observation		1/2 of PIA teachers 1/3 of control teachers	86	58
Teacher questionnaire	May 1971	All teachers	179	184

[a] Copies of all instruments appear in Appendix E; each instrument used in PIA schools differs in part from the corresponding instrument used in control schools.

[b] Urban site 3 data are included here but were not used in analyses.

III

RESULTS OF MONITORING PROCEDURES

Purpose of Monitoring

Monitoring of the field test was carried out to determine whether experimental (PIA) schools in each site effectively met the requisites for satisfactory program implementation and to secure further descriptive information about all participating schools, both experimental and control. The purposes and results of monitoring must be viewed in the context of the general design of the evaluation, particularly with regard to the requisites for PIA schools. Theoretically, we would expect that for both groups an equal possibility would exist for varying degrees of effective mathematics program implementation and that, consequently, student achievement data from no schools or sites could legitimately be dropped from analysis on the basis of ineffective implementation; thus, we would also expect that monitoring to assess implementation practices would be essentially unnecessary. However, because of a variety of factors--PIA was completely new to the teachers and a somewhat unusual program in that it utilized telecast instruction; teachers as a rule did not actively participate in the decision to use PIA and in some instances used it against their will; and possible technical difficulties were associated with the adoption of PIA--it was believed not inconsistent with the evaluation plan to set some basic requisites for the PIA groups which, if satisfied, would guarantee a "fair trial" of the program and justify inclusion of the data from these sites in the analysis. An arbitrary decision was made not to drop individual schools from the study on the basis of requisite information, but in the event of extreme cases of poor implementation involving an entire site to exclude the site entirely. Eventually all data from urban site 3 were omitted from the analysis according to this plan. The requisite information, summarized in Table 4, and the implementation and program appropriateness ratings derived from it are reported here primarily for descriptive purposes. In Chapter IV these ratings are related to pupil achievement in PIA schools.

Again, keeping in mind the overall plan of the evaluation and the random assignment to groups, it perhaps would not appear necessary to further describe the PIA and control groups via information from monitoring procedures. Note, however, as reported earlier, assignment in urban site 2 could not be random due to technical constraints, and therefore, the comparative data become more relevant. Also, where differences exist between experimental or control groups, whether due to chance or not, it is desirable to document them. The comparative information summarized in Table 6 may also be of interest to prospective consumers of PIA who identify parallel conditions in their local situations.

Implementation Requisites

Table 4 summarizes the results by site for the experimental group for each of the six implementation requisites detailed in Chapter II. The first requisite regarding inservice attendance was simply a matter of record, and the second requisite (use of telecasts and workbooks) was examined by means of a questionnaire. The primary source of information from PIA schools for the remaining four implementation requisites was the personal interviews held with PIA principals and teachers at various times during the school year. Generally, all sites were visited once in the fall and once in the spring and about half of the interviews occurred each time. The interviews

TABLE 4

PERCENT OF TEACHERS OR SCHOOLS SATISFYING PIA IMPLEMENTATION REQUISITES

Requisite	Urban Site 1	Urban Site 2	Urban Site 3[a]	Rural Site 1	Rural Site 2	Mean, Excluding Urban Site 3[b]	Source of Data[c]
	% of Teachers Satisfying Requisites						
1 (inservice attendance)	86%	91%	70%	100%	100%	87%	Center records
2 (use of telecast lessons)	93%	68%	15%[d]	97%	100%	87%	Teacher questionnaire
(use of workbook exercises)	86%	68%	15%[d]	100%	89%	86%	
4 (PIA utilization)							Teacher interview and observation
a (manual read)	89%	66%	--	81%	100%	82%	
b (pre-telecast activity)	84%	68%	--	84%	90%	80%	
c (post-telecast activity)	73%	76%	--	84%	84%	77%	
d (follow-up activity)[e]	83%	58%	--	88%	--	75%	
e (workbook exercises)	100%	94%	--	100%	98%	98%	
f (manipulatives used)	31%	43%	--	53%	79%	44%	
5 (PIA appropriateness)[f]							Teacher interview
a (positive student attitude)	64%	36%	--	57%	53%	54%	
b (telecast pace)	71%	65%	--	75%	88%	72%	
c (supplementary material not required)	69%	63%	--	81%	34%	67%	
d (exercise difficulty)	58%	52%	--	66%	61%	59%	
e (objectives difficulty)	69%	45%	--	71%	66%	64%	
f (time interval)	59%	42%	--	60%	63%	55%	

(continued)

TABLE 4 (continued)

	% of Schools Satisfying Requisites						
Requisite	Urban Site 1	Urban Site 2	Urban Site 3[a]	Rural Site 1	Rural Site 2	Mean, Excluding Urban Site 3[b]	Source of Data[c]
6 (time allotments)	96%	68%	--	93%	95%	86%	Teacher interview
3 (technical aspects)							Principal interview
a (good reception)	71%	60%	100%	40%	71%	66%	
b (regular schedule)	100%	100%	0%	100%	100%	100%	
c (repeat telecasts)	100%	100%	100%	100%	100%	100%	

a Information wa' frequently not available from urban site 3 since the program was essentially not used (see requisite 2).

b This average is across all teachers (or schools); it should be noted that the number of teachers/schools per site is disproportionate. (See Table 1.)

c Sample sizes are given in Table 3.

d Estimates based on monitoring data, not questionnaires.

e Data reported are for Grade 3 teachers only, since the Grade 4 manual did not include this category of activity for most lessons.

f Ratings were adjusted according to the achievement level of the group(s) of students in each teacher's class.

with PIA teachers were focused for requisites 4 and 5 on questions about the lesson the teacher was currently using. Thus, each interview concerned an individual lesson but the summary in Table 4 reflects a composite of lessons across the four grade levels. Since the interviews spanned the entire school year, a representative sample of lessons was assured. Additional information to corroborate the verbal statements of the teachers regarding their instructional procedures (requisite 4) was secured through the classroom observations which occurred on the same day as the interviews for about one-half of the teachers.

As a whole, the set of requisites was satisfactorily fulfilled in all sites except urban site 3. Attendance of PIA teachers at the preprogram inservice meetings (requisite 1) was very good in all sites except urban site 3. Program utilization (requisite 2), the extent to which the PIA telecasts and student exercises were used, was comprehensive in three of the five sites; in urban site 2 almost one-third of the teachers did not complete the telecasts and workbooks, and participation was totally lacking in urban site 3. This factor alone, obviously, makes data from urban site 2 open to some suspicion and data from urban site 3 unusable. Requisite 4, which deals with the recommended instructional procedures for PIA, was met by the great majority of teachers, although in urban site 2 there were again some distinct weaknesses. All sites were notably lacking in their use of common mathematics manipulative aids specified by the program.

Except for poor reception, which was a fairly common complaint, the other requirements of requisite 3 regarding technical aspects were easily met in four sites. In urban site 3, however, an error in Grade 1 scheduling resulted in no schools meeting the requisite. The time allotted to PIA (requisite 6) was sufficient in four sites; about one-third of the urban site 2 schools did not spend enough time on PIA lessons.

The appropriateness of PIA for particular groups of students (requisite 5) was negatively viewed by from one-half to one-third of the teachers in all sites. This problem is in part due to the nature of a televised instructional course which allows no variation in the pacing or order of lessons presented. (To alleviate these difficulties, the National Instructional Television Center,[1] which distributes PIA, has since made the program available for audio-visual use; that is, the lessons can be shown on classroom video-tape players on a schedule adapted to individual student needs.) The results for requisite 5 were noted when interpreting achievement data, but sites or schools were not omitted on this basis.

As discussed earlier, in order to be consistent with the evaluation plan it was decided not to eliminate data from individual schools from the final analysis on the basis of requisite information and to dismiss site data only in extraordinary circumstances. Using this criterion, all data from urban site 3 were omitted. Data from urban site 2 must be viewed cautiously in light of the requisite information.

Portions of the requisite information were used to derive implementation and program appropriateness scores for each PIA teacher/class except those in urban site 3. These scores allow us to describe from another perspective the instructional practices and teacher judgments of PIA's appropriateness in each site and to provide another viewpoint from which to

[1]The Patterns in Arithmetic program for Grades 1-6 is published and distributed by the National Instructional Television Center, Box A, Bloomington, Indiana 47401.

interpret achievement results. Each PIA teacher was assigned an implementation score of 1-6 and an appropriateness score of 1-6 based on the parts of requisites 4 and 5; both scores were very simply and arbitrarily derived by giving the teacher 1 point for each aspect of the two requisites satisfied. Some parts of requisite 4 (PIA instructional procedures) had to be slightly redefined in terms of a criterion; 1 point was given for each of the following:

4a. The teacher had read at least three of five background segments of the teacher's manual prior to the telecast lesson.

4b. The teacher had carried out a pre-telecast activity, either one specifically suggested in the teacher's guide or one created independently.

4c. The teacher had carried out a post-telecast activity, either one specifically suggested in the teacher's guide or one created independently.

4d. The teacher had utilized at least one "Highly Recommended" activity from the manual.

4e. The teacher had used all or some of the exercise pages.

4f. The teacher had utilized at least one-half of the common mathematics concrete aids at some time during the year's mathematics instruction.

An individual teacher's answers for all but 4f above reflect his utilization of the lesson at hand at the time of the interview. Credit was given only if the conditions were satisfied for <u>all or most</u> students, regardless of achievement/ability level.

As mentioned above, the appropriateness of PIA for each class (requisite 5) also had six aspects; most of these were judged by the teacher in terms of achievement, that is, for students above, at, and below grade level, although not all three groups were represented in every class. The appropriateness conditions were considered met, as with the instructional procedures, only if the program was viewed as suitable for <u>all or most</u> students regardless of achievement/ability level. Again, the judgments were made for the current lesson. An important point to be aware of here is that teachers could "pick and choose" among the exercises and activities offered to adapt the program to various groups of students; this made attainment of 5c and 5d more readily possible. However, such characteristics as the pace and order of telecast presentations could not be altered (see 5a, 5b, 5e, and 5f). Some parts of requisite 5 had to be slightly restated; 1 point was given for each of the following six aspects of appropriateness:

5a. Students should exhibit a positive attitude toward the telecasts.

5b. The pace of the telecast presentation should maintain student attention.

5c. The pupil exercises should be challenging but not overly difficult.

5d. Use of supplementary materials from other curricula should be largely unnecessary.

5e. The objectives of each lesson should be challenging but not overly difficult.

5f. The time intervals between telecasts should be appropriate.

Table 5 summarizes the average implementation and appropriateness scores by site and by grade. It can be seen that, in general, teachers in Grades 1 and 2 felt the PIA program was less appropriate for their students and implemented it somewhat less well than teachers in Grades 3 and 4. Teachers in urban areas had lower implementation scores both as independent sites and as a whole than the rural sites; however, it is less easy to generalize about the appropriateness scores. Although overall results show that the program was viewed as slightly less appropriate in urban areas, this was due to the low ratings given by urban site 2 teachers; in urban

TABLE 5

MEAN PIA IMPLEMENTATION AND APPROPRIATENESS SCORES BY SITE AND GRADE[a]

Mean Implementation Scores

Grade	Urban Site 1	Urban Site 2	Rural Site 1	Rural Site 2	Mean[b]
1	--	3.79(24)	5.23(13)	--	4.30(37)
2	--	4.04(23)	4.73(11)	--	4.26(34)
3	4.50(36)	--	4.50(8)	--	4.50(44)
4	4.06(34)	--	--	5.26(19)	4.49(53)
Mean	4.29(70)	3.91(47)	4.88(32)	5.26(19)	4.40(168)
Mean urban, rural sites		4.14(117)		5.02(51)	

Mean Appropriateness Scores

1	--	2.88(24)	3.08(13)	--	2.95(37)
2	--	2.52(23)	3.64(11)	--	2.88(34)
3	3.33(36)	--	3.00(8)	--	3.27(44)
4	3.35(34)	--	--	2.95(19)	3.21(53)
Mean	3.34(70)	2.70(47)	3.25(32)	2.95(19)	3.10(168)
Mean urban, rural sites		3.09(117)		3.14(51)	

[a] Highest possible score is 6; scores were derived from interviews with teachers.

[b] It should be noted that the number of teachers per site is disproportionate.

site 1 the program was described as relatively more appropriate than in either rural site. An interesting contrast appears in the results for rural site 2, where teachers implemented the program at a very effective level but nevertheless seemed to view it as somewhat inappropriate. Consistent with other monitoring findings in urban site 2, PIA was viewed as quite inappropriate and also was implemented relatively ineffectively. Further discussion of the relationship of these scores to pupil achievement appears in Chapter IV.

Comparative Description of Field Test Schools

The second type of monitoring information, summarized in Table 6, includes both experimental and control groups and affords us a more complete description of the field test sites as a whole as well as a comparative view of the PIA and control schools in each site. Data were drawn from the instruments described in Chapter II.

