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AUTHOR Johnson, Lary
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ABSTRACT

The evaluation of the third year of the Individually Prescribed Instruction (IPI) mathematics project at the Hall School in Minneapolis (grades 1-6) is discussed, and results for the three years are summarized. The process evaluation during the third year concentrated on three areas: group instructional methods, instructional materials other than the Standard Teaching Sequence booklets, and prescription practices. To determine whether the IPI project was successful in raising the median raw scores on overall mathematics achievement, the basic evaluation techniques used during the third year were a standardized achievement test, a semantic differential attitude scale, a locally developed arithmetic basic skills test, a record of student progress in the IPI continuum, and teacher interviews. Students in grades 4-6 in two other Title I elementary schools were used as a comparison population. The evaluation data are tabulated and discussed. Results of the study showed that Hall students continued to make progress during the third year. Students in grades 3 and 4, who had had most of their formal math instruction with IPI, had higher percentile ranks than students in grades 5 and 6. Process evaluation of instructional activities indicated differences between classrooms in use of group instruction, variety of instructional materials, and prescription practices. Reactions of the teachers emphasized the value of the individualized approach for student achievement and attitude. Fourth and fifth grade students at Hall had a more positive attitude toward math than did students at the two comparison schools. Appendixes provide Basic Operational Skills Test for Grades Four and Six and The Semantic Differential Scale Used with IPI in 1971-72. (DB)

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Minneapolis IPI Mathematics Project 1971-72: Third Year Evaluation

A Title I, ESEA Project

Lary Johnson

Ideas expressed in this report do not necessarily reflect the official position of the Minneapolis Public School Administration nor the Minneapolis School Board

November 1972
Order No. C-71-21

Research and Evaluation Department
Educational Services Division

Minneapolis Public Schools

Minneapolis IPI Mathematics Project 1971-72: Third Year Evaluation

Summary

The Individually Prescribed Instruction (IPI) project has been in operation at Hall School for three years. Funded by Title I, ESEA, the IPI project served about 325 students in grades 1-6 in each of the three years of operation.

The main goal of the IPI project was to improve the students' mathematics achievement. Beginning at a level determined by a pretest, each student progressed at his own rate as he mastered successive skills. Results from the first two years (1969-70, 1970-71) indicated that Hall students made achievement gains equal to gains expected by average students in the test publisher's normative group and somewhat greater than gains expected by students who started below the average. See p. 7

Hall students continued to make progress during the third year (1971-72). Students in grades three and four (those students who have had most of their formal math instruction with IPI) had higher percentile ranks than students in grades five and six. In May 1972, the percentile ranks on the ITBS Modern Math Supplement were 28, 34, 41, and 56 for grades 6, 5, 4, and 3, respectively. A trend where the percentile rank at each grade has increased in each successive year has appeared. Compared with May 1971, the May 1972 ranks at grades 6, 5, 4, and 3 were higher by 7, 6, 5, and 10 percentile points, respectively. See pp. 21-24

A process evaluation of instructional activities indicated differences between classrooms in the use of group instruction, variety of instructional materials, and prescription practices. See pp. 11-18

Reaction by staff members to the IPI project have been favorable since its beginning. The teachers emphasized the value of an individualized approach for student achievement and attitude. See p. 36 Fourth and fifth grade students at Hall tended to have a more positive attitude toward math than did students at two comparison schools when measured by a semantic differential scale. See p. 30

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Research and Evaluation Department
Educational Services Division
807 N. E. Broadway
Minneapolis, Minnesota 55413

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Minneapolis Public Schools

Minneapolis IPI Mathematics Project 1971-72.
Third Year Evaluation

The Individually Prescribed Instruction (IPI) mathematics project funded by Title I of the Elementary and Secondary Education Act completed its third year of operation in June 1972. This evaluation report covers the 1971-72 project year and briefly summarizes results for the three years. Readers who are interested in a more complete description of the IPI materials and instructional procedures should refer to reports from the first two years.[1,2]

The City of Minneapolis

The program described in this report was conducted in the Minneapolis Public Schools. Minneapolis is a city of 434,400 people located on the Mississippi River in the southeastern part of Minnesota. With its somewhat smaller twin city, St. Paul, it is the center of a seven county metropolitan area of over 1,874,000, the largest population center between Chicago and the Pacific Coast. As such it serves as the hub for the entire Upper Midwest region of the country.

The city, and its surrounding area, long has been noted for the high quality of its labor force. The unemployment rate in Minneapolis is lower than in other major cities, possibly due to the variety and density of industry in the city as well as to the high level capability of its work force. The unemployment rate in May of 1972 was 4.1%, compared with a 5.2% national rate for the same month. As the economic center of a prosperous region rich in such natural resources as forests, minerals, water power and productive agricultural land, Minneapolis attracts commerce and workers from throughout the Upper Midwest region. Many residents are drawn from the neighboring states of Iowa, Wisconsin, Nebraska and the Dakotas as well as from the farming areas and the Iron Range region of outstate Minnesota.

More Minneapolitans (32%) work in clerical and sales jobs than in any other occupation, reflecting the city's position as a major wholesale-retail center and a center for banking, finance and insurance. Almost as

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[1] Hestwood, Diana. "First Year Evaluation IPI Mathematics Project 1969-70." Minneapolis Public Schools, November 1970.

[2] Johnson, Lary and Ostrum, Donald R. "Second Year Evaluation IPI Mathematics Project 1970-71." Minneapolis Public Schools, October 1971.

many (26%) are employed as craftsmen, foremen and operatives, and 23% of the work force are professionals, technicians, managers, and officials. One out of five workers is employed in laboring and service occupations.

Minneapolis city government is the council-dominated type. Its mayor, elected for a two year term has limited powers. Its elected city council operates by committee and engages in administrative as well as legislative action.

Minneapolis is not a crowded city. While increasing industrial development has occupied more and more land, the city's population has declined steadily from a peak of 522,000 in 1950. The city limits have not been changed since 1927. Most homes are sturdy, single family dwellings built to withstand severe winters. Row homes are practically non-existant even in low income areas. In 1970, 48% of the housing units in Minneapolis were owner-occupied.

Most Minneapolitans are native born Americans, but about 35,000 (7%) are foreign born. Swedes, Norwegians, Germans, and Canadians comprise most of the foreign born population.

Relatively few non-white citizens live in Minneapolis although their numbers are increasing. In 1960 only three percent of the population was non-white. The 1970 census figures indicate that the non-white population has more than doubled (6.4%) in the intervening 10 years. About 70% of the non-whites are black. Most of the remaining non-white population are Indian American, mainly Chippewa and Sioux. Only a small number of residents from Spanish-speaking or Oriental origins live in the city. In 1970 non-white residents made up 6.4% of the city's population but accounted for 15% of the children in the city's elementary schools.

Minneapolis has not reached the stage of many other large cities in terms of the level of social problems. It has been relatively untouched by racial disorders or by student unrest. Crime rates are below national averages. Continuing concern over law and order, however, is still evidenced by the recent re-election of Mayor Charles Stenvig, a former police detective.