Perusal of Table 6 reveals that for the characteristics examined, the experimental and control groups in each site and across all sites were generally quite comparable; however, there are a few noticeable differences. From a socioeconomic standpoint, the control groups in both urban sites and one rural site had a definite advantage. This can be partially explained in the case of urban site 2 in which assignment was not random; of necessity, a control district was matched as closely as possible to the experimental district which had the broadcast facilities. At least two schools in the control district had very few disadvantaged students; all schools in the experimental district had a heavy majority of students from impoverished home backgrounds. For the rural sites, the socioeconomic imbalance can be partially explained by the fact that after the random assignment was

TABLE 6

COMPARATIVE DESCRIPTION OF FIELD TEST SCHOOLS BY SITE AND TREATMENT

Variable	Site / Treatment	Urban Site 1 PIA	Urban Site 1 Control	Urban Site 2 PIA	Urban Site 2 Control	Urban Site 3[a] PIA	Urban Site 3[a] Control	Rural Site 1 PIA	Rural Site 1 Control	Rural Site 2 PIA	Rural Site 2 Control	Total, All Sites[b] PIA	Total, All Sites[b] Control	Source of Data[c]
Home background of students														
Percent of schools in which 1/2 or more of parents have annual income below $4,000 (urban sites only)		54%	33%	40%	25%	66%	--	--	--	--	--	53%	32% (Urban sites only)	Principa intervic
Percent of schools in which 1/4 to 1/2 of parents have annual income below $4,000 (rural sites only)[d]		--	--	--	--	--	--	0%	0%	57%	25%	33%	15% (Rural sites only)	Principa intervie
Percent of schools in which paraprofessional aides are available to field-test teachers		23%	26%	100%	75%	100%	--	25%	20%	0%	12%	35%	29%	Principa intervie
Percent of schools that participated in innovative mathematics curriculum programs at the field test grade levels during the 2 years prior to the present evaluation		5%	0%	20%	25%	25%	--	0%	0%	0%	0%	7%	2%	Principa intervie

(continued)

TABLE 6 (continued)

Variable	Site / Treatment	Urban Site 1 PIA	Urban Site 1 Control	Urban Site 2 PIA	Urban Site 2 Control	Urban Site 3[a] PIA	Urban Site 3[a] Control	Rural Site 1 PIA	Rural Site 1 Control	Rural Site 2 PIA	Rural Site 2 Control	Total, All Sites[b] PIA	Total, All Sites[b] Control	Source of Data[c]
Mean time allotment in minutes per day for mathematics:														
Grade 1		--	--	26.0	28.8	36.3	--	40.0	33.0	--	--	33.5	32.5	Principal interview
Grade 2		--	--	30.6	30.0	41.3	--	44.5	33.8	--	--	38.2	33.3	
Grade 3		51.1	48.3	--	--	--	--	44.5	40.0	--	--	50.1	46.5	
Grade 4		50.1	49.2	--	--	--	--	--	--	42.0	49.0	48.1	49.0	
Mean time in minutes per day actually spent by teachers on mathematics instruction:														
Grade 1		--	--	30.3	24.7	36.8	--	32.1	35.6	--	--	30.9	29.3	Teacher interview
Grade 2		--	--	42.6	35.0	37.5	42.0	39.4	40.8	--	--	41.6	37.6	
Grade 3		55.7	52.8	--	--	--	--	38.3	48.0	--	--	52.1	51.0	
Grade 4		50.1	49.0	--	--	--	--	--	--	44.3	53.3	47.4	49.7	
Percent of students at each of 3 general achievement levels (not only mathematics):														
above grade level		16%	19%	13%	17%	27%	--	35%	21%	32%	14%	19.6%	18.8%	Teacher interview
at grade level		42%	38%	39%	44%	44%	--	45%	60%	31%	63%	40.8%	46.6%	
below grade level		42%	43%	48%	39%	29%	--	20%	19%	37%	23%	39.6%	34.5%	

(continued)

TABLE 6 (continued)

Variable	Site / Treatment	Urban Site 1 PIA	Urban Site 1 Control	Urban Site 2 PIA	Urban Site 2 Control	Urban Site 3[a] PIA	Urban Site 3[a] Control	Rural Site 1 PIA	Rural Site 1 Control	Rural Site 2 PIA	Rural Site 2 Control	Total, All Sites[b] PIA	Total, All Sites[b] Control	Source of Data[c]
Mean number of students per teacher		39.0	33.0	27.8	31.0	--	--	23.8	25.0	29.3	37.0	31.9	30.0	Teacher interview
Percent of classes in which there was evidence of individualization (e.g., children working on different objectives, in small groups, etc.)		24%	25%	38%	18%	--	33%	21%	36%	18%	0%	25%	25%	Teacher observati[illegible]
Percent of classes in which mathematics manipulatives were used		3%	3%	3%	9%	--	3%	3%	5%	8%	3%	4%	5%	Teacher observati[illegible]

[a] Since many teachers/schools did not remain in the study, data are incomplete for this site.

[b] Urban site 3 is included when data are available. Averages are across all schools (or teachers); it should be noted that the number cf teachers/schools per site is disproportionate (see Table 1).

[c] Sample sizes are giveu in Table 3.

[d] No schools in rural sites reported over 1/2 of parents with annual income below $4,000.

completed, technical facilities for television were found to be unavailable in a few schools. These schools were then dropped from the experimental group and new schools were added. Typically, these schools had attained their telecast facilities through eligibility for special funds for equipment, and consequently, these schools also had a greater preponderance of students of low socioeconomic status. Two other school-wide characteristics, aide availability and degree of previous involvement in innovative mathematics programs, were about the same for experimental and control groups in four sites; there were some discrepancies in aide availability for urban site 2 due to the factors just mentioned.

Grade by grade, the time officially allotted to mathematics instruction as reported by the principals was roughly equivalent for the two groups across all sites. When teachers reported their actual instructional time for mathematics this equivalence was borne out across all sites, although at particular grade levels within some sites there was as much as ten minutes per day difference in time for mathematics.

When asked to assign their students to three general achievement groups, teachers indicated about the same proportions of students for each group in the urban sites; in the two rural sites, noticeably fewer children were judged to be above grade level in control schools than in PIA schools and more were judged to be at grade level. Taking all sites together, however, proportions were about the same for the two groups.

The average number of students per teacher was somewhat less for PIA than for control classes in all but urban site 1. The evidence of individualization varied inconsistently for PIA and control groups within sites, while use of mathematics manipulatives was more nearly equivalent.

In summary, the experimental and control groups across all sites were generally quite comparable except for socioeconomic status. Within sites, urban site 2 had several conspicuous differences between control and experimental groups, while all other sites showed less extensive differences. Subsequent differences in achievement, reported in Chapter IV, could not be directly attributed to lack of equivalent experimental and control groups in any site, although the discrepancies were kept in mind.

An additional item of interest derived from interview results is that in control schools, which used whatever mathematics curricula were preferred, 11 different major basic text series were represented.

IV

ANALYSIS OF DATA

Introduction

Theory

The general purpose of the study was to evaluate the effectiveness of the PIA program in urban and rural sites. The specific objective of the study was to determine, for each grade level included, if the PIA program had a positive effect on mathematics achievement for the specific target population in the study. To achieve this objective, the design of the study included the random assignment of approximately equal numbers of schools within each of the four sites to each of two treatment conditions; about half of the schools were to use PIA in Grades 1-4 and about half were to use any program except PIA at those grade levels, presumably whatever program they would have used had there been no study. The objective can be stated as a null test hypothesis: if students in the target population use PIA, there will be no effect on their achievement of mathematics concepts and computational skills and problem-solving skills.

Students in all schools were tested on selected mathematics tests early in the academic year to provide baseline (pretest) measurements and again near the end of the academic year to provide data on achievement after one full year with whatever program they were using (i.e., posttest scores). Thus, within each site the mean posttest scores for the PIA schools provided unbiased estimates of mean performance for the schools in the site with the PIA program. The corresponding mean scores for the control schools provided unbiased estimates of the mean performance expected for all schools if there had been no study. If PIA had no effect, then the two sets of estimates should be unbiased estimates of the same quantities and should differ only because of sampling and measurement errors. Thus, rather simple assumptions about the probability distributions of the differences, e.g., those which are based on the presumed random assignment of schools to treatments, and usual normal theory assumptions about measurement error distributions provide the basis for determining the likelihood of differences as large or larger than those observed.

A positive effect of PIA for a given grade level was inferred only if the probability of a difference as large or larger than that observed for that grade was equal to or less than .05, and then only if the differences consistently "favored" the PIA schools. The analysis for each grade level was done independently.

Measurement of Mathematics Achievement

Mathematics achievement level was a multivariate variable in this analysis. The measure used has three basic components: (1) a measure of concept attainment from standardized tests of mathematics concepts appropriate to the grade level at which it is used; (2) a measure of computational proficiency also from standardized tests appropriate at each grade level; and (3) a measure of proficiency in application of concepts and computational skills to problems from standardized tests appropriate for the grade level. These three components are hereafter termed concepts, computations, and problems. The analysis used multivariable analysis of variance to estimate program effects and to test the various statistical hypotheses required for inferences. Only one of the two test scores available for concepts was used in each case because it was felt that the two scores available were so highly correlated that the use of both would not increase the information gained enough to compensate for the loss of degrees of freedom that would result. However, univariate results are presented for both tests.

In addition, several subscale scores for the concepts and computations components were also analyzed to supplement the main analysis. These were constructed to be measures of specific content areas (numbers and numerals; addition, etc.). Moreover, the relevant items which are specifically content valid for PIA were separated from those which are not to form PIA content valid as well as nonvalid subscales (see Appendix D). Thus, the analysis of these scores yielded information regarding the effectiveness of PIA specifically in relation to its objectives. The final inferences or conclusions regarding the overall effectiveness of PIA were based on the most reasonable interpretation of all the analytic results.

Unit of Analysis

Students were assigned to experimental conditions by school; hence, assignment of students was not by simple random process. Because of this, the statistical unit of analysis within each grade level was the school rather than the student. However, this unit is also the more theoretically relevant as the program is applied on a school (or a classroom) basis and it should follow that one would want to determine effectiveness on performance for the school (or classroom). Unfortunately, as in most studies which use the student as the unit of analysis, attention was focused on mean performance levels for each school within each grade level rather than on the entire performance distribution for each school. The mean level is but one aspect, and it is an oversimplification to take it as the only or even the most relevant aspect of that distribution. However, it is analytically convenient to do so, and when the number of schools is small, as in this study, it is difficult if not impossible to perform valid statistical analyses with multiple measures of the entire distribution.

However, so as not to ignore all variation from the mean entirely, two mean scores were computed for each school on each test administered. Students were categorized by sex, and a mean score for each group was computed. Sex was chosen because the data identifying sex of students were available and because there is some evidence that mathematics achievement does depend on sex.

These two scores, one per sex group, were treated as repeated measures on each school for each achievement component considered. For this study, there was little interest in the "main effect" of sex on mathematics achievement. The key question was whether the effectiveness of PIA varies with the sex of the student, i.e., whether there was a "treatment by sex interaction." If such an interaction was inferred, then the main effect of PIA--the average of the two sex-specific effects--would not be used as the criterion of effectiveness unless the sex-specific effects were in the same direction, e.g., unless it was evident that PIA effectiveness varied only in magnitude but not direction with sex. Otherwise, if the sex-specific effects varied greatly in magnitude, the effectiveness of PIA would be analyzed specifically for each sex group. If the interaction was inferred, the main effect of PIA might be no more meaningful (for program planning) than telling someone that a river can be crossed on foot because its average depth is only three feet. If the sex-specific effects did not appear to differ by more than a "small" magnitude, the average or main effect would be used as the criterion. ("Small" in this case indicates too small to detect by the statistical tool [illegible] interaction.)

Preliminary Test on Site by Treatment Interaction

Schools in two sites--one urban and one rural--were studied at each grade level. There was thus the possibility that PIA effectiveness might be found to vary with site either in general or by sex of student. The main effect of PIA was the average of the two site-specific effects, and this was to be used as the criterion of effectiveness only if site differences in PIA effectiveness appeared to be small or if the site-specific effects were not greatly different and in the same direction.

Thus, two preliminary tests were performed at each grade level. The first was to determine if PIA effectiveness varied with sex in either site, i.e., a test of sex x treatment combined with sex x treatment x site interaction. If the test statistic was not significant, the second preliminary test would be used to determine if PIA effectiveness varied with site, i.e., to test the hypothesis of no site x treatment interaction. The significance level used for both tests was the .15 level to insure reasonably adequate power for detection of lack of fit to the simple additive model while not unduly raising the risk of using a more complicated model when the simple one would be adequate for the purposes of this study.

Implementation Factors

Inferences concerning program effectiveness are limited to the results for the program as implemented for the populations under study. The levels of implementation might be less than optimal (as that is an ideal) but perhaps no better or worse than what might be expected should the program be adopted in these or comparable sites. However, implementation of any program must, at least *a priori*, be considered an important factor in realized effectiveness. Whether good implementation or bad implementation can account for results such as those to be reported is difficult if not impossible to determine. The problem is that for experimental purposes the objective is usually to control implementation at or near an optimal level while the actual levels achieved are in part determined by factors beyond experimental control which may directly or indirectly in other ways affect achievement levels. This does not invalidate statistical inferences, but it can reduce the power of detecting true program effects and affect the practical significances of the inferences.

The available data could not yield an answer to the question of how much the results, whether positive or negative, were influenced by the level of implementation. However, the influence of this factor was considered worthy of some exploration as was the factor of the appropriateness of the PIA material to the students in the study. To study the effects of implementation, each PIA classroom was given a rating designating the degree to which a qualified Center observer considered the PIA program to have been implemented relative to instructions given all PIA teachers during inservice. The scale ranged from 1 for the lowest level of implementation to 6 for the highest level. Mean scores by grade were computed, and the correlations of this score with the three main components of mathematics scores were computed and analyzed. To study appropriateness of the material for the students, a measure of appropriateness was similarly derived, based on responses of PIA teachers to questions about the extent to which they perceived the PIA materials appropriate for their students. These data were analyzed in the same manner as the implementation scores.

Obviously, such results suffer from the well-known defects of correlational analyses. One can not be certain of what other variables may be correlated with either of the two scores just described. Moreover, there is no assurance that variation in either implementation levels or levels of perceived appropriateness is great enough to permit reliable conclusions. But, if interpreted with caution, such analyses may provide a valuable perspective for interpretation of the results of the main analysis.

Missing Data

In some cases students present for fall testing were absent at spring testing and vice versa. This presented no problem as the school (within grade level) is the unit of analysis and mean scores of students present for each testing provided unbiased estimates of mean achievement levels for the school/grade at that point in time.

In a small number of other cases, data on one complete instrument were missing for the entire school/grade for either fall or spring testing (but not both) but data on remaining instruments were available. This usually resulted from misunderstanding of directions or from administration of the wrong test. In these cases estimates of the missing scores were obtained using a ratio-estimate method. For example, suppose the fall score on computations was missing for Grade 1. The mean for the remaining Grade 1 schools on fall computation was computed. In addition, the Grade 2 fall score on computation was available as well as the mean score for all other Grade 2 schools for fall. The estimate of the Grade 1 score was then made equal to the mean of all other Grade 1 schools multiplied by the ratio of the Grade 2 score for that school to the mean Grade 2 score for all other schools.

Such estimation was required in 12 of the total 912 cases (each case is a pretest or posttest score for both sex groups on one main measure for one grade level for one school). In three cases posttest (spring) scores were estimated, and in nine cases pretest (fall) scores were estimated. No posttests were estimated for PIA schools, as all had complete spring data. Pretest scores were estimated for four PIA and five control schools.

Of less importance, in two cases (one PIA and two control) no scores for girls were available on pretests. These cases are for the same grade level (Grade 4) in the same site (urban site 1). In these cases the sex difference was taken to be zero. (Dropping these two schools from the analysis of the sex by treatment produced only minor changes in results.)

Use of Analysis of Covariance

As might be expected, the pretest scores indicated great variability among schools from the same site. This variability was the result of a large number of mostly unknown factors which, it seemed most likely, would produce comparable variation in posttest scores within each sample (PIA or control) for each site. With random assignment, the effects of this variability could be treated as "error" variance and assumptions concerning the probability distribution of this and other sources of experimental error could be made. However, if this variability was great the power of statistical tests might have been greatly reduced. Analysis of covariance was used here to increase the power by reducing the magnitude of the extraneous variation attributed to error. Pretest scores were selected as candidates for covariates. First, the regression of posttest scores on pretest scores was checked to determine if the observed (linear) relationships were statistically significant and also to determine if the residual error variance after "removal" of the covariates had been reduced. In all cases, the hypothesis of no relationship was rejected and considerable reduction in error variance was found. However, results of analyses of variance both with and without covariates are shown.

In urban site 2 and for a few schools in other sites, random assignment was not achieved. In this case the efficiency of analysis of covariance might have been seriously reduced if the actual assignment tended to favor one of the experimental conditions over the other. This would result from the effective confounding of the covariates with the treatment factor which, while perhaps reducing total error variance, would tend to greatly increase the variances of treatment effect estimators. However, in this case the essential problem was whether the usual probability distributional assumptions were justified in the absence of random assignment even with the adjustment for covariates. It was presumed that this was the case merely to present some analysis. However, the reader is advised to keep this consideration in mind.

Results

Preliminary Test Results

Results regarding site x treatment and sex x treatment x site interactions are substantially the same for all four grade levels: whatever the effect of PIA, it appears to be substantially the same for each site and both sex groups. The results of the statistical tests using (multivariate) analyses of variance are summarized in Tables 7-10 for the three major components of mathematics achievement. Results for the subscales formed of PIA content valid items were generally the same and are thus not presented. Sample mean scores by grade, by site, and by experimental group on both pretests and posttests, including the subscales, are shown in Tables 11-14.

TABLE 7
GRADE 1--ANALYSIS OF VARIANCE OF MATHEMATICS ACHIEVEMENT SCORES (URBAN SITE 2, RURAL SITE 1)

	Results[a]													
	Multivariate				Univariate								Separate Univariate	
	df				df for Hyp.	Concepts (ETS)		Computation (CAT)		Problems (CAT)			Concepts (CAT)	
	Num.	Denom.	F	p		Mean Square	p	Mean Square	p	Mean Square	p		Mean Square	p
Total	--	--	--	--	36	--	--	--	--	--	--		--	--
Mean	--	--	--	--	1	--	--	--	--	--	--		--	--
Between schools	--	--	--	--	17	--	--	--	--	--	--		--	--
Between cells	--	--	--	--	3	--	--	--	--	--	--		--	--
Sites	3	12	16.29	.0002[b]	1	1020.07	.0003[b]	425.84	.04	263.23	.11		801.00	.003[b]
PIA	3	12	0.30	.82	1	40.54	.35	36.47	.52	81.27	.36		34.81	.46
Site x PIA	3	12	.08	.97	1	2.00	.83	15.69	.67	2.56	.87		7.90	.72
Within cells (Error)	--	--	--	--	14	43.22	--	82.84	--	89.99	--		59.44	--
Within schools	--	--	--	--	18	--	--	--	--	--	--		--	--
Sex	3	12	4.17	.03[b]	1	5.36	.27	12.55	.15	38.78	.008[b]		5.36	.27
Sex x site	3	12	4.23	.03[b]	1	0.96	.64	1.46	.62	25.69	.02		0.96	.64
Sex x PIA x site	6	24	1.54	.21	2	9.02	.15	10.38	.19	11.41	.09		9.02	.15
Sex x schools	--	--	--	--	14	4.13	--	5.53	--	3.98	--		2.78	--
Covariance														
Covariates														
Arithmetic survey	3	11	5.69	.01[b]	1	354.97	.0009[b]	480.60	.0097[b]	446.61	.02		393.41	.005[b]
Sites	3	11	2.28	.14	1	3.10	.69	49.20	.35	77.03	.29		1.14	.86
PIA	3	11	0.18	.91	1	5.54	.60	15.82	.59	0.91	.91		10.27	.59
PIA x site	3	11	0.15	.93	1	6.53	.57	0.51	.92	8.16	.72		47.56	.26
Error	--	--	--	--	13	19.25	--	52.25	--	62.55	--		33.74	--
Within school														
Covariates	3	11	0.13	.94	1	1.05	.56	.32	.78	.18	.80		.25	.75
Sex	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Site	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Sex x PIA	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Error	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC

[a] NC signifies not computed.

[b] Significant at .05 Level.

TABLE 8

GRADE 2--ANALYSIS OF VARIANCE OF MATHEMATICS ACHIEVEMENT SCORES (URBAN SITE 2, RURAL SITE 1)

	Results[a]													
	Multivariate					Univariate							Separate Univariate	
	df				df	Concepts (ETS)		Computation (CAT)		Problems (CAT)			Concepts (CAT)	
	Num.	Denom.	F	p	for Hyp.	Mean Square	p	Mean Square	p	Mean Square	p		Mean Square	p
Total	--	--	--	--	34									
Mean	--	--	--	--	1	--	--	--	--	--	--		--	--
Between schools	--	--	--	--	16	--	--	--	--	--	--		--	--
Between cells	--	--	--	--	3	--	--	--	--	--	--		--	--
Sites	3	11	14.25	.0005[b]	1	933.43	.0001[b]	1051.52	.0001[b]	929.35	.0001[b]		933.43	.0001
PIA	3	11	3.21	.07	1	268.12	.007	116.08	.07	179.52	.03		268.12	.007
Site x PIA	3	11	1.26	.33	1	63.49	.15	.00	.99	42.54	.26		63.49	.15
Within cells (Error)	--	--	--	--	13	26.47	--	28.71	--	30.23	--		29.94	--
Within schools	--	--	--	--	17	--	--	--	--	--	--		--	--
Sex	3	11	0.74	.55	1	2.94	.25	1.76	.65	2.76	.54		2.94	.25
Sex x site	3	11	1.29	.33	1	6.23	.10	.72	.77	.11	.90		6.23	.10
Sex x PIA x site	6	22	0.88	.53	2	2.72	.29	.73	.91	6.10	.44		2.72	.29
Sex x schools	--	--	--	--	13	2.01	--	8.10	--	6.96	--		3.47	--
Covariance														
Covariates														
Pretests	9	19.6205	3.00	.02[b]	3	76.28	.01[b]	56.69	.10	82.19	.02		76.28	.0098
Sites	3	8	8.13	.008[b]	1	126.46	.008[b]	298.23	.003[b]	184.31	.005[b]		126.46	.008
PIA	3	8	.56	.65	1	11.29	.35	.52	.88	15.97	.32		11.29	.35
PIA x site	3	8	.74	.56	1	19.29	.23	.34	.90	6.95	.51		19.29	.23
Error	--	--	--	--	10	11.54	--	20.32	--	14.65	--		11.54	--
Within school														
Covariates	9	19.6205	.78	.64	3	0.31	.97	8.24	.37	11.71	.23		0.20	.97
Sex	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Site	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Sex x PIA	NC	NC	NC	NC		NC	NC	NC	NC	NC	NC		NC	NC
Error	--	--	--	--	10	3.71	--	6.98	--	6.81	--		2.55	--

[a] NC signifies not computed.

[b] Significant at .05 level.

TABLE 9

GRADE 3--ANALYSIS OF VARIANCE OF MATHEMATICS ACHIEVEMENT SCORES (URBAN SITE 1, RURAL SITE 1)

	Results												
	Multivariate				Univariate							Separate Univariate	
	df				df for Hyp.	Concepts (CAT)		Computation (CAT)		Problems (CAT)		Concepts (ETS)	
	Num.	Denom.	F	p		Mean Square	p	Mean Square	p	Mean Square	p	Mean Square	p
Total	--	--	--	--	108	--	--	--	--	--	--	--	--
Mean	--	--	--	--	1	--	--	--	--	--	--	--	--
Between schools	--	--	--	--	53	--	--	--	--	--	--	--	--
Between cells	--	--	--	--	3	--	--	--	--	--	--	--	--
Sites	3	48	6.89	.0006[a]	1	1068.79	.0004[a]	158.56	.21	583.39	.0065[a]	497.21	.02[a]
PIA	3	48	.63	.60	1	59.59	.37	21.42	.64	110.94	.22	41.78	.48
Site x PIA	3	48	1.76	17	1	0.35	.95	53.84	.46	157.68	.15	21.50	.61
Within cells (Error)	--	--	--	--	50	74.21	--	96.46	--	72.26	--	83.63	--
Within schools	--	--	--	--	54	--	--	--	--	--	--	--	--
Sex	3	48	5.86	.0018[a]	1	117.88	.0003[a]	0.74	.72	5.51	.57	41.92	.06
Sex x site	3	48	.81	.50	1	12.53	.20	10.15	.18	11.54	.42	1.20	.74
Sex x PIA x site	6	96	.19	.98	2	1.87	.78	0.91	.85	4.02	.79	3.42	.58
Sex x schools	--	--	--	--	50	7.53	--	5.61	--	17.19	--	11.21	--
Covariance													
Covariates													
Pretests	9	109.67	7.60	.0001[a]	3	729.42	.0001[a]	628.33	.0001[a]	738.89	.0001[a]	728.87	.0001[a]
Sites	3	45	4.03	.01[a]	1	197.89	.02[a]	2.28	.85	114.36	.06	172.01	.05-
PIA	3	45	.85	.47	1	6.45	.66	.00	.99	57.07	.17	.00	.99
PIA x site	3	45	2.05	.12[a]	1	14.31	.51	100.05	.21	174.88	.02	20.21	.49
Error	--	--	--	--	47	32.39	--	62.52	--	29.71	--	42.45	--
Within school													
Covariates	9	109.67	4.77	.0001[a]	3	28.61	.007[a]	41.05	.0001[a]	64.81	.007[a]	86.47	.0001[a]
Sex	3	45	3.37	.03[a]	1	28.60	.04	13.69	.05-	1.08	.78	.32	.82
Site	3	45	1.07	.37	1	11.28	.18	5.58	.20	21.77	.22	1.70	.61
Sex x PIA	6	90	.52	.79	2	5.64	.41	2.79	.44	10.89	.47	2.72	.66
Error	--	--	--	--	47	6.18	--	3.34	--	14.15	--	6.41	--

[a] Significant at .05 level.