One's first impression is that Minneapolis doesn't really have serious problems of blight and decay. But the signs of trouble are evident to one who looks beyond the parks and lakes and tree-lined streets. As with many

other large cities, the problems are focused in the core city and are related to increasing concentrations there of the poor, many of them non-whites, and of the elderly. For example, nine out of 10 black Americans in Minneapolis live in just one-tenth of the city's area. While Minneapolis contains 11% of the state's population, it supports 28% of the state's AFDC families.

There has been a steady migration to the city by Indian Americans from the reservations and by poor whites from the small towns and rural areas of Minnesota. They come to the "promised land" of Minneapolis looking for a job and a better way of life. Some make it; many do not. The Indian American population is generally confined to the same small geographic areas in which black Americans live. These same areas of the city have the lowest median incomes in the city and the highest concentrations of dilapidated housing, welfare cases, and juvenile delinquency.

The elderly also are concentrated in the central city. In 1970, 15% of the city's population was over age 65. The elderly, like the 18 to 24 year old young adults, live near the central city because of the availability of less expensive housing in multiple-unit dwellings. Younger families have continued to migrate toward the outer edges of the city and to the surrounding suburban areas.

The Minneapolis Schools

About 77,500 children go to school in Minneapolis. Most of them, about 64,700 attend one of the city's 98 public schools; 12,800 attend parochial or private schools.

The Minneapolis Public Schools, headed by Dr. John B. Davis, Jr., who became superintendent in 1967, consists of 67 elementary schools (kindergarten-6th grade), 15 junior high schools (grades 7-9), nine high schools (grades 10-12), two junior-senior high schools, and five special schools. Nearly 3,500 certificated personnel are employed.

Control of the public school system ultimately rests with a seven member board which levies its own taxes and sells its own bonds. These non-salaried officials are elected by popular votes for staggered six

year terms. The superintendent is selected by the board and serves as its executive officer and professional adviser.

Almost 40 cents of each local property tax dollar goes to support a school system whose annual operating general fund budget in 1972-73 is $78,992,236 up from $74,340,271 in 1971-72. Minneapolis received federal funds totaling 8 million dollars in 1971-72 from many different federal aid programs. The Elementary and Secondary Education Act provided about 6.8 million dollars, of which 3.4 million dollars was from Title I funds. Per pupil costs in the system were $920 in 1970-71 while the range of per pupil costs in the state was from $254 to $1,041.

One of the superintendent's goals has been to achieve greater communication among the system's schools through decentralization. Consequently two "pyramids" or groups of geographically related schools have been formed. First to be formed, in 1967, was the North Pyramid, consisting of North High School and the elementary and junior high schools which feed into it. In 1969 the South-Central Pyramid was formed around South and Central High Schools. Each pyramid has an area assistant superintendent as well as advisory groups of principals, teachers, and parents. The goals of the pyramid structure are to effect greater communication among schools and between schools and the community, to develop collaborative and cooperative programs, and to share particular facilities and competencies of teachers.

Based on sight counts on October 19, 1971 the percentage of black American pupils for the school district was 9.7%. Seven years before the proportion was 5.4%. Indian American children currently comprise 3.4% of the school population, more than double the proportion of seven years ago. The proportion of minority children in the various elementary schools generally reflects the prevailing housing pattern found in each school area. Although some non-white pupils are enrolled in every elementary school, non-white pupils are concentrated in two relatively small areas of the city. Of the 67 elementary schools, 11 have more than 30% non-white enrollment and four of these have over 50%. There are no all-black schools and there is one all-white school. Thirty-seven elementary schools have non-white enrollments of less than 5%.

The proportion of school age children in AFDC homes has almost doubled from approximately 12% in 1962 to 23% in 1971.

While the median pupil turnover rate for all the city schools in 1970-71 was about 23%, this figure varied widely according to location (turnover rate is the percent of students that come in new to the school or leave the school at some time during the school year, using the September enrollment as a base figure). Target Area schools generally experience a much higher turnover rate; in fact only two of the Target Area schools had turnover rates less than the city median. Compared with the city, the median for the Target Area schools was almost twice as large (39%).

The Target Area

The Target Area is a portion of the core city of Minneapolis where the schools are eligible to receive benefits from programs funded under Title I of the Elementary and Secondary Education Act (ESEA). A school is eligible to receive Title I aid if the percentage of families residing in that school's district who receive AFDC payments (in excess of $2,000 a year) or have an annual income under $2,000 exceeds the citywide percentage for families in that category.

In 1971-72, nearly 24,500 children attended the 24 elementary schools, six junior highs, three senior highs and eight parochial schools that were eligible to receive this aid. One third of these students were from minority groups and one third were defined by the State Department of Education as educationally disadvantaged, i.e. one or more grade levels behind in basic skills such as reading and arithmetic. Federal programs are concentrated on the educationally disadvantaged group.

According to 1970 census data, over 170,000 persons resided in the Target Area. Of that group, 11 percent were black and 3½ percent were Indian, more than double the citywide percentage of minority group members. Over half of the Target Area residents over 25 years old have not completed high school, compared to the 35 percent of the non-Target Area residents who do not have high school diplomas. One out of five Target Area residents over the age of 25 has gone to college, and nine percent have completed four or more years. One out of four of the non-Target Area residents have gone to college, and 15 percent have completed four or more years.

The income for an average Target Area family was $9,113 in 1970, over $2,000 less than the citywide average. The homes they live in have an average value of $10,385, over 40 percent less than the average value of a single family residence in Minneapolis. One out of five Target Area children between the ages of 6 and 17 is a member of a family that is below the poverty level, while only 6 percent of the non-Target Area children have such a family status.

The Project School and Its Neighborhood

The Individually Prescribed Instruction project described in this report took place at Hall School, one of eight elementary schools in the North Pyramid of the Minneapolis Public School System. Hall was designated as a Title I school because its district falls below the city median on a combination of economic criteria.

Based on 1970 U. S. Census data, the median family income of residents in the Hall School area was in the $6,000 - $6,999 range. Thirty-six percent of the families in the neighborhood earned less than $5,000 per year and 30% earned $10,000 or more annually. More than one-third of the families and unrelated individuals received social security, railroad retirement, or public assistance payments. About three-fourths of the employed males worked in blue collar occupations, about 20% of the families owned their homes, and slightly less than two-thirds of the individuals 25 years or older had not completed high school.

Hall School, built in 1960, includes kindergarten and grades 1-6. It is a relatively small school with a student population of about 375 children. For the past few years, the annual student turnover, the total number of entries and withdrawals during the year, has been about one-third of the student population. Forty-two percent of the students have minority background; 16% Indian American, 23% Black American, and 3% Spanish-surnamed.

The principal of Hall School was John D. Manville, and the IPI project coordinator was Donald R. Ostrum.

Historical Background

Individually Prescribed Instruction (IPI) is an instructional system based on the premise that each child should progress at his own rate. Development of the system and materials began in the early sixties at the Learning Research and Development Center at the University of Pittsburgh. After hearing encouraging reports regarding IPI materials, staff members of the Research, Development, and Federal Programs Office of the Minneapolis Public Schools visited one of the experimental schools. Subsequently, Title I funds were made available for a three-year trial at Hall School, a school whose math achievement scores on standardized tests were well below the city average.

First year (1969-70) evaluation results indicated that Hall students made gains in mathematics equal to gains made by average students on the standardized test publisher's norms. Hall students also made greater gains in mathematics than did students in three comparable Title I schools which did not use IPI materials. Staff reactions were positive and students gave high rankings to mathematics compared with other subjects.