TABLE 10
GRADE 4--ANALYSIS OF VARIANCE OF MATHEMATICS ACHIEVEMENT SCORES (URBAN SITE 1, RURAL SITE 2)

	Results										
	Multivariate				Univariate						
	df				df for Hyp.	Concepts (CTBS)		Computation (CTBS)		Problems (CTBS)	
	Num.	Denom.	F	p		Mean Square	p	Mean Square	p	Mean Square	p
Total	--	--	--	--	126	--	--	--	--	--	--
Mean	--	--	--	--	1	--	--	--	--	--	--
Between schools	--	--	--	--	62	--	--	--	--	--	--
Between cells	--	--	--	--	3	--	--	--	--	--	--
Sites	3	57	.35	.79	1	.40	.95	12.73	.70	12.45	.71
PIA	3	57	1.11	.35	1	29.16	.57	22.83	.61	17.74	.65
Site x PIA	3	57	.10	.96	1	20.11	.63	14.82	.68	6.63	.78
Within cells (Error)	--	--	--	--	59	87.15	0	84.87	--	87.26	--
Within schools	--	--	--	--	63	--	--	--	--	--	--
Sex	3	57	13.12	.0001[a]	1	1.55	.76	339.11	.0001[a]	15.15	.34
Sex x site	3	57	1.86	.15	1	76.16	.04	59.07	.04	53.34	.08
Site x PIA x site	6	114	.85	.53	2	5.58	.71	3.08	.79	5.50	.72
Sex x schools	--	--	--	--	59	16.44	--	13.34	--	16.70	--
Covariance											
Covariates											
Pretests	9	131.5724	6.32	.0001[a]	3	890.86	.0001[a]	520.99	.0001[a]	858.62	.0001[a]
Sites	3	54	.39	.76	1	2.35	.82	9.26	.70	21.58	.50
PIA	3	54	1.15	.34	1	12.81	.59	1.76	.87	124.38	.11
PIA x site	3	54	.33	.81	1	36.93	.36	39.50	.43	31.55	.41
Error	--	--	--	--	56	44.08	--	61.51	--	45.94	--
Within school											
Covariates	9	131.57	6.21	.0001[a]	3	118.14	.0001[a]	107.40	.0001[a]	131.45	.0001[a]
Sex	3	54	10.21	.0001[a]	1	14.00	.26	181.22	.0001[a]	0.20	.89
Site	3	54	.60	.62	1	17.76	.21	4.70	.57	3.40	.57
Sex x PIA	6	108	.66	.68	2	10.95	.38	2.45	.75	1.03	.91
Error	--	--	--	--	56	10.98	--	8.30	--	10.55	--

[a] Significant at .05 level.

TABLE 11
GRADE 1--SAMPLE MEANS BY EXPERIMENTAL GROUP BY SITE

Variable	Urban Site 2			Rural Site 1			Average--Both Sites		
	PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
Number of schools	5	4	9[a]	5	4	9[a]	10[a]	8[a]	18[a]
Number of students	524	429	953[a]	280	222	502[a]	804[a]	651[a]	1455[a]
Pretests									
Arithmetic survey	59.96	65.24	62.31	72.99	75.00	73.88	66.48	70.12	68.10
Boys	58.89	63.85	61.09	71.38	75.03	73.00	65.14	69.44	67.05
Girls	61.03	66.62	63.52	74.60	74.97	74.76	67.82	70.79	69.14
Posttests									
Concepts (ETS)	54.05	57.75	55.69	69.70	72.05	70.75	61.88	64.90	63.22
Concepts (CAT)	54.16	55.62	54.81	66.31	70.45	68.15	60.24	63.03	61.48
Computation (CAT)	35.20	39.95	37.31	46.60	47.59	47.04	40.90	43.77	42.18
Problems (CAT)	50.20	55.24	52.44	58.53	62.04	60.09	54.37	58.64	56.27
NV (Content valid (V) and nonvalid (X) subscales (CAT)[b])	.66	.67	.67	.80	.83	.81	.73	.75	.74
MV	.53	.56	.54	.65	.76	.70	.59	.66	.62
+V	.62	.68	.65	.77	.78	.77	.69	.73	.71
-V	.45	.53	.48	.66	.65	.66	.55	.59	.57
NX	.44	.46	.45	.57	.64	.60	.51	.55	.53
MX	.48	.52	.50	.61	.63	.62	.55	.57	.56
+X	.52	.56	.54	.62	.69	.65	.57	.62	.5[illegible]
-X	.30	.36	.33	.41	.43	.42	.36	.39	.37

[a] These numbers are totals.

[b] See Appendix D for summary of subscales.

TABLE 12

GRADE 2--SAMPLE MEANS BY EXPERIMENTAL GROUP BY SITE

Variable	Urban Site 2			Rural Site 1			Average--Both Sites		
	PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
Number of schools	5	4	9[b]	5	3	8[b]	10[b]	7[b]	17[b]
Number of students[a]	630	460	1,090[b]	245	240	485[b]	875[b]	700[b]	1,575[b]
Pretests									
Concepts (ETS)	50.21	61.29	55.13	70.51	72.94	71.42	60.36	66.28	62.80
Concepts (CAT)	59.29	70.83	64.42	77.85	80.93	79.00	68.57	75.16	71.28
Computation (CAT)	37.24	46.62	41.41	50.29	56.00	52.43	43.77	50.64	46.60
Problems (CAT)	52.65	68.62	59.75	67.60	75.86	70.70	60.13	71.72	64.90
NV } Content valid (V) and nonvalid (X) subscales (CAT)[c]	.62	.72	.66	.78	.79	.78	.70	.75	.72
MV	.45	.58	.51	.64	.65	.64	.55	.61	.57
+V	.60	.68	.64	.75	.79	.77	.67	.73	.69
-V	.39	.53	.45	.59	.70	.63	.49	.61	.54
NX	.42	.54	.47	.61	.69	.64	.51	.60	.55
MX	.48	.57	.52	.64	.67	.65	.56	.61	.58
Posttests									
Concepts (ETS)	44.54	53.79	48.65	62.77	65.81	63.91	53.65	58.94	55.82
Concepts (CAT)	70.05	81.76	75.25	88.67	92.48	90.09	79.36	86.35	82.24
Computation (CAT)	49.59	54.92	51.96	65.73	71.03	67.72	57.66	61.83	59.38
Problems (CAT)	64.73	74.31	68.99	82.63	85.74	83.79	73.68	72.21	73.07
NV } Content valid (V) and nonvalid (X) subscales (CAT)[c]	.69	.79	.73	.88	.89	.88	.79	.84	.81
MV	.71	.80	.75	.81	.86	.83	.76	.82	.78
+V	.72	.78	.75	.89	.94	.91	.81	.85	.83
-V	.53	.61	.57	.76	.85	.79	.65	.71	.67
NX	.62	.67	.64	.71	.71	.71	.66	.69	.67
MX	.41	.58	.49	.61	.75	.66	.51	.65	.57
Gain									
Concepts (ETS)	-5.68	-7.50	-6.49	-7.75	-7.12	-7.51	-6.71	-7.34	-6.97
Computation	12.34	8.30	10.54	15.44	15.03	15.29	13.89	11.19	12.78
Problems	12.07	5.69	9.23	15.03	9.88	13.10	13.55	11.19	12.58
NV } Content valid (V) and nonvalid (X) subscales (CAT)[c]	.07	.07	.07	.10	.10	.10	.09	.08	.09
MV	.26	.22	.24	.17	.20	.18	.22	.21	.22
+V	.13	.10	.12	.14	.16	.15	.13	.12	.13
-V	.13	.07	.10	.17	.14	.16	.15	.10	.13
NX	.20	.14	.17	.10	.02	.07	.15	.09	.13
MX	-.07	.01	-.03	-.03	.08	.01	-.05	.04	-.01

[a] Numbers are approximate; exact data were unavailable at time of report.
[b] These numbers are totals.
[c] See Appendix D for summary of subscales.

TABLE 13
GRADE 3--SAMPLE MEANS BY EXPERIMENTAL GROUP BY SITE

Variable	Urban Site 1			Rural Site 1			Average--Both Sites		
	PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
Number of schools	22	23	45[a]	5	4	9[a]	27[a]	27[a]	54[a]
Number of students	1,017	1,174	2,191[a]	269	202	471[a]	1,286[a]	1,376[a]	2,662[a]
Pretests									
Concepts (ETS)	64.13	67.39	65.80	72.98	72.38	72.71	65.77	68.13	66.95
Concepts (CAT)	83.66	86.70	85.21	91.26	93.25	92.14	85.07	87.67	86.37
Computation (CAT)	53.92	54.88	54.41	50.80	54.01	52.22	53.34	54.75	54.04
Problems (CAT)	77.23	76.85	77.04	84.07	83.49	83.81	78.49	77.83	78.16
MV	.65	.68	.67	.71	.73	.72	.66	.68	.67
NV Content valid	.74	.74	.74	.79	.79	.79	.75	.74	.75
+V (V) and	.88	.89	.89	.89	.90	.89	.88	.89	.89
-V nonvalid (X)	.74	.77	.76	.80	.82	.81	.75	.78	.77
OV subscales	.67	.72	.70	.76	.78	.77	.69	.73	.71
MX (CAT)[b]	.77	.76	.76	.79	.78	.79	.77	.76	.77
-X	.56	.58	.57	.55	.61	.58	.55	.58	.57
+X	.25	.27	.26	.16	.17	.16	.23	.25	.24
Posttests									
Concepts (ETS)	82.09	84.13	83.13	[illegible].98	96.44	95.07	84.30	85.95	85.12
Concepts (CAT)	98.69	99.89	99.30	105.40	110.01	107.44	99.94	101.39	100.66
Computation (CAT)	63.75	64.12	63.94	65.97	71.73	68.53	64.16	65.25	64.70
Problems (CAT)	75.55	76.90	76.24	80.36	90.93	85.05	76.44	78.98	77.71
NV	.73	.73	.73	.79	.83	.81	.74	.75	.75
MV	.74	.77	.76	.80	.83	.82	.75	.78	.77
+V Content valid	.93	.92	.92	.93	.94	.93	.93	.92	.93
-V (V) and	.80	.79	.79	.82	.87	.84	.80	.80	.80
OV nonvalid (X)	.80	.80	.80	.83	.86	.84	.81	.81	.81
MX subscales	.87	.88	.88	.90	.88	.89	.88	.88	.88
-X (CAT)[b]	.50	.48	.49	.50	.61	.55	.50	.50	.50
+X	.34	.40	.37	.36	.52	.43	.34	.42	.38
*V	.61	.59	.60	.65	.70	.67	.62	.60	.61
Gain									
Concepts (ETS)	17.97	16.74	17.34	20.99	24.06	22.35	18.53	17.82	18.17
Concepts (CAT)	15.03	13.19	14.08	14.15	16.76	15.31	14.87	13.72	14.29
Computation (CAT)	9.82	9.24	9.52	15.17	17.72	16.30	10.81	10.50	10.65
Problems (CAT)	-1.68	.05	-.79	-3.71	7.44	1.24	-2.05	1.14	-.45

(continued)

TABLE 13 (continued)

Variable		Urban Site 1			Rural Site 1			Average--Both Sites		
		PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
MV	Content valid (V) and nonvalid (X) subscales (CAT)[b]	.09	.06	.07	.08	.10	.09	.09	.06	.08
NV		.01	.03	.02	.01	.04	.02	.01	.04	.03
+V		.05	.03	.04	.04	.04	.04	.05	.03	.04
-V		.06	.02	.04	.02	.05	.03	.05	.03	.04
OV		.13	.08	.10	.07	.08	.07	.12	.08	.10
MX		.10	.12	.11	.11	.10	.11	.11	.12	.12
-X		-.06	-.10	-.08	-.05	.01	-.02	-.05	-.08	-.06
+X		.09	.13	.11	.20	.34	.26	.11	.16	.14

[a] These numbers are totals.

[b] See Appendix D for summary of subscales.