The results for the second year (1970-71) showed that Hall students were continuing to make progress. On a standardized mathematics achievement test, students in grade 4, 5, and 6 gained nine, ten, and seven grade equivalent months, respectively, during an eight-month period from early October to late May. Compared with the publisher's norms, the fourth and fifth graders scored eleven percentile points higher on the posttest than the pretest. Reactions to the IPI project by both staff and students continued to be favorable. Teachers preferred IPI over more traditional math programs, while students rated mathematics as one of their favorite subjects.

Project Objectives

The major objective of the IPI project as stated in the Title I application was:

> In fall 1972, the median raw scores on overall mathematics achievement for children involved in Title I components emphasizing mathematics will be significantly higher than were median raw scores of Title I children in the same grades the previous year.

No other product, process, or management objectives for the IPI project were given in the Title I application.

Project Context

Participants

All children in grades 1-6 participated in the IPI mathematics project during its third year of operation in 1971-72. About 325 children were enrolled in these grades. First graders did not begin using IPI materials until the second semester.

Personnel

The IPI project added two certificated teachers and six teacher aides to the regular staff of twelve classroom teachers at grades 1-6 for the 1971-72 school year.

The regular classroom teacher had a key role in the project. Each classroom teacher was responsible for evaluating the record for each pupil, diagnosing his needs, and preparing an individual learning prescription. These activities occurred daily. Rather than making presentations to the entire class, the majority of the teachers' time was to be spent helping individual students, evaluating their progress, and diagnosing learning needs. Three of the teachers were new to Hall School this year, three teachers were in their second year with IPI materials, and six teachers had been with the IPI project since the beginning. One of the new teachers left in the middle of the year. His position was taken by a first-year teacher.

The two additional certificated teachers served as floating teachers within the classrooms. They were to assist the teachers in reviewing records and writing individual prescriptions, to devise supplementary worksheets and learning materials, to present seminars to large groups of students when necessary, and to work with individuals and small groups of children. One floating teacher also served as the IPI project coordinator. His responsibilities included coordinating all phases of the project, as well as making public presentations on the project, planning tours for visitors, and assisting with the evaluation efforts.

Two teacher aides were assigned to each classroom. They were responsible for correcting all pupil work booklets, skill sheets, and tests, and helping individuals or small groups of children.

Physical Arrangements

An unused classroom at Hall School was designated as a materials center and office for the IPI project. Special shelving had been purchased to accomodate the printed instructional materials, tests, and supplementary worksheets. The project coordinator, the floating teacher, and the teacher aides used this room as an office when they were not in the classroom. The students remained in their classrooms throughout the day, while the two floating teachers and the teacher aides moved from room to room, taking all math materials and equipment with them on rolling carts. The math classes were scheduled throughout the day in 45 minute blocks with two classes in session during each block.

Budget

All funds for the 1971-72 IPI project at Hall School came from Title I of the Elementary and Secondary Education Act. The total budget of $62,101 was allocated as follows:

Certificated salaries	$29,495
Teacher aide salaries	23,350
Fringe on salaries	4,756
IPI math materials	3,500
Instructional supplies	1,000
Total	$62,101

Based on 325 children in the IPI project, the per pupil expenditure for the IPI math materials was $10.77. The expenditure for the entire IPI project was $191.08 per pupil.

Project Activities

The IPI math program is organized on a continuum of 416 specific math skills. These skills are grouped into eight levels, from A to H, according to increasing difficulty. There are thirteen topic areas, which cut across all levels: Numeration, Place Value, Addition, Subtraction, Multiplication, Division, Combination of Processes, Fractions, Money, Time, Systems of Measurement, Geometry, and Special Topics. A unit consists of a group of skills in a topic area at a particular level. The precise point at which a child is working in the continuum can be identified by naming the level, the topic area, and the specific skill number within that topic area.

Procedures

The first step in using the IPI program is to assess the child's level of skill acquisition so that he can be placed at the proper point in the continuum. A placement test, with a mastery criterion of 80% correct for each unit, is used to determine the skill objectives for each child.

The teacher then writes an individual prescription that assigns the child to the Standard Teaching Sequence (STS) booklet that covers the skill on the continuum that he should master next. Each STS booklet covers one skill and contains a number of pages which the child works himself. Within each booklet there are two Curriculum Embedded Tests (CET). The CET serves as a short test of a child's progress toward acquisition of the skill. If the child fails a CET (less than 85% correct), he is assigned to supplementary materials on that particular skill.

When the child has completed the instructional materials on all the skills in a particular unit, he takes a posttest to measure his level of mastery of the entire unit (criterion level 85% correct). He does not move on to a new unit until this level of mastery is achieved.

Some deviations from the suggested procedure for following the continuum of skills did occur. In the fifth and sixth grade classrooms, the D and E levels of Multiplication and Division were presented twice a week in 10-15 minute presentations to the entire class. It was felt that the pupils, particularly at sixth grade, did not receive sufficient exposure to skills in these two topic areas when they followed the usual procedure.

Many presentations to the entire class were given in the primary classrooms, apparently because of the teachers' and/or the floater's belief that the learned skills should be reinforced frequently.

A variety of approaches and materials other than the prepared STS booklets were utilized. In addition to children working alone, other instructional approaches used were teacher tutor, aide tutor, peer tutor, small group instruction (two to ten students brought together for a particular skill), large group instruction (eleven or more students), and seminars (usually the entire class).

A variety of materials in addition to the STS booklets could be included in a prescription. Some possibilities were curriculum texts, teacher made skill sheets, film strips, and manipulative devices.

Planning and Training

The three teachers new to Hall School, two new teacher aides, the project coordinator, and the primary floating teacher participated in a three-day in-service meeting in August 1971 designed to acquaint these new people with the IPI project and its operation.

Five other in-service meetings were held during the school year on Tuesday afternoons, a time that was designated as released time for teacher meetings throughout the city. Four of these meetings were used to review and discuss IPI procedures. The fifth meeting was used to discuss a mid-year evaluation report with the project evaluator.

The project coordinator also indicated that weekly and daily planning between the individual teachers and the floating teachers occurred throughout the school year.

Process Evaluation

The two previous evaluation reports on the IPI project stressed outcome evaluation questions. Did the students improve their basic mathematics skills and did the students have a positive attitude toward mathematics. Although descriptions of operational and procedural aspects of the IPI project were included in the reports, a formal survey of the actual operational activities had not been undertaken.

During the third year of the project (1971-72), a more objective study of various IPI procedures was attempted. This process evaluation concentrated on three areas: group instructional methods, instructional materials other than the Standard Teaching Sequence (STS) booklets, and prescription practices.