TABLE 14
GRADE 4--SAMPLE MEANS BY EXPERIMENTAL GROUP BY SITE

Variable	Urban Site 1			Rural Site 2			Average--Both Sites		
	PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
Number of schools	22	23	45[a]	9	9	18[a]	31[a]	32[a]	63[a]
Number of students	1,145	1,136	2,281[a]	598	488	1,086[a]	1,743[a]	1,624[a]	3,367[a]
Pretests									
Concepts (CTBS)	90.84	96.27	93.61	89.24	92.75	90.99	90.38	95.28	92.87
Computation (CTBS)	123.29	124.36	123.83	120.04	124.60	122.32	122.35	124.43	123.41
Applications (CTBS)	66.35	69.51	67.97	65.69	72.90	63.30	66.16	70.46	68.34
Content valid (V) subscales (CAT)[b]									
NV	.62	.66	.64	.60	.62	.61	.61	.65	.63
MV	.52	.53	.52	.49	.54	.51	.51	.53	.52
+V	.83	.82	.83	.79	.81	.80	.82	.82	.82
-V	.68	.69	.69	.67	.72	.69	.68	.70	.69
OV	.67	.70	.68	.67	.71	.69	.67	.70	.69
GV	.59	.61	.60	.60	.59	.59	.59	.60	.60
*V	.71	.72	.72	.68	.69	.69	.70	.71	.71
Posttests									
Concepts (CTBS)	108.[illegible]4	110.12	109.10	109.14	108.71	108.93	108.36	109.72	109.05
Computation (CTBS)	151.51	153.33	152.43	151.61	151.28	151.44	151.54	152.75	152.15
Applications (CTBS)	82.34	81.69	82.01	84.04	81.95	82.99	82.83	81.76	82.29
Content valid (V) subscales (CAT)[b]									
NV	.73	.75	.74	.73	.73	.73	.73	.74	.74
MV	.72	.75	.74	.72	.75	.73	.72	.75	.73
+V	.92	.92	.92	.92	.92	.92	.92	.92	.92
-V	.85	.86	.86	.84	.84	.84	.85	.85	.85
OV	.70	.71	.71	.71	.69	.70	.70	.70	.70
GV	.72	.71	.71	.73	.72	.72	.72	.71	.71
*V	.91	.90	.91	.91	.90	.90	.91	.90	.90
+V	.85	.88	.86	.87	.86	.86	.86	.87	.87
Gain									
Concepts (CTBS)	17.20	13.85	15.49	19.90	15.96	17.93	17.98	14.44	16.18
Computation (CTBS)	28.22	28.97	28.61	31.57	26.68	29.12	29.19	28.32	28.74
Applications (CTBS)	15.99	12.18	14.04	18.35	9.05	13.70	16.68	11.30	13.95

(continued)

TABLE 14 (continued)

Variable		Urban Site 1			Rural Site 2			Average--Both Sites		
		PIA	Control	Average	PIA	Control	Average	PIA	Control	Average
NV	Content valid (V) subscales (CAT)[b]	.11	.09	.10	.13	.12	.13	.12	.10	.11
+V		.09	.10	.09	.12	.10	.11	.10	.10	.10
-V		.17	.17	.17	.17	.12	.14	.17	.16	.16
OV		.03	.02	.03	.04	-.02	.01	.03	.00	.01
GV		.13	.10	.11	.13	.13	.13	.13	.11	.12
*V		.19	.18	.19	.23	.21	.22	.20	.19	.19
MV		.20	.22	.2[illegible]	.23	.21	.22	.21	.22	.22

[a] These numbers are totals.

[b] See Appendix D for summary of subscales.

Treatment Effect

Estimates of treatment effect, i.e., estimates of the difference between treatment and control "true" means, obtained by the method of least squares assuming no variation in PIA effect by site or sex are shown by grade in Tables 15-18. Estimates of standard errors are also shown. In no case can the null hypothesis of no treatment effect be rejected using the criterion that the *F*-ratio approximation to the multivariate test be significant at the .05 level. While only results for the major components of mathematics achievement are shown in the analysis of variance summary tables (Tables 7 to 10), results for the subscales are generally quite similar. For Grades 1, 3, and 4 the evidence against the null hypothesis, as measured inversely by the observed significance level of the test statistic, can not even be considered moderately strong. For Grade 2 the significance level observed is .07; however, the tests used are non-directional and, if anything, this evidence would point to a difference in favor of the control schools. This is indicated by the negative estimates of treatment effects shown in Table 16.

In fact, with very few exceptions the estimated PIA effect is negative in all grade levels and both sex groups. The exceptions are for the problems subtest, two subscales for Grade 4, and three subscales for Grade 3. However, only in Grade 2 are the estimated values substantially larger than the corresponding standard errors of the estimates. In Grade 2 the estimates are almost uniformly at least double the size of the corresponding standard errors and in most cases would be statistically significant by univariate .05 level two-tailed *t*-tests. For all other grade levels, the most that can be inferred is that the program produces little change in achievement over existing programs.

TABLE 15
GRADE 1--ESTIMATES OF EFFECTS OF PIA ON MATHEMATICS ACHIEVEMENT (URBAN SITE 2, RURAL SITE 1)

Variable	Estimated Difference Due to PIA							
	Posttest Score				Gain Score			
			Adjusted for Covariate[a]				Adjusted for Covariate	
	PIA Effect[b]	S.E. Est.	PIA Effect[b]	S.E. Est.	PIA Effect[b]	S.E. Est.	PIA Effect[b]	S.E. Est.
Concepts (ETS)	-3.02	3.11	1.24	2.31	Pretests not comparable to posttests			
Boys	-3.86	3.32	--	--				
Girls	-2.18	3.21	--	--				
Concepts (CAT)	-2.80	3.66	1.68	3.05				
Boys	-4.26	3.74	--	--				
Girls	-1.34	3.74	--	--				
Computation (CAT)	-2.86	4.32	2.09	3.80				
Boys	-3.93	4.46	--	--				
Girls	-1.80	4.46	--	--				
Problems (CAT)	-4.28	4.50	0.50	4.16				
Boys	-6.25	4.61	--	--				
Girls	-2.31	4.60	--	--				
NV (Content valid (V) and nonvalid (X) subscales (CAT)[c])	- .02	.04	.03	.03				
MV	- .07	.05	- .01	.04				
+V	- .04	.05	.04	.04				
-V	- .04	.07	.04	.07				
NX	- .05	.04	- .00	.04				
MX	- .03	.05	.02	.05				
+X	- .05	.05	- .01	.05				
-X	- .04	.07	.03	.07				
Pretest[d]								
Arithmetic survey	-3.64	2.04	--	--				
Boys	-4.30	2.28	--	--				
Girls	-2.98	2.07	--	--				

[a] Arithmetic survey (pretest) used as covariate.
[b] A positive value indicates PIA produces a positive effect.
[c] See Appendix D for summary of subscales.
[d] Analyzed in the same way as posttest data.

TABLE 16
GRADE 2--ESTIMATED EFFECTS OF PIA ON MATHEMATICS ACHIEVEMENT
(URBAN SITE 2, RURAL SITE 1)

Variable	Estimated Difference Due to PIA							
	Posttest Score				Gain Score			
			Adjusted for Covariate[a]				Adjusted for Covariate[a]	
	PIA Effect[b]	S.E. Est.	PIA Effect[b]	S.E. Est	PIA Effect[b]	S.E. Est.	PIA Effect[b]	S.E. Est.
Concepts (ETS)	-6.41	2.70	-3.27	2.57	.70	1.86		
Boys	-6.07	3.34	--	--	--	--		
Girls	-6.76	2.28	--	--	--	--		
Concepts (CAT)	-8.09	2.54	-2.77	2.80	-.42	2.54		
Boys	-9.23	2.71	--	--	--	--		
Girls	-6.95	2.56	--	--	--	--	Same as for	
Computation (CAT)	-5.32	2.65	-2.34	3.77	2.38	3.16	posttests	
Boys	-5.43	2.84	--	--	--	--	adjusted for	
Girls	-5.21	3.15	--	--	--	--	covariates	
Problems (CAT)	-6.62	2.72	1.60	3.41	5.81	2.26		
Boys	-5.54	3.45	--	--	--	--		
Girls	-7.70	2.50	--	--	--	--		
NV (Content valid (V) and nonvalid (X) subscales (CAT)[c])	- .06	.02	- .03	.02	.00	.02		
MV	- .07	.03	- .04	.03	.01	.03		
+V	- .05	.03	- .07	.03	.01	.04		
-V	- .08	.04	- .06	.04	.05	.05		
NX	- .03	.02	- .00	.01	.07	.04		
MX	- .16	.04	- .11	.04	-.10	.04		

[a] Covariates: for Concepts (ETS), Computation (CAT), and Problems (CAT) were the corresponding pretest scores.
for Concepts (CAT) were pretest scores on Concepts (CAT), Computation (CAT), and Problems (CAT).
for the NV, MV, NX, and MX subscales were the corresponding set of pretests.
for the +V and -V subscales were the pretests for NV, MV, NX and MX.

[b] A positive value indicates PIA produces a positive effect.

[c] See Appendix D for summary of subscales.

TABLE 17
GRADE 3--ESTIMATES OF EFFECTS OF PIA ON MATHEMATICS ACHIEVEMENT
(URBAN SITE 1, RURAL SITE 1)

Variable	Estimated Difference Due to PIA[a]							
	Posttest Score				Gain Score			
			Adjusted for Covariate[b]				Adjusted for Covariate	
	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.
Concepts (ETS)	-2.10	2.35	- .72	1.62	0.52	1.63		
Boys	-2.63	2.47	--	--	--	--		
Girls	-1.58	2.46	--	--	--	--		
Concepts (CAT)	-1.76	2.49			1.11	2.14		
Boys	-2.27	2.52			--	--		
Girls	-1.26	2.78			--	--		
Computation (CAT)	-1.26	2.68	.01	2.25	0.07	2.52	Same as posttest scores adjusted for covariates	
Boys	-1.23	2.76	--	--	--	--		
Girls	-1.29	2.74	--	--	--	--		
Problems (CAT)	-2.87	2.32	-2.15	1.54	-3.28	1.80		
Boys	-3.36	2.49	--	--	--	--		
Girls	-2.38	2.66	--	--	--	--		
NV (Content valid (V) and nonvalid (X) subscales (CAT)[d])	- .01	.02	.01	.02	- .03	.01		
MV	- .03	.02	- .02	.01	.02	.02		
+V	.01	.01	.01	.01	.02	.01		
-V	.00	.02	.01	.02	.02	.02		
OV	- .01	.02	.02	.02	.04	.02		
MX	- .00	.02	.01	.02	- .01	.03		
-X	- .01	.04	.02	.03	.03	.04		
+X	- .08	.05	- .05	.04	- .06	.05		
*V	.01	.05	.04	.04	NC[e]	NC		

[a] Assumes no site x treatment interaction.
[b] Covariates: for main tests, see Table 12 footnote.
for subscales NV, MV, OV, and MX were the corresponding pretests.
for subscales +V, -V, -X, +X, and *V were the corresponding pretests.
[c] A positive value indicates PIA produces a positive effect.
[d] See Appendix D for summary of subscales.
[e] NC signifies not computed.

TABLE 18
GRADE 4--ESTIMATES OF EFFECTS OF PIA ON MATHEMATICS ACHIEVEMENT
(URBAN SITE 1, RURAL SITE 2)

Variable	Estimated Difference Due to PIA[a]							
	Posttest Score				Gain Score			
			Adjusted for Covariates[b]				Adjusted for Covariate	
	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.	PIA Effect[c]	S.E. Est.
Concepts (CTBS)	-1.36	2.35	.93	1.72	3.52	2.36	Same as for posttests adjusted for covariates	
Boys	-1.85	2.79	--	--	--	--		
Girls	-0.87	2.32	--	--	--	--		
Computation (CTBS)	-1.20	2.32	.34	2.04	.86	3.02		
Boys	-1.33	2.66	--	--	--	--		
Girls	-1.08	2.32	--	--	--	--		
Problems (CTBS)	1.06	2.35	2.89	1.76	5.38	2.52		
Boys	.82	2.72	--	--	--	--		
Girls	1.31	2.41	--	--	--	--		
NV (Content valid (V) subscales (CTBS)[d])	- .01	.02	- .01	.01	.02	.02		
MV	- .03	.02	- .03	.02	- .01	.02		
+V	- .01	.01	- .01	.01	- .01	.02		
-V	- .01	.02	- .01	.01	.01	.02		
OV	- .00	.02	.01	.01	.03	.02		
GV	.01	.02	.01	.01	.02	.01		
*V	.01	.01	.01	.01	.01	.02		
±V	- .02	.02	- .02	.02	NC[e]	NC		

[a] Assumes no treatment x site interaction.

[b] Covariates were the corresponding sets of pretests for Concepts, Computation, and Problems; for NV, MV, OV, and GV; and for +V, -V, *V, and ±V.

[c] A positive value indicates PIA produces a positive effect.

[d] See Appendix A for summary of subscales.

[e] NC signifies not computed.

Gain, or more neutrally, change, scores obtained by subtracting pretest scores from posttest scores are available for all grades except Grade 1. Estimates of the effect of PIA on change during the academic year are also shown in Tables 16 to 18. In this case, with few exceptions, the effect is positive, i.e., students in PIA schools had greater observed gains than those in control schools. However, the multivariate analysis of the gain score data (not shown) does not provide even moderately strong evidence against the hypothesis of no PIA effect.