Instructional Methods

For six non-consecutive days in the late fall of 1971, a teacher aide in each classroom recorded occurrences of the following instructional methods: seminars (all students participating), large groups (10 or more but not all), small groups (2 to 9), aide tutor, and peer tutor. Table 1 on page 12 gives the total number of occurrences for each instructional

Table 1

Use of Various Instructional Methods Over a Six-day Period

Classroom	A	B	C	D	E	F	G	H	I	J	K	Average Across Classes
Days Observed	6	6	6	6	6	6	6	6	6	6	5	6
Seminars (All students)	3	4	8	2	8	6	4	4	3	4	2	4.4
Average Time (Min)	8	12	16	13	13	13	13	10	8	10	15	12
Large Groups (10 or more)	2	0	0	1	1	0	1	0	0	0	0	0.5
Average Time (Min)	15	-	-	15	10	-	5	-	-	-	-	-
Average No. Pupils	10	-	-	14	7	-	10	-	-	-	-	-
Small Groups (2-9)	4	5	1	7	13	5	7	0	0	0	0	3.6
Average Time (Min)	25	25	10	17	15	17	14	-	-	-	-	-
Average No. Pupils	3-4	3-4	3	4	3-4	2-3	4-5	-	-	-	-	-
Average Number of Aide-Student Tutoring Contacts Per Day	15	32	8	7	10	30	19	18	15	15	15	17

method and the average length of time for the group meetings for each classroom during the six days of operation. When a student was not participating in a group, it was assumed that he was working alone.

Differences between classrooms in the use of instructional methods were revealed by the data. The number of seminars (presentations to the entire class) during the six days of observation varied from 2 to 8 among individual classrooms. For example, eight seminars averaging 16 minutes in length were held in classroom C during the six days. Averaging across all classrooms, seminars of 12 minutes in length were held two out of every three days.

Large groups were used more than once during the six days in only one classroom. Small groups (2-9 pupils) were popular at grades 2, 3, 4 (A-G), but were not used in grades 5 and 6 (H-K). In classroom E, thirteen small groups of 3 to 4 students lasting 15 minutes each were held during the six days of observation.

Averaging across classrooms the teacher aides had tutoring contacts with about 17 students each day. Peer tutors were used in only one classroom.

Instructional Materials

In addition to the problems in the STS booklet, students could work with curriculum texts, teacher-made worksheets, audio-visual media such as filmstrips, and manipulative devices (or instructional games). During the same six days that the aides recorded the instructional methods, the aides recorded the number of students that used instructional materials other than the STS booklet (Table 2, page 14). Also, an attempt was made to determine whether or not the content of the instructional material was related to the STS skill on which the student was currently working. If the material was not related to the STS, one could assume the material was reinforcing a mastered STS skill, was presenting a to-be-learned STS skill, or was being used to develop positive attitudes. Since the aide was busy with her usual IPI duties, the accuracy of the figures in Table 2 is questionable. Accuracy is particularly dubious for the related-to-STS and not-related-to-STS percentages. However, with this reservation in mind, the figures probably do give a rough representation of the use of instructional materials other than the STS booklets.

Curriculum texts were used only occasionally as supplementary learning

Table 2

Pupil Use of Instructional Materials Other than STS Booklets Over a Six-day Period

Classroom	A	B	C	D	E	F	G	H	I	J	K	Average Across Classes
Curriculum Texts												
Number of Pupils	0	0	0	0	9	0	19	0	0	0	0	2.5
Related to STS	-	-	-	-	-	-	0%	-	-	-	-	-
Not Related to STS	-	-	-	-	-	-	53%	-	-	-	-	-
Don't Know	-	-	-	-	100%	-	47%	-	-	-	-	-
Worksheets												
Number of Pupils	39	0	63	14	88	135	69	7	24	0	23	42
Related to STS	72%	-	40%	0%	3%	1%	12%	0%	0%	-	0%	14%
Not Related to STS	28%	-	60%	100%	64%	99%	32%	100%	100%	-	100%	71%
Don't Know	0%	-	0%	0%	33%	0%	57%	0%	0%	-	0%	15%
Audio-Visual Media												
Number of Pupils	19	87	16	29	28	0	0	0	0	0	0	16
Related to STS	74%	24%	100%	31%	36%	-	-	-	-	-	-	39%
Not Related to STS	26%	41%	0%	69%	64%	-	-	-	-	-	-	44%
Don't Know	0%	34%	0%	0%	0%	-	-	-	-	-	-	17%
Games, Manipulative Devices												
Number of Pupils	2	11	51	41	42	40	29	22	23	28	0	26
Related to STS	100%	100%	55%	7%	43%	48%	0%	0%	13%	0%	-	29%
Not Related to STS	0%	0%	45%	66%	21%	52%	0%	100%	87%	100%	-	52%
Don't Know	0%	0%	0%	27%	36%	0%	100%	0%	0%	0%	-	19%

STS = Standard Teaching Sequence

materials. The use of supplementary worksheets varied greatly among classrooms. One-hundred-thirty-five students in classroom F used worksheets during the six-day observation period, while classrooms B and J did not use any worksheets. Averaging across classrooms, 42 students used worksheets during the six days. The worksheets usually were not related to the skill the student was working on in his STS booklet. As a rough estimate across all classrooms, 14% of the worksheets were related to the student's present STS skill.

Audio-visual materials were used in the primary classrooms (A-E) but not in the intermediate classrooms (F-K). Manipulative devices and instructional games were used in most classrooms, but apparently more for reinforcement and attitude development than for STS skill mastery. On the average, 26 students in each classroom worked with manipulative devices and games during the six day period. About 29% of the materials were related to the current STS skill in the students' booklets.

Prescription Practices

Each STS booklet contains, in order, a number of pages of problems, the first curriculum embedded test (CET I), more pages of problems, and the second curriculum-embedded test (CET II). This sequence is repeated for each skill in the booklet.

In order to compare actual prescription practices with the practices set forth in the IPI training manual, the prescription sheets for two skills for each student were analyzed in October 1971 and again for one skill for each student in April 1972. The following questions were asked for each skill:

Was every page before the CET I prescribed?
On every page before the CET I that was prescribed, was every problem prescribed?
Did the child pass the CET I on the first try?
If Yes, was the child prescribed additional pages on the skill after passing the CET I?

Answers to these questions showed that teachers tended to prescribe all pages preceding the CET I and also to prescribe all problems on all pages. Results were similar in October 1971 and April 1972 as shown in Table 3 on page 16.

Table 3

STS Booklet Prescription Practices at Hall School

			A	B	C	D	E	F	G	H	I	J	Average Across Classes
Was every page before CET I prescribed?	Oct 71	Yes	100%	100%	100%	100%	100%	82%	77%	100%	98%	84%	95%
		No	0	0	0	0	0	18	23	0	2	16	5
	April 72	Yes	100%	96%	100%	100%	100%	71%	100%	100%	83%	73%	93%
		No	0	4	0	0	0	29	0	0	17	27	7
On every page before CET I that was prescribed, was every problem prescribed?	Oct 71	Yes	100%	100%	100%	100%	100%	84%	98%	100%	94%	84%	95%
		No	0	0	0	0	0	16	2	0	6	16	4
	April 72	Yes	100%	100%	100%	100%	100%	87%	100%	100%	100%	100%	98%
		No	0	0	0	0	0	13	0	0	0	0	2
Did the child pass the CET I on first try?	Oct 71	Yes	81%	70%	86%	81%	96%	86%	61%	76%	85%	86%	83%
		No	19	30	14	19	4	14	39	24	15	14	17
	April 72	Yes	83%	77%	83%	72%	96%	79%	79%	86%	78%	85%	81%
		No	17	23	17	28	4	21	21	14	22	15	19
If Yes, was the child prescribed additional pages on that skill after passing the CET I?	Oct 71	All	41%	100%	100%	100%	0%	78%	19%	9%	4%	5%	51%
		50-99%	7	0	0	0	0	0	8	0	0	0	1
		1-49%	10	0	0	0	0	0	4	6	4	0	
		None	41	0	0	0	100	22	70	84	91	95	48
	April 72	All	50%	80%	100%	100%	4%	16%	0%	8%	7%	0%	43%
		50-99%	0	0	0	0	0	0	0	0	0	0	
		1-49%	14	16	0	0	4	0	0	0	0	0	3
		None	36	4	0	0	92	84	100	84	93	100	54

STS=Standard Teaching Sequence

CET=Curriculum Embedded Test

The majority of the students in each classroom were able to meet the passing criterion level on the CET I. However, there were differences between individual classrooms in the number of additional pages that were prescribed on a skill after the student had passed the CET I. In some classrooms, all students who passed the CET I were prescribed all of the pages on the skill that came after the CET I. In other classrooms, less than 10% of the students were prescribed additional pages on a particular skill after they passed the CET I.

Classroom F changed prescription practices between October 1971 and April 1972. In October, 78% of the students who passed the CET I were prescribed all pages after CET I. In April, only 16% were prescribed additional pages.

Comments on Process

Within the IPI project at Hall School in 1971-72, differences existed between classrooms in the use of group instructional methods, instructional materials, and prescription practices.

Students in fifth and sixth grades (classrooms H to K in Table 1) spent most of their time working individually on their STS booklets. Little class time was spent on seminars, large groups, and small groups. Other instructional materials (Table 2) such as skill sheets and manipulative devices were used occasionally, but they were usually not directly related to the particular skills on which the individual students were working at that time. These instructional procedures at 5th and 6th grade was verified by interviews with the teachers. The teachers felt the greatest benefits from the IPI project came from individualizing instruction with the STS booklets. One teacher indicated that students asked for the STS booklets when too much time was spent on group activities or skill sheets. However, skill sheets were useful as a settling down activity at the beginning of the IPI period. Manipulative devices were usually reserved for Fridays for reinforcement, fun, and occasionally for instruction in new skills.

Group instructional methods were used more frequently in grade 2-4 classrooms (A-G in Table 1) than in grade 5-6 classrooms. Greater emphasis was placed on seminars and small group instruction in grades 2-4. However, some variations within the grade 2-4 classrooms did occur because of

different philosophies of the teachers and floating teachers. One fourth grade class worked mainly in the STS booklets with very little group instruction. The teacher in this class preferred having instructional personnel available to help as many individuals as possible during the class period to avoid hang-ups and discouragement.

Most other grade 2-4 classrooms used daily seminars as a mode of instruction. In one class that had seminars each day for 15-30 minutes, the teacher felt it was a useful technique for teaching topics that were applicable to all students, such as regrouping in addition and subtraction. She also indicated that students needed to learn to work as a group and that they seemed to enjoy this activity. A second grade teacher felt seminars were particularly necessary at the beginning of the year because the children were too young to adequately handle the independent work.

However, several teachers felt extensive use of seminars was contrary to the individualized purpose of the IPI project. One teacher said seminars were bad for students who knew the material because they became bored. Another teacher said the students reacted negatively to the seminars. Apparently there were some conflicts between some of the classroom teachers and the floating teacher regarding the use of individualized instruction versus group techniques. Occasionally conflicts came to the surface, while at other times, they were not brought into the open in order to avoid disruptions.

Grade 2-4 classrooms made greater use of instructional materials other than the STS booklets than did the grade 5-6 classrooms. Group skill sheets were used frequently in most third and fourth grade classrooms. Manipulative devices and games were usually used as small group activities for reinforcement and positive attitude building. Only occasionally were they used as a learning device for a new skill.

The practice of prescribing additional pages after a pupil passed the first curriculum embedded test (CET I) varied greatly within the IPI project. The upper grades tended to follow the IPI training manual, which states that a child should proceed to the next skill after passing the CET I. Most lower grades prescribed all pages on a skill no matter how well the student did on the CET I. Some teachers in the lower grades indicated that they prescribed pages past the CET I because they wanted to be sure the pupils understood the skill. Other teachers only prescribed additional pages if the pupil had difficulty on the pages before the CET I.

Product Evaluation

What were the outcomes of the IPI project? Did the IPI project attain its objectives? The one objective specified in the 1971-72 Title I proposal was that:

> In fall 1972, the median raw scores on overall mathematics achievement for children involved in Title I components emphasizing mathematics will be significantly higher than were median raw scores of Title I children in the same grades the previous year.

It seemed reasonable to pursue an evaluation design similar to that used in the two previous years of the project. It also seemed reasonable to continue an evaluation of the students' attitude toward mathematics, even though affective objectives were not included in the Title I proposal.

The basic evaluation techniques used during the third year of the IPI project were a standardized achievement test, a semantic differential attitude scale, a locally developed arithmetic basic skills test, a record of student progress in the IPI continuum, and teacher interviews. The results of the product evaluation will be reported in four subsections: Student Progress in the IPI Continuum, Achievement Test Data, Student Attitudes Toward Mathematics, and Teacher Reactions to the IPI Project.

Student Progress in the IPI Continuum

Table 4 on page 20 indicates the percentage of students at each grade level who were working at each level in the IPI continuum at the beginning of the 1971-72 school year and on May 15, 1972, near the end of the school year. It appears that students made progress through the IPI continuum, considering that a criterion level of 85% correct was necessary before a student could move on to another unit within a given level. As an example, in September, all second graders were working in levels A and B (78% in A, 22% in B). By the following May, 61% of these students had progressed to levels C or D, and only 6% were still at level A. Similar patterns of progress may be observed for each grade.

Table 4

Percentage of Students in Each Grade Working at Various IPI Levels on September 13, 1971 and May 15, 1972

Grade	Date	Level A	Level B	Level C	Level D	Level E	Level F
Grade 2	Sept 1971	78%	22%				
N=36	May 1972	6%	33%	53%	6%		
Grade 3	Sept 1971	11%	65%	24%			
N=37	May 1972		14%	35%	51%		
Grade 4	Sept 1971		35%	55%	10%		
N=49	May 1972			10%	69%	20%	
Grade 5	Sept 1971		10%	46%	38%	5%	
N=39	May 1972				31%	51%	18%
Grade 6	Sept 1971			33%	62%	5%	
N=42	May 1972			2%	12%	60%	26%

If students in the IPI project are improving in mathematics, one would expect fewer students working in the lower levels and more students working in the upper levels after each successive year of the project. Table 5 gives the percentage of students in the combined grades 2 through 6 who were working at the various levels of the IPI continuum at the end of each of the three years of the IPI project. A trend does appear. In May of 1970, 1971, and 1972, respectively, 42%, 39%, and 28% of the IPI students were working in levels A, B, and C. At the end of the same three years, 58%, 61%, and 72% of the IPI students were working at the three upper levels D, E, and F.

Table 5

Percentage of Students in Combined Grades 2-6 Working at Various IPI Levels on May 1970, 1971, and 1972

Date	N	Level A	Level B	Level C	Level D	Level E	Level F
May 1970	260	0%	14%	28%	35%	23%	0%
May 1971	202	1%	12%	26%	31%	30%	1%
May 1972	203	1%	8%	19%	36%	27%	9%

These figures do not necessarily indicate that the 1971-72 students had better math skills than the 1969-70 students, but it does indicate that the 1971-72 students were further along in the IPI continuum of skills than the 1969-70 students.