Pretest Differences

Part of the discrepancy between the observed differences for posttest scores and those for pretest scores can be attributed to the fact that pretest scores were generally higher for control than for PIA schools (Tables 11-14). This situation was almost certainly caused by the inability to maintain stringent random assignment, particularly in urban site 2 as explained previously. In one case (Grade 2), the difference between treatment and control sample means is statistically significant using the same criterion used for posttests. Moreover, pretest and posttest scores are correlated to a statistically significant extent as shown in Tables 7 to 10. In addition, by comparing the mean squares for error without and with the covariates removed in Tables 7 to 10, one can appreciate the extent of the association. Except for computations, the mean square for error is reduced by about 50% for the variables at all grade levels. The decrease for computations is about 33%. Given these results, it is not surprising that posttest scores are higher for control schools.

Analysis of Covariance

The estimates of the effect of PIA on mathematics achievement after removal of covariates are shown in Tables 15 to 18. For Grades 1, 3, and 4 the use of covariates produces moderate to large decreases in the standard error of the estimates of the PIA effects. This is not true for Grade 2 largely because of confounding between the treatment "factor" and the covariates. For Grades 1 and 4 the adjusted estimates for the PIA effect on the major components of mathematics achievement are positive. For Grades 2 and 3 the adjusted estimates are negative with one exception for Grade 3 but are much smaller in absolute magnitude than the unadjusted estimates. However, the analysis of covariance results do not provide even moderate evidence against the hypothesis of no PIA effect.

Summary of Results of Analyses

The results of these analyses do not provide sufficient evidence to reject the hypothesis of no effect of PIA on mathematics achievement in favor of the hypothesis of a positive effect at any grade level. Rather, the evidence suggests that student achievement levels are about as high with programs generally in use in the target populations studied as under PIA. These results appear to be the same regardless of sex of student or whether the school is in an urban or in a rural setting.

Implementation and Appropriateness Results

Mean scores and variances for level of implementation for the PIA schools are shown in Table 19 by grade. The correlations of level of implementation with each of the three main measures of mathematics achievement are also presented in Table 19. It is somewhat puzzling that in Grades 1 and 2 the observed correlations are negative; however, none of these differ from zero by a statistically significant amount. Of course, the small number of degrees of freedom for error makes both estimation and testing quite imprecise at these grade levels. For Grade 3 the correlations are positive and the relationships are statistically significant. (The multivariate test of the regression of the three main components of mathematics achievement on implementation produces a result significant at the .05 level.) Moreover, the variability of implementation at Grade 3 appears to be considerably higher than at Grades 1 or 2. For Grade 4 the observed correlations are positive but smaller in magnitude than those for Grade 3, perhaps partly because of the somewhat smaller variance of implementation scores. The observed correlations at Grade 4 are not statistically significant.

An analysis paralleling the one just described was performed on scores obtained from teachers' responses to questions designed to determine the extent they perceived the materials in PIA appropriate for their students. Means and variances of these scores as well as observed correlations with the main measures of mathematics achievement are shown in Table 19. In general, the correlations are small. For the most part, they are negative for Grades 1 and 2 and positive for Grades 3 and 4. None are statistically significant.

TABLE 19

IMPLEMENTATION OF PROGRAM AND APPROPRIATENESS OF MATERIAL--
CORRELATIONS WITH MATHEMATICS ACHIEVEMENT OF PIA STUDENTS

Score	GRADE (PIA only) 1	2	3	4
Implementation score				
Mean	4.46	4.25	4.49	4.42
Variance	.71	.59	1.57	.93
Appropriateness score				
Mean	2.96	2.98	3.30	3.25
Variance	1.16	.74	1.87	1.38
Correlations Implementation with				
Concepts (ETS)	-.37	-.49	.37[a]	--
Concepts (CAT)[a]	-.31	-.60[c]	.50[c]	.27
Computation (CAT)	-.42	-.44	.38[a]	.30
Problems (CAT)	-.36	-.52	.56[c]	.18
Correlations Appropriateness with				
Concepts (ETS)	-.12	.06	-.05	--
Concepts (CAT)	-.09	-.02	.03	.01
Computation (CAT)	-.09	.11	.15	.11
Problems (CAT)	-.31	-.19	.14	.10
df error	8	8	24	27

[a] Significant at .10 level.

[b] At Grade 4 the CTBS was administered instead of the CAT.

[c] Significant at .05 level.

V

SUMMARY AND DISCUSSION

The central question of this evaluation was what the effect of the PIA program was on student achievement in mathematics in Grades 1 to 4. The schools selected for the study represented urban and rural settings of generally low socioeconomic status in which a television-based mathematics program is thought to have particular advantages, e.g., requiring less advanced reading skills. The results of this one-year study indicated, however, that pupils in control schools who participated in several conventional mathematics programs achieved equally as well as the PIA students on standardized measures of achievement in mathematics concepts, skills, and problem solving. These results did not vary with sex, site, or grade level.

Apparently, the possible advantages of television instruction did not in this case outweigh the disadvantages frequently pointed out by the participating teachers. A severe drawback present when television lessons are not available in a video-tape format is the rigidity of a broadcast schedule that allows neither for flexibility of lesson presentations within the daily or weekly classroom schedule nor for individualization in pacing the lessons for students of different ability. (PIA is now available in video-tape format.) Similarly, there is no possibility of varying the rate at which a single telecast is presented or of pausing during instruction to clear up questions or repeat segments. In general, the lack of interaction between television teacher and student--the impersonality of such instruction--is seen as a disadvantage. For the PIA telecasts in particular, the fact that they were not produced in color or with animation makes them less appealing to students accustomed to commercially produced programs and high-budget shows such as "Sesame Street."

A principal feature of televised mathematical instruction is its use of manipulative and visual aids to illustrate abstract ideas; it is assumed that teachers will model their follow-up instruction on the telecast presentation by relying heavily on manipulative objects. Field test monitoring visits verified that appropriate manipulatives were readily available in the experimental classrooms but that less than half of the teachers ever used them. Thus, many teachers depended completely on the telecast presentations for translating the mathematical abstractions into realistic situations for their students. A more extensive inservice training period is probably necessary to equip teachers to employ televised instruction effectively.

REFERENCES

Braswell, J. Formative evaluation of Patterns in Arithmetic, Grade 5, 1967-68. Working Paper No. 18, Madison: Wisconsin Research and Development Center for Cognitive Learning, 1969a.

Braswell, J. Patterns in Arithmetic field testing, Grade 2, 1967-68. Working Paper No. 17, Madison: Wisconsin Research and Development Center for Cognitive Learning, 1969b.

Braswell, J. The formative evaluation of Patterns in Arithmetic, Grade 6, using item sampling. Technical Report No. 113, Madison: Wisconsin Research and Development Center for Cognitive Learning, 1970.

Braswell, J. S., & Romberg, T. A. Objectives of Patterns in Arithmetic and evaluation of the telecourse for Grades 1 and 3. Technical Report No. 67, Madison: Wisconsin Research and Development Center for Cognitive Learning, 1969.

Marshall, J. L., & Fischbach, T. J. Evaluation of Patterns in Arithmetic in Grades 1-4, 1970-71: Effects on teachers. Technical Report No. 225, Madison: Wisconsin Research and Development Center for Cognitive Learning, 1972.

Van Engen, H. Teacher's Manual, Patterns in Arithmetic. Madison: Wisconsin Research and Development Center for Cognitive Learning, 1967.

APPENDICES

APPENDIX A

OVERVIEW OF THE KEY MATHEMATICAL IDEAS IN PATTERNS IN ARITHMETIC, GRADES 1-6

The following is a brief description of the fundamental concepts which run through the *Patterns in Arithmetic* series.

1. Set: The concept of a set is fundamental for developing and communicating ideas in mathematics. Since the idea of a set is a rather primitive one, as early as Grade 1 pupils become familiar with the simple concepts which involve sets, such as setting up a one-to-one correspondence (matching) between sets and comparing the numerousness of two sets. The set idea is found to be particularly useful in the teaching of addition (set union) and subtraction (set complementation). Set ideas are also applied in the later grades to equivalent fractions, equivalent ratios, and geometric figures.

2. Number: One of the main features of the program is the logical development of the rational numbers, beginning with the positive integers. Near the beginning of Grade 3 the pupils will be able to determine the cardinality of any set with less than 10,000 members and to use the ordinal numbers. During the First, and again the Second Grade, the pupil is taught the ideas of betweenness, less than, greater than, and equal to for numbers less than 1,000. The number line is used to picture the order of integers and the pupil is taught how to use this line to perform addition and subtraction. These ideas are reinforced and extended so that near the end of Grade 6 the pupil is totally familiar with the positive rational numbers. Other miscellaneous topics covered in the series are even and odd numbers, prime numbers, prime factorization of natural numbers, the least common multiple and greatest common factor of pairs of natural numbers, and the negative integers.

3. Numeration System: After some degree of understanding has been achieved in counting with both cardinal and ordinal numbers, the pupils are taught how to write the numbers 0-9, and after 9, the concept of place value is introduced. Although the pupils do not fully comprehend place value at this time, extensive use of tally charts and regrouping is introduced in order to overcome some of the mystery of place value. Near the beginning of Grade 4 the pupil should be able to write all numerals and interpret place value for larger numbers. Although emphasis is on the decimal system (Base 10), numeration systems with other bases (Base 5, Base 2) are introduced to promote understanding of place value. Positive rational numbers and the several notations associated with them (common fraction, mixed number, decimal fraction) are introduced in Grades 4-6.

4. Operations: A considerable portion of elementary school arithmetic is concerned with the four fundamental operations--addition, subtraction, multiplication, and division--and how these operations act with various sets of numbers (natural numbers, positive rationals, integers). Of course, one of the major objectives of any elementary school arithmetic program is to develop accuracy and speed in computing. However, computing in itself is not enough; therefore, we have placed considerable emphasis on ideas associated with computing in an attempt to make the four operations more than rote calculation. For example, in forming the sum 3 + 2, the pupil considers a stationary set with 3 objects

and another set of 2 objects which appear to be joining the given 3. Thus 3 + 2 is looked upon as a set of 3 being joined by a set of 2 to form a set of 5. The concept of column addition is approached through tally charts in an attempt to impart some understanding of place value in our Base 10 numeration system. Rectangular arrays are used to analyze geometrically the operation of multiplication. Geometric arguments are made to lend substance to the operations applied to the positive rationals. The notion of operation is extended in Grades 5 and 6 by introduction of an operation with a simple geometric realization.

Beginning in the First Grade the commutative, associative, and distributive properties of the operations receive considerable attention as aids to computation. Not until Grade 5 are the properties formalized for the pupils. Upon completion of Grade 6 the pupil will be able to compute efficiently with the positive rational numbers in their many notations.

Throughout PIA the pupils are presented verbal situations in which they can apply their newly acquired computational skills. In these situations special attention is devoted to developing the ability to formulate mathematical sentences in a clear and natural way.

5. Mathematical Sentence (Equation): Since language is the vehicle through which we communicate our ideas, it is important that pupils begin to develop the ability to generate mathematical sentences as soon as possible. In the First Grade, the pupil encounters many experiences with pictures and objects which lead to basic sentence forms. In word problems pupils are requested to "write a sentence which tells the story of the problem" before finding the solution. (Problem: A box holds 6 apples. How many boxes are needed for 30 apples? Sentence: $N \times 6 = 30$.) Throughout the series the same importance is attached to the need to translate verbal problems into mathematical sentences.

6. Measurement: Owing to its importance in everyday life as a key link between our physical and social environment, we begin a systematic study of measurement in the First Grade. As an introduction, the First Grade pupil becomes familiar with the concept of relative length (the desk is less than five pencil-lengths long) and a non-standard unit of measurement (the pencil above). Upon completing the first four grades, the pupil will be able to carry out approximate linear measurements in standard units (inches, feet) and he will be able to find the perimeter of some elementary geometrical forms (triangle, rectangle). In Grades 5 and 6 the concepts of area and volume are discussed in terms of non-standard and standard units of measure and approximation techniques are used to estimate areas and volumes of irregular regions. Formulas for areas or volumes of elementary regions, such as a rectangular region and right rectangular prisms, are introduced.

7. Geometry: One of the more unique features of the program is a systematic development of elementary geometrical concepts beginning in the First Grade. Aside from learning the names of the more common geometrical figures, the pupil becomes familiar with open and closed

curves, interior and exterior of geometrical forms, points, lines and angles, intersection of curves, parallelism, and perpendicularity. The notions of congruence and similarity are introduced intuitively in the early grades and in the later grades approached from transformations in the plane (reflections and dilations).

8. Practical Aspects: Although the practical aspects should not perhaps be mentioned as a fundamental strand, these aspects are important enough in the daily activities of pupils to warrant special attention. Beginning in the primary grades the pupil is exposed to aspects of linear and cubic (cup, pint, etc.) measurement. By the end of Grade 4 the pupil will have some experience in measuring the boundary and area of plane geometrical forms. Other practical aspects covered in the first three grades are money and making change and use of the thermometer.

APPENDIX B

EXAMPLE MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT

The Wisconsin Research & Development Center for Cognitive Learning and the _______________________________________ agree cooperatively to field test, during the 1970-71 academic year, the Patterns in Arithmetic instructional materials developed by the Center.

The Center will provide:

1. All materials for students and teachers including one teacher's manual for each experimental teacher, workbooks for all students in the experimental schools, and video materials including the related shipping costs. In regard to the video materials the Center will either pay rental charges for video tape to be broadcast by the ____ or an equivalent amount if the ________ prefers to acquire video tape on a more permanent basis.
2. Spring and fall inservice workshops for all teachers of experimental and control classrooms. The Center will pay each teacher and a maximum of five additional staff honoraria at the rate of _____ per day. Staff and consultants to conduct the workshops will be furnished by the Center.
3. A field test coordinator who will be responsible for the conduct of the field test and field test monitors who will visit each experimental and control school at least once during the year.
4. All evaluation instruments and related scoring services.
5. Copies of a final report showing the results of the field test.

The ______________________________ will:

1. Arrange for video reception facilities and classroom reception time.
2. Provide essential supplementary instructional materials in the experimental schools as recommended in the PIA manuals.
3. Provide the usual program of arithmetic instruction in the control schools.
4. Permit random selection and assignment of schools to experimental and control conditions.
5. Designate one staff member from the ______________________ as a field test coordinator and one staff member in each school as a local coordinator. These coordinators will monitor the day to day conduct of the field test and make student records and data available to the Center.
6. Provide facilities and release staff for the inservice workshops.
7. Follow field test procedures recommended by the Center.

SIGNED: ______________________

____
Research & Development Center

____

____

8/17/70

APPENDIX C

INSERVICE AGENDAS AND MATERIALS

Sample Agenda

Orientation Meeting

for the

Patterns in Arithmetic field test

September 19, 1970

Welcome and Introductions

Overview of the National Field Test

Sites
Objectives

Testing Program for Students

Teacher Questionnaire and Test

Lunch

Patterns in Arithmetic Utilization
(for PIA teachers only)

Sample Agenda

Final Meeting

for the

Patterns in Arithmetic field test

May 1, 1971

Welcome and Introductions

Field Test Results

Interviews and Observations
Teacher and Student Test Performance
Final Report

Spring Testing Program for Students

PIA Programming for 1971-72

Teacher Questionnaire and Test

Outline of PIA Major Topics

Set

Number

Numeration Systems

Operation

Mathematical Sentence (Equations and Inequalities)

Measurement

Geometry

Number Theory

Practical Aspects (Time, Money, etc.)

OUTLINE OF PIA MANUAL

THE STUDENT CAN

● Behavioral objectives

THE TV TEACHER WILL

● Telecast synopsis

OVERVIEW

Lesson synopsis

MATHEMATICAL BACKGROUND

Mathematics content
Purpose of the lesson
Comments

★ PRE-TELECAST ACTIVITIES

☛ MATERIALS

During the telecast

TELECAST DESCRIPTION

⊕ POST-TELECAST ACTIVITIES

FOLLOW-UP ACTIVITIES

* * * Highly Recommended
* * Optional
* Advanced

DIRECTIONS FOR PUPIL EXERCISES

CHECK-UP EXERCISES

PATTERNS IN ARITHMETIC

Sample Lesson Plan (Primary grades)

MONDAY	TUESDAY		WEDNESDAY		THURS...
PRE-TELECAST ACTIVITY	CLASSROOM TEACHER REVIEWS TELECAST OBJECTIVES		HIGHLY RECOMMENDED ACTIVITY #2		
TELECAST	EXERCISES PART A (GROUP 1)	EXERCISES PARTS A & B	REPEAT TELECAST	EXERCISES PARTS C & D	NEW TELE...
POST-TELECAST ACTIVITY		OPTIONAL ACTIVITY #1 (GROUP 2)	EXERCISES PART B (GROUP 1)	ADVANCED ACTIVITY #1 (GROUP 2)	
HIGHLY RECOMMENDED ACTIVITY #1					

5' modules

APPENDIX D

SUMMARY OF SUBSCALES FORMED FROM PIA CONTENT VALID ITEMS

Appendix D

SUMMARY OF SUBSCALES FORMED FROM PIA CONTENT VALID ITEMS

Test	Subtest	Number of Items in Subtest	Subscale Content	Code	Test Form	Content Valid Items (Item Number)	Number of Items in Subscale
California Achievement Test, Level 1, Forms A and B	Concepts	32	Sets, numbers, numeration	NV	A	1,2,4-6,8-12,14-18,23,24,27	18
					B	1-12,14-18,23,24	19
			Miscellaneous (e.g., time, money)	MV	A	13,21,30,31	4
					B	13,19,28,30,31	5
	Computation	40	Addition	+V	A	1-5,8,10,29-34	13
					B	1-14,29-34	20
			Subtraction	-V	A	15-23,35-40	15
					B	15-28,35-40	20
California Achievement Test, Level 2, Forms A and B	Concepts	30	Sets, numbers, numeration	NV	A	2,6,9,10,12,18,21,23-26,28	12
					B	2,6,9,10,12,18,20,21,23-28,30	15
			Operations, properties	OV	A	5,7,11,14,22	5
					B	5,7,11,14,22	5
			Miscellaneous (e.g., time, money)	MV	A	1,3,4,8,13,15,17,19	8
					B	1,3,4,8,13,15,17,19,29	9

Appendix D (continued)

Test	Subtest	Number of Items in Subtest	Subscale Content	Code	Test Form	Content Valid Items (Item Number)	Number of Items in Subscale
	Computation	72	Addition	+V	A	1-18	18
					B	1-20	20
			Subtraction	-V	A	21-34,36	15
					B	21-35	15
			Multiplication	*V	A	none	--
					B	37-56	20
Comprehensive Tests of Basic Skills, Level 1, Forms Q and R	Concepts	30	Sets, numbers, numeration	NV	Q	3,4,7,8,13,18,19,20,28,30	10
					R	3,6-9,12,15,21,22,25,30	11
			Operations, properties, number sentences	OV	Q	1,2,14,16,21,24,25	7
					R	1,2,5,26-29	7
			Geometry, linear measure	GV	Q	5,9,11,12,15,26	6
					R	10,11,13,17,19,23	6
			Miscellaneous	MV	Q	6,10,22,23,27,29	6
					R	4,14,16,18,20,24	6
	Computation	60	Addition	+V	Q	1-12,14,15	14
					R	1-15	15
			Subtraction	-V	Q	16-30	15
					R	16-30	15
			Multiplication	*V	Q	31-45	15
					R	31-45	15
			Division	+V	Q	none	--
					R	46-60	15

APPENDIX E

MONITORING INSTRUMENTS: INTERVIEW AND OBSERVATION GUIDES

Interview Guide
Teachers in PIA Schools

Teacher________________

Grade________________

School________________

Interviewer________________

Directions: The purposes of this interview are (1) to determine specifically how one PIA lesson was used by the teacher and (2) to identify attitudes of teachers and students toward one PIA lesson.

After establishing rapport, explain that the information given is confidential and will be pooled with that from interviews on other dates and in other sites. Suggest that you wish to talk about the lesson finished immediately prior to the current one and if the teacher has his manual, ask him to locate this lesson and open your own manual and exercise book to it. Pointing to the relevant sections, ask the following questions giving the teacher time enough to skim the manual when necessary. (You might want to make a brief introductory statement or two about the content of the telecast and lesson to help the teacher recall it.)

Program # ___

1. Which of the following sections did you actually take time to read before the telecast?

Grade 3 only

___ The Student Can
___ The TV Teacher Will
___ Overview
___ Mathematical Background
___ Telecast Description

Grade 4 only

___ Objectives
___ Comments
___ Suggested Activities

2. Did you actually use this suggested Pre-telecast Activity with your class?... Or did you make up one?

___ Yes, used this one ___ Yes, created one ___ No, did not use any

3. What, in general, was the attitude of your students during this telecast?

___ obviously interested, enthusiastic ___ indifferent; or partly interested, partly not ___ obviously bored, restless

___ other (specify) ___________________

4. Rate the pace of the TV Teacher's presentation during the telecast.

___ about right ___ too fast ___ too slow

5. Did you actually use this suggested Post-telecast Activity with your class?... Or, did you make one up?

___ Yes, used this one ___ Yes, created one ___ No, did not use any

NOTE: Indicate here that the next few questions require answers according to the general achievement levels of the children in their class.

6. (Background question) Roughly, how many of your students fall into each of these groups?

Number of Children

___ above grade level in general achievement ___ at grade level ___ below grade level

7. Of these suggested Follow-up Activities, how many did your students actually do?

Number of Activities

Students:	Highly Recommended (***)	Optional (**) (Grade 3 only)	Advanced (*)
above grade level	____	____	____
at grade level	____	____	____
below grade level	____	____	____

8. Of these pupil exercises, which ones did you actually use?

Students:	All ?	How Many?
above grade level	____	____
at grade level	____	____
below grade level	____	____

9. Rate the difficulty of the exercise pages for:

	about right	too hard	too easy
Students above grade level	____	____	____
at grade level	____	____	____
below grade level	____	____	____

10. Did you need to use any supplementary textbook or workbook assignments for this lesson?

	No	Yes
Students above grade level	____	____
at grade level	____	____
below grade level	____	____

What text series? ______ ________________________________
(title, publisher)

11. Did you need to make up any worksheets for this lesson?

	No	Yes
Students above grade level	____	____
at grade level	____	____
below grade level	____	____

12. As a whole, rate the difficulty of the concepts or objectives of this lesson for:

	about right	too hard	too easy
Students above grade level	____	____	____
at grade level	____	____	____
below grade level	____	____	____

13. Did you use the repeat telecast for any students?

____ all students ____ no students ____ students above grade level
____ students at grade level
____ students below grade level

14. Was the length of time which elapsed between this program and the new telecast appropriate?

____ about right ____ no, not enough time to reach objectives of the lesson ____ no, there was too much time...students were ready to go on

15. What is the average length of your arithmetic class each day?
_______ minutes

16. Has using Patterns in Arithmetic made you spend more time on arithmetic than you would ordinarily?

____ Yes ____ No Comment (how much additional time?) ______________

____

____

17a. Which of the following manipulative materials (homemade or commercial) do you have available in your classroom?

Available		Used
_____	flashcards	_____
_____	number line	_____
_____	fraction pie	_____
_____	geometric shapes (2-D or 3-D)	_____
_____	counters	_____
_____	rulers	_____
_____	place value chart	_____
_____	play money	_____
_____	flannel board (or magnetic board)	_____
	other ____________________	

17b. Which of the above materials have you actually used in conjunction with PIA this year?

18. Have you had any problems utilizing Patterns in Arithmetic?

____

____

____

19. What are some of the assets of Patterns in Arithmetic?

Comments (interviewer's general impressions):

Interview Guide

Teachers in Control Schools

Teacher* ________________

Grade ________________

School ________________

Interviewer ________________

*Note if Mathematics teacher rather than homeroom teacher

Directions: Feel free to ask these questions in any order, to reword them, and to ask additional questions or omit questions when appropriate. Although the specific responses requested here are important, often the interviewer's general impressions are also very valuable.

After establishing rapport with the interviewee, explain that the information to be given is confidential and will be pooled with that from interviews on other dates and in other sites so that no one teacher's responses will be quoted or reported individually. Indicate that all questions refer to the teacher's <u>mathematics</u> class, as opposed to her homeroom class (if different).

1. What is the average length of your arithmetic class each day?

_______ minutes

2. Roughly, how many of your students fall into each of these groups?

Number of Children

____ above grade level in general achievement ____ at grade level ____ below grade level

3. What basic textbook series (or other mathematics program) do you use?

Title ______________________ Publisher ______________ Edition (yr.) _______

3a. If more than one basic textbook is used, please identify and indicate for which children each text is used and for what percent of instructional time each is used.

____

____

____

____

4. Do you use the workbook (if any) which accompanies your basic textbook series? ________ Yes ________ No

For all children? ___________ Yes __________ No

Specify: ____

____

4a. If not, is some other workbook used? ___________ Yes ____________ No

Specify: ____

5. On the average, how many worksheets (duplicated exercises or chalkboard exercises, etc.) do you use per day (or week) for arithmetic (not including assignments from the textbook)?