Another indicator of student progress in the IPI continuum is the number of units completed during the school year. The figures in Table 6 indicate that the average child completed about one grade level of material during the 1971-72 school year. This estimate was based on the fact that each level B through F contains from 9 to 12 units. If a student met the passing criterion for any unit on the pretest, he could skip to the next unit that he had not passed.

Table 6

Number of Units Completed at Each Grade Level
Between September 1971 and May 1972

Grade	N	Fewest Completed	Most Completed	Median Completed
2	36	2	20	10
3	37	1	18	7
4	49	2	19	9
5	39	4	13	9
6	42	4	17	9

About 15% of the second and third grade students completed less than 4 units during the year. Although this seemingly slow progress through the IPI continuum was at least partially due to the large number of skills in each unit at the A and B levels, perhaps there is some way these slower moving students could progress faster.

Achievement Test Data

Pretest and posttest data on the Modern Math Supplement to the Iowa Tests of Basic Skills were obtained for 36 fifth graders and 40 sixth graders. Only two students in grades 5 and 6 who were at Hall during the entire 1972-73 school year did not have both a pretest and posttest. To reduce the amount of testing, students in grades 3 and 4 were not given a pretest in October 1971. May 1972 scores on the Modern Math

Supplement were obtained for 41 of the 42 third graders and 48 of the 53 fourth graders who were on roll at that time. The second grade students were not given a standardized achievement test.

Table 7 gives the pretest and posttest mean raw scores, the corresponding grade equivalents, the publisher's percentiles, and the gains at grades 5 and 6 between pretest and posttest. The mean raw score gains during the seven-month period from October 1971 to May 1972 at grades 5 and 6 were equivalent to eight and six grade equivalent months, respectively. The fifth and sixth grade students in the IPI project progressed at a rate similar to that of the average student in the publisher's sample. In fact,

Table 7

Mean Raw Scores, Grade Equivalents, Publisher Percentiles, and Gains for Hall Students in Grades 3-6 on the Modern Mathematics Supplement to the Iowa Tests of Basic Skills in October 1971 and May 1972

	Pretest[a]	Posttest	Gain
Grade 6 (N=40)			
Mean Raw Score	12.9	17.8	4.9
Grade Equivalent	5.0	5.8	.8
Publisher Percentile	22	28	+6
Grade 5 (N=36)			
Mean Raw Score	13.9	17.2	3.2
Grade Equivalent	4.5	5.1	.6
Publisher Percentile	32	34	+2
Grade 4 (N=48)			
Mean Raw Score	-	17.2	-
Grade Equivalent	-	4.4	-
Publisher Percentile	-	41	-
Grade 3 (N=41)			
Mean Raw Score	-	18.1	-
Grade Equivalent	-	3.9	-
Publisher Percentile	-	56	-

[a]Students in grades 3 and 4 were not tested in the fall of 1971.

the somewhat higher percentile ranking in May 1972 compared with October 1971 indicates that Hall students made slightly better than expected gains when compared with other students who started below grade level at the beginning of the year.

Table 7 also shows that the publisher percentile ranks corresponding to the mean raw scores became progressively lower from grade 3 up to grade 6. The third graders, most of whom received all of their formal mathematics instruction in the IPI project, ranked at the 56th percentile on the publisher's norms. The mean scores at grades four, five, and six were at the 41st, 34th, and 28th percentiles, respectively.

The better test results at grades 3 and 4 compared with grades 5 and 6 could be cited as evidence that the IPI project is raising mathematics achievement. On the other hand, the better scores of the younger children might reflect the fact that the children have not been in school long enough to fall very far behind the publisher's norms. Perhaps, as with many groups of children in educationally disadvantaged areas across the country, they will compare less favorably with the normative group as they become older. However, the spring Modern Math Supplement mean scores for the last three years indicate that the higher scores at the lower grades might be holding up better than expected in the upper grades. Table 8 on page 24 gives the publisher's percentile associated with the mean raw score at each grade level in May of each of the three years of the IPI project. Although some turnover of students occurred from 1971 to 1972, the May 1971 percentiles for students in grades 3, 4, and 5 held up fairly well when they took the test one year later as fourth, fifth, and sixth graders. The 1971 fifth graders scored at the same percentile in 1972 when they were sixth graders, the 1971 fourth graders dropped two points from the 36th to the 34th percentile as fifth graders in 1972, and the 1971 third graders dropped five points from the 46th to the 41st percentile as fourth graders in 1972.

At each grade level, with a minor deviation at sixth grade, the percentiles were higher after each successive year of the IPI project. For example, at fifth grade, the percentile rank in May 1972 was six points higher than in May 1971 and twelve points higher than in May 1970. Figure 1 on page 24 illustrates the trend over the three years of the project.