_______________ exercises per _____________

6. On what page in your textbook(s) is your class currently working? _______

6a. If some children are working on different pages (or in different texts) please specify: ____

____

____

7. How far do you expect to progress in your text series this year?

_____ will finish the text

_____ will finish and go on to ____________________

_____ will not finish -- Specify: ____________________________

8. Rate the difficulty of the concepts or objectives of your textbook(s) for:

	about right	too hard	too easy
Students above grade level	____	____	____
at grade level	____	____	____
below grade level	____	____	____

9. Which of the following manipulative materials (homemade or commercial) do you have available in your classroom?

Available		Used
_____	flashcards	____
_____	number line	____
_____	fraction pie	____
_____	geometric shapes (2-D or 3-D)	____
_____	counters	____
_____	rulers	____
_____	place value chart	____
_____	play money	____
_____	flannelboard (or magnetic board)	____
_____	other ______________________	____

9a. Which of the above materials have you already used this year?

____

10. In general, what is the attitude of each of these groups of students toward arithmetic?

	frustrated, bored	indifferent, neutral	enthusiastic, interested
Students above grade level	____	____	____
at grade level	____	____	____
below grade level	____	____	____

11. Do you have access to the televised program (Patterns in Arithmetic)?

__________ Yes __________ No

11a. If yes, how many of the telecasts has your class viewed this year (if any)?

_____ none _____ number of telecasts (Note if all telecasts have been viewed)

12. How do you feel about your participation in this study (as a control school teacher)? (e.g., do you feel you are working harder on math this year or spending more time than you ordinarily would?)

____

____

13. Is there any other information about your class, of whatever kind, that you feel would help in interpreting the results of the study?

____

____

Interviewer's general impressions:

PRINCIPAL QUESTIONNAIRE
PIA Schools

Principal ______________________

School ______________________

Date ______________________

1. Please estimate the percentage of children in this school who fall into each of these groups:

   ____Negro (black)   ___ White (except Puerto Rican, Cuban, etc.)

   ___ Puerto Rican, Cuban, etc.   ___ Other (specify) ____________

   ____

1a. About what percent of the Puerto Rican, Cuban, etc., children speak primarily Spanish at home? _______ 0-25% ____ 26-50%

   _______ 51-75% ____ 76-100%

2. Can you estimate what percent of the parents of children in this school have a median annual income of <u>below</u> $4000 (or are on welfare)?

   ____ 0-25% ____ 26-50% ____ 51-75% ____ 76-100%

3. Can you establish what percent of the children in this school are <u>one year or more below</u> grade level (according to standardized tests)

   in reading? ___ 0-25%   in math? ___ 0-25%

   ___ 26-50%   ___ 26-50%

   ___ 51-75%   ___ 51-75%

   ___ 76-100%   ___ 76-100%

4. How are the Grade 3 and Grade 4 <u>mathematics</u> classes grouped?

	Grade 3	Grade 4
heterogenously	______	______
homogenously by general achievement	______	______
homogenously by math achievement	______	______
homogenously by reading level	______	______

5. If the Grade 3 and Grade 4 teachers for mathematics <u>are not</u> the homeroom teachers, how were they selected?

____

____

____

6. Is there any auxilliary aide or mothers' assistance available to Grade 3 and 4 teachers? ___ Yes ___ No
If so, how many hours per week? ______________

7. What is the time allotment for mathematics in Grades 3 and 4 per day (or week) in minutes?

Grade 3: ____________ minutes per __________

Grade 4: ____________ minutes per __________

8. Who determines the allotment? (state, city, Archdiocese, local school board) ______________________

9. How much change, if any, have you noticed in the amount of time spent on mathematics since <u>Patterns in Arithmetic</u> was started?

___ more time on Math (specify) ______________

___ less time on Math (specify) ______________

___ no change

10. Do you happen to know what textbook series (by publisher, edition, and title, if possible) was used last year for

Grade 3 ______________________________

Grade 4 ______________________________

11. In the last two years, has your school been involved in any "special" or significant math projects for Grades 1, 2, 3, or 4? (e.g. the Madison Project, another TV math course, etc.)

____

____

12a. Were the Patterns in Arithmetic telecasts used last year in Grade 4?

_____Yes

_____No

b. If yes, did each teacher have a PIA Teacher's Manual?
Grade 4 _____Yes

_____No

c. If yes, did each child have a PIA Pupil Exercise Book?
Grade 4 _____Yes

_____No

If not, were the exercises duplicated from one copy, or written on the chalkboard? _____Yes _____No

13. Did all the PIA instructional materials (manuals, pupil exercise books) arrive in time for the start of the field test on September 28?

_____ Yes _____No, specify__________________

14. Is the TV reception consistently good?

_____Yes _____No, specify__________________

15. Is there a TV in each PIA classroom?

_____Yes _____No, specify__________________

16. Have you needed to buy any manipulative materials or audiovisual aids as a result of beginning PIA?

_____No _____Yes, specify__________________

18. Are all math materials kept in a central location, such as a "math resource center?" _____No _____Yes

If yes, describe ______________________________

19. What do you, as principal, think are the valuable aspects of utilizing the Patterns in Arithmetic series?

____

____

20. What are the most significant problems you have thus far identified in the utilization of Patterns in Arithmetic for Grades 3 and 4? ______________

____

21. Rate as accurately as possible the attitude of your Grade 3 and 4 teachers toward presenting the Patterns in Arithmetic series:

_____ very dissatisfied with the series

_____ somewhat dissatisfied

_____ somewhat satisfied

_____ very satisfied

Further comments:

PRINCIPAL QUESTIONNAIRE
Control Schools

Principal________________________

School__________________________

Date____________________________

1. What is the time allotment for mathematics per day (or week) in minutes?

Grade 4 ______________________ minutes per ____________________

2. Who determines the allotment? (state, city, Archdiocese, local school board) ____

3. How are the mathematics classes grouped? (Check one per grade.)

	Grade 4
heterogeneously	________
homogeneously by general achievement	________
homogeneously by math achievement	________
homogeneously by reading level	________

4. If teachers for mathematics are not the homeroom teachers, how were they selected? (e.g., because they expressed interest, have special talents or training, etc.)

____

____

5. Is there any auxilliary aide or mothers' assistance available to these teachers? __________ Yes __________ No

If so, how many hours per week? ____________________________________

6. In the last two years, has your school been involved in any "special" or significant math projects? (e.g., the Madison Project, another TV math course, etc.) For what grade levels?

____

____

____

7. Were the Patterns in Arithmetic telecasts used last year in your school?

__________ Yes __________ No

For what grade(s)? ______________

7a. If yes, were the PIA exercise books used? ________ Yes __________ No

8. Have your teachers access to (and have they used) any of the PIA telecasts this year:

Grade 4 _____ Yes _____ No

8a. Are the PIA exercise books being used? Grade 4 _____ Yes _____ No

Comments:

9. Are there math manipulative materials in a central location, such as a "learning center," in your school? _________ Yes _________ No

9a. If no, are there such materials in each classroom? _____ Yes _____ No

10. Please estimate the percentage of children in this school who fall into each of these groups:

____ Black (Negro) ____ White (except Puerto Rican, Cuban, etc.)

____ Puerto Rican, Cuban, etc. ____ Other (specify) ________________

____

10a. About what percent of the Puerto Rican, Cuban, etc., children speak primarily Spanish at home? (Indicate the percent when possible.)

______ 0-25% _____ 26-50%

______ 51-75% _____ 76-100%

11. Can you estimate what percent of the parents of children in this school have a median annual income of below $4000 or are on welfare? (Indicate the percent when possible.

___ 0-25% ___ 26-50% ___ 51-75% ___ 76-100%

12. Can you estimate what percent of the children in this school are one year or more below grade level according to standardized tests? (Indicate the percent when possible.)

in reading? ____ 0-25% in math? ____ 0-25%

____ 26-50% ____ 26-50%

____ 51-75% ____ 51-75%

____ 76-100% ____ 76-100%

13. Indicate, in general, the attitude of your teachers toward participation as a control school in this study.

____ willing, cooperative, positive ____ neutral, indifferent

____ negative, uncooperative, antagonistic

Comment: ____

____

14. Do you feel your teachers are working harder or spending more time on mathematics this year because of their participation in this study?

__________ Yes __________ No

Comment: ____

____

General Comments:

Observation Guide
PIA Schools

School ____________

Teacher ____________

Grade ____________

Observer ____________

Program # ___

Length of Visit _____ to _____

DIRECTIONS: Please complete as fully as possible, noting any unusual disturbances, discipline problems, or technical disruptions which may affect what you observe.

If there is no telecast, begin with question #7 and answer all remaining questions

1a. Was there a Pretelecast Activity directly related to the telecast?
Yes _______ No _______

b. If yes, was the activity suggested in the PIA manual?

Yes _______ No _______

2. Did the class appear attentive and interested in the telecast?

Yes, all students ___ Yes, most ____ Yes, some ___ No, very few ____

3. Rate the technical quality of the telecast (picture stable, sound clear, etc.)

Good _________ Fair _________ Poor _________

4a. Was there a Posttelecast Activity directly related to the telecast?

Yes ______ No _______

b. If yes, was the activity suggested in the PIA manual?

Yes ______ No _______

5. What happened immediately after the Posttelecast Activity? (Check as many as apply.)

	for all students	for some students
Pages in the PIA exercise book were assigned	______	______
Pages in a supplementary textbook were assigned	______	______
Teacher-made worksheets were assigned	______	______
Follow-up activities from the PIA manual were assigned	______	______

Comments: ____

6. How many TV sets were used for the telecast? ______________

7. How many students were in the math class? ______________

if a telecast is shown, skip this question

8. What happened in general? (Check as many as apply.)

	for all students	for some students
The teacher retaught or reviewed the objectives of the lesson	______	______
Follow-up Activities from the PIA manual were done	______	______
Teacher-made worksheets were assigned	______	______
Exercises from the PIA exercise book were assigned	______	______
Other ______________	______	______

9. Was there any evidence of individualization in this classroom? (e.g. did children do different exercise pages, or a differing amount of problems on the same exercise page, or work in groups with different goals, etc.)

____ Yes ____ No

Comment: ____

10. Were any "cues" from the TV Teacher followed through on by the classroom teacher (e.g. making a reference to questions posed by the TV Teacher)?

Yes _________ No ___________

11. What manipulative and other audio-visual materials were obviously available in the room? Which were actually used while you were there?

	Obviously available	Used
flashcards	_______	_______
number line	_______	_______
counters	_______	_______
graph paper	_______	_______
fraction pie	_______	_______
geometric shapes (2-D or 3-D)	_______	_______
rulers	_______	_______
place value chart	_______	_______
play money	_______	_______
flannelboard	_______	_______
other:		

12. Was there evidence of special emphasis on mathematics in this classroom? (e.g. a math materials table, a math bulletin board, a math "art" display, etc.)

_____ Yes _____ No

Comment: ____

____

____

13. Is the telecast schedule posted in a location such that children can read it?

Yes ___________ No ___________

14. What was the overall attitude of the students during the observation period?

_____ openly bored, frustrated _____ indifferent, unresponsive

_____ enthusiastic, interested _____ other (specify): _______________

15. What was the overall attitude of the teacher during the observation period?

_____ very enthusaistic _____ somewhat enthusiastic

_____ somewhat unenthusiastic _____ very unenthusiastic

Comments (observer's general impressions); use back:

Observation Guide

Control Schools

School ____________________

Teacher* ____________________

Grade ____________________

Observer ____________________

*Note if mathematics teacher rather than homeroom teacher

Length of Visit ____ to ____

DIRECTIONS: Please complete as fully as possible, noting any unusual disturbances or discipline problems which may affect what you observe.

1. How many students were in the mathematics class? ____________________

2. Did an aide assist with the class? ________ Yes ____________ No

2a. For what portion of the class? ______________________________

3. What happened in general? (Check as many as apply.)

	For all students in the class	For small groups of students
The teacher introduced or reviewed a concept(s) or skill(s).	______	______
Exercises from the text (or workbook) were assigned.	______	______
Worksheets or chalkboard exercises were assigned.	______	______
Activities with manipulative objects were used.	______	______
Other ____________________ ____________________ ____________________	______	______

Comment: ____

____

4. Was there evidence of individualization in this classroom? (e.g., did children do different exercise pages, or a differing amount of problems on the same exercise page, or work in groups on different activities, etc.)

_______ Yes   _________ No

Specify: ____

____

5. What manipulative and other audio-visual materials were obviously available in the room? Which were actually used while you were there?

	Obviously Available	Used
flashcards	____	____
number line	____	____
counters	____	____
fraction pie	____	____
geometric shapes (2-D or 3-D)	____	____
rulers	____	____
place value chart	____	____
play money	____	____
flannelboard	____	____
other ____________	____	____
____________	____	____

6. Was there evidence of special emphasis on mathematics in this classroom? (e.g., a math materials table, a math bulletin board, a math "art" display, etc.)

_______ Yes   _________ No

Specify: ____

____

7. What was the overall attitude of the students during the observation period?

____ openly bored, frustrated   ____ indifferent, unresponsive

____ enthusiastic, interested   ____ other (specify): __________

8. What was the overall attitude of the teacher during the observation period?

____ very enthusiastic   ____ somewhat enthusiastic

____ somewhat unenthusiastic   ____ very unenthusiastic

Comments: (observer's general impressions) use back if necessary.