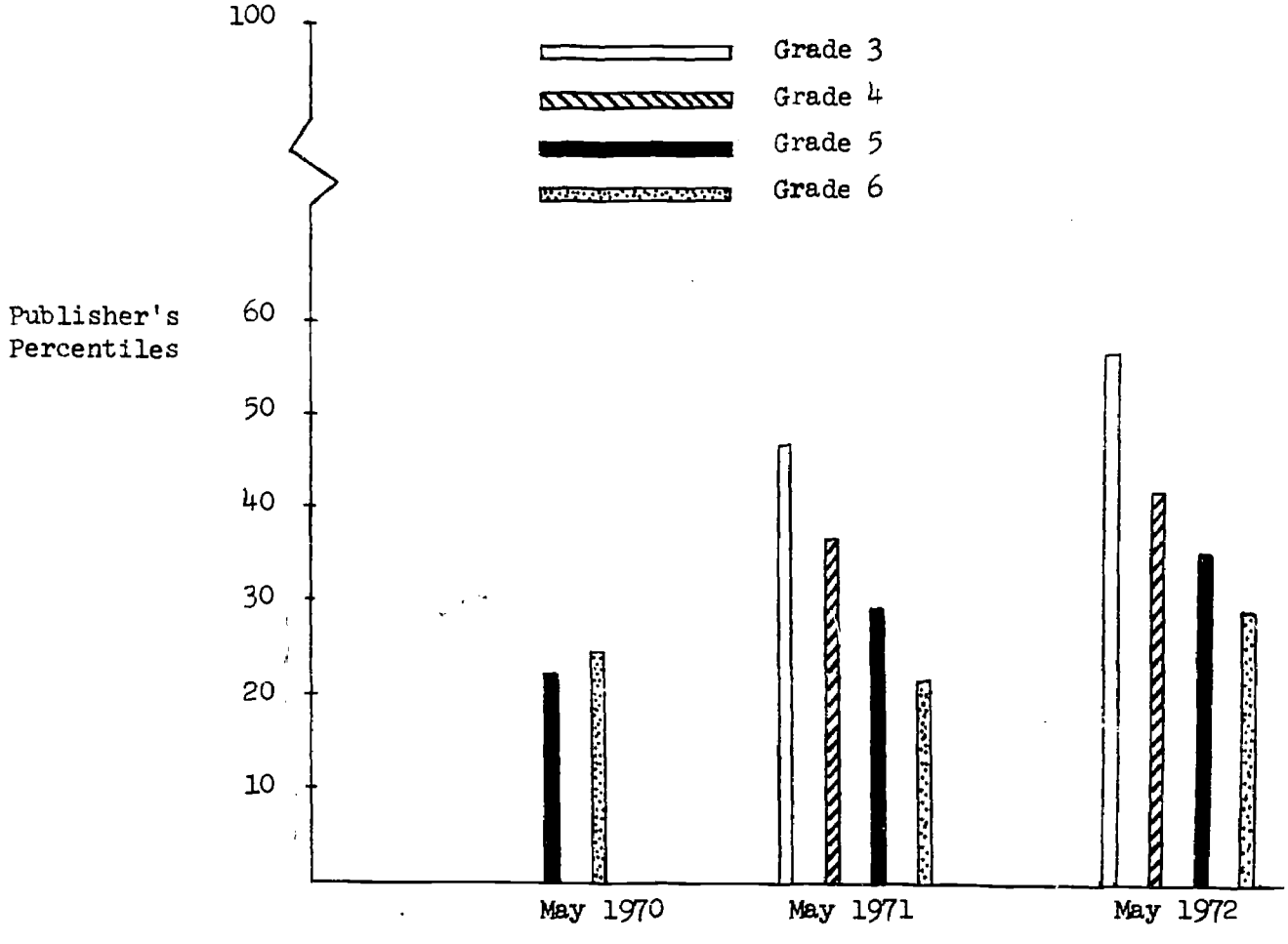
Table 8

Publisher's Percentiles on the Spring 1970, 1971, and 1972 ITBS Modern Math Supplement for Hall Students in Grades 3-6

	May 1970	May 1971	May 1972
Grade 6	24	21	28
Grade 5	22	28	34
Grade 4	a	36	41
Grade 3	a	46	56

[a]ITBS Modern Math Supplement was not given in grades 3 and 4 in May 1970.

Figure 1
May 1970, 1971, and 1972 Publisher Percentiles for ITBS Modern Math Supplement for Hall Students in Grade 3-6



Comparison schools. Students in grades 4-6 in two other Title I elementary schools in Minneapolis were used as comparison populations. All comparisons that will be discussed should be viewed with caution, since many between-school variations that probably existed were not controlled. The two comparison schools were similar to Hall in that they had Title I funds available for compensatory programs in basic skills. Citywide test information indicated that students at Hall and the two comparison schools had similar reading skills. At least one-third of the students in all three schools came from minority-group backgrounds, although the total percentage and the specific minority group representation varied greatly among schools.

Fifth graders in the two comparison schools were given the ITBS Modern Math Supplement (MMS) in May 1972 in order to compare their gains in mathematics achievement with gains made by Hall students in the IPI project. The citywide administration of the Modern Math Supplement (MMS) to fourth graders in February of 1971 was used as pretest information. All fifth graders who attended Hall and the two comparison schools between February 1971 and May 1972, and who had scores for the fourth grade MMS, the fifth grade MMS, and the fourth grade Lorge-Thorndike Intelligence Test were included in the comparison.

A similar comparison was made between sixth graders at Hall and the two comparison schools who had complete test data on the fourth grade MMS (February 1970), the sixth grade MMS (October 1971), and the fourth grade Lorge-Thorndike Intelligence Test.

To be included in the comparison, fifth graders had to attend the same school during the period between February 1971 and May 1972, while sixth graders had to attend the same school during the period between February 1970 and October 1972. Thus, the sample includes only the stable population at Hall and the comparison schools. The scores of the stable population indicate a biased sample of all students. For example, the mean raw score on the MMS in May 1972 was 17.8 for all Hall fifth graders (Table 7) and 19.5 for the stable Hall fifth graders (Table 9). On the other hand, the stable groups had the most consistent exposure to the math program in their school (IPI at Hall, for example).

Table 9 gives the mean raw scores on the MMS pretest and MMS posttes , the corresponding grade equivalents, and the gain in grade equivalents for the fifth and sixth graders at each school. The fifth graders at Hall had a lower mean raw score and grade equivalent than fifth graders at Schools A and B on the fourth grade MMS (February 1971). By the spring of 1972, Hall fifth graders had a higher mean raw score than the fifth graders at Schools A and B. During the one year and three months period between pretest and posttest, fifth graders at Hall gained two grade equivalent years, compared with gains of 1.5 and 1.4 years for Schools A and

The sixth graders at Hall had a substantially higher mean raw score on the fourth grade MMS (February 1970) than did the sixth graders at Schools A and B. On the October 1971 MMS, the Hall sixth graders still scored higher than School A and B sixth graders; however, the differences between the schools were not as great as on fourth grade pretest. During the period between February 1970 and October 1971, Hall sixth graders gained 1.4 years while sixth graders at Schools A and B gained 1.6 and 1. years.

Table 9

A Comparison of Fifth and Sixth Grade Gains on the ITBS Modern Math Supplement for Hall and Two Other Title I Schools

Grade 5		Modern Math Gr 4 Feb 71 Mean	GE	Modern Math Gr 5 May 72 Mean	GE	Modern Math Grade Equiv. Gain
Hall	(N=25)	12.5	3.5	19.5	5.5	2.0
School A	(N=44)	13.9	3.8	18.3	5.3	1.5
School B	(N=62)	13.4	3.7	16.8	5.1	1.4
Grade 6		**Modern Math Gr 4 Feb 70 Mean**	**GE**	**Modern Math Gr 6 Oct 71 Mean**	**GE**	**Modern Math Grade Equiv. Gain**
Hall	(N=27)	13.6	3.7	13.5	5.1	1.4
School A	(N=42)	10.8	3.2	12.2	4.8	1.6
School B	(N=62)	9.7	3.0	12.6	4.9	1.9

Note: Differences in grade equivalent gains should be interpreted with caution. When differences between schools on the fourth grade math achievement and intelligence tests were controlled, the difference between Hall and School A at the fifth grade level was the only difference that was statistically significant. See Table 10 on page 28.

Since there are a number of uncontrolled factors affecting the MMS posttest scores and the grade equivalent gains, it would be risky to make statements about the relative effectiveness of the math programs at Hall and Schools A and B based on the data presented in Table 9. Perhaps the most significant finding is that students at all three schools made gains equal to or greater than the gains that would be made by the publisher's normative sample of students. However, it must be kept in mind that the samples in Table 9 consist of the "stable" students.

It appears that Hall fifth graders made greater gains than did fifth graders at Schools A and B, and that Hall sixth graders made lesser gains than did sixth graders at Schools A and B. However, when differences between the students on the pretest score, verbal intelligence, and nonverbal intelligence were statistically controlled, only one of the differences between the posttest scores at Hall and either of the two comparison schools was statistically significant (Table 10 on page 28). The adjusted posttest mean of the fifth graders at Hall was significantly higher than the adjusted posttest mean of the fifth greaders at School A.

Basic skills test. Use of the ITBS Modern Math Supplement for the IPI project has been criticized in the past on at least two points. One, the items do not sample the content of the IPI materials, and two, the reading required by many items invalidates the test as a measure of math achievement for poor readers.

The first-year evaluation (1969-70) of the IPI project at Hall School addressed itself to both of these problems. It found that 20 of the 66 items on the fifth and sixth grade levels of the Modern Math Supplement did not measure skills in the IPI continuum. It also found that, according to the students' end-of-the-year working levels, there were 38 items out of the total 66 items which no students were expected to answer correctly. For each fifth and sixth grader, a comparison was made between test items the student was expected to know (the student had studied the related IPI skills), and items he was not expected to know (the student had not studied the related IPI skills). The students knew significantly more of the expected items than the non-expected items.

Table 10

A Comparison of Fifth and Sixth Grade ITBS Modern Math Supplement Means for Hall and Schools A and B When Fourth Grade ITBS and Verbal and Nonverbal Intelligence Were Controlled by Analysis of Covariance

Comparison	Criterion		Covariates			F-test		
	Mod Math Not-Adjusted Mean	Mod Math Adjusted Mean	Grade 4 Mod Math Mean	Lorge-T Verbal Mean	Lorge-T Nonverbal Mean	R^2_{Full}	R^2_{Rest}	F
Gr 5 Hall vs A								
Hall (N=25)	19.5	20.3	12.5	38.2	42.9	.695	.671	5.04*
School A (N=44)	18.3	17.9	13.9	37.3	43.3			
Gr 5 Hall vs B								
Hall (N=25)	19.5	18.9	12.5	38.2	42.9	.621	.611	2.43
School B (N=62)	16.8	17.0	13.4	32.8	39.1			
Gr 6 Hall vs A								
Hall (N=27)	13.5	13.0	13.6	34.5	41.1	.519	.518	1.0
School A (N=42)	12.2	12.5	10.8	35.7	41.9			
Gr 6 Hall vs B								
Hall (N=27)	13.5	11.8	13.6	34.5	41.1	.477	.466	1.76
School B (N=62)	12.6	13.4	9.7	38.0	37.3			

*.05 level of significance. $F_{.05}(1,64) = 4.00$

The first-year evaluation also considered whether or not reading difficulty of the items was a factor. Students who had the test read to them scored slightly, but not significantly, higher than students who did their own reading. However, it is unlikely that reading an item to a student completely eliminates any problem he has with the interpretation of verbal materials.

Prompted by the work of the first-year evaluator and by the concept that a set of basic skills exists whose attainment would be a common goal for any math program, the third-year evaluator developed basic operational skills tests for grades four and six. Basic operational skills were defined as addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals. From a list of operational skills that were thought to be appropriate for the average student in fourth and sixth grade, a 35-item fourth grade test and a 36-item sixth grade test were written. Very few of the items required reading (copies in Appendix A).

Although the final forms of the tests had undetermined validity, it was thought that they would provide another rough estimate of the value of the IPI program in relation to other math programs. The results of an April 1972 testing at Hall and Schools A and B are given in Table 11.

Table 11

Basic Operational Skills Test at Hall and Schools A and B

	Grade 4			Grade 6		
	N	Mean	S.D.	N	Mean	S.D.
Hall	50	20.1	5.8	39	21.5	6.4
School A	51	24.3	6.2	43	22.2	6.4
School B	61	18.5	8.3	66	20.2	6.4

Hall students in grades four and six did not score better than students in the two Title I comparison schools. However, the criticism made of the ITBS Modern Math Supplement can be made for the basic operational skills tests: many of the items do not measure skills that the students worked on in the IPI continuum. On the other hand, if there is a set of basic operational skills that can be identified as common

objectives for all elementary math programs, the value of a program could be partially assessed by the degree to which the students master these skills.

Student Attitudes Toward Math

Students at Hall School have expressed positive attitudes toward math at the end of each of the first two years of the IPI program. Mathematics was ranked as either their first, second, or third favorite subject by students in grades 2 to 6 at Hall. When mathematics was not ranked number one, it was outranked by art or/and gym.

In March 1972 fourth and fifth grade students at Hall and the two comparison schools completed a semantic differential attitude instrument. All students who were present on the administration date were included. No attempt was made to pick up absentees.

A five-point scale with seven bipolar adjectives was developed to measure student attitudes toward the following seven concepts:

Reading Time During the School Day Is
Going to School Is
Going to the School Library Is
Math Time During the School Day Is
I Am
At Reading I Am
At Math I Am

It was hypothesized that the first four concepts measured attitudes toward various aspects of school while the last three concepts measured self concept. For example, the "Math Time During the School Day Is" concept measured how well the children liked their math class, and the "At Math I Am" concept measured the children's self concept in math.

The seven bipolar adjectives used with each scale were Good:Bad, Beautiful:Ugly, Kind:Cruel, Pleasant:Unpleasant, Nice:Awful, Smart:Dumb, and Happy:Sad. Previous research had indicated that these adjectives seemed to tap a similar evaluative dimension. The order of the pairs of adjectives was randomly assigned to each concept. The five points on the scale for each pair of adjectives were labeled "very, sort of, neither, sort of, and very" to help the children mark the scale. A copy of the first page of the attitude scale with one of the two sample concepts is in Appendix B. Each child completed the scales independently except

for assistance from the examiner when he had difficulty reading a word.

For each of the seven bipolar adjectives in a particular concept, a child was assigned a score from one to five according to whether he answered negatively or positively. A mark at the most negative end of the scale was assigned 1, the next most negative was assigned 2, ... and the most positive was assigned 5. The scores for the seven adjectives were summed to give a total score for each concept that ranged from seven (most negative) to thirty-five (most positive).

The mean scores for the fifth and fourth graders at Hall and the two comparison schools are given in Tables 12 and 13 on pages 32 and 34.

Overall, student attitudes were more positive than negative on all concepts in all three schools at both fourth and fifth grades. The attitudes of fourth graders tended to be better than the attitudes of fifth graders, particularly in School A.

Two contrasts for each concept at each grade level were analyzed using a two-tailed t-test: Hall versus comparison School A and Hall versus comparison School B. Hall 5th graders had significantly more positive attitudes than 5th graders at School A on all four attitude-toward-school concepts and significantly more positive attitudes than students at School B on two of these four concepts (Table 12). The difference between Hall 5th graders and the students at Schools A and B on the "Math Time During the School Day" concept was significant at the .01 level.

Although the 5th graders at Schools A and B had better self concepts than did the Hall 5th graders as measured by the last three items, the contrast between Hall and School B on the "I Am" item was the only one that was significant. A composite view of the fifth graders' attitudes is illustrated in Figure 2 on page 33.

At the fourth grade level, there were only two significant differences between Hall and the comparison schools (Table 13 on page 34). Hall fourth graders expressed more positive attitudes than did the fourth graders at School A on the "Reading Time" and "Math Time" concepts. A composite view of the fourth graders' attitudes is illustrated in Figure 3 on page 35.

A comparison between the two fourth grade classrooms at Hall School indicated a significant difference on the "Math Time" concept. One classroom had a mean score of 30.5, while the other classroom had a mean score

Table 12

Mean Scores, Standard Deviations, and t-test Contrasts on the Semantic Differential for Fifth Graders at Hall and Two Comparison Schools

Concept	Hall N=33 Mean	Hall N=33 SD	School A N=54 Mean	School A N=54 SD	School B N=80 Mean	School B N=80 SD	Hall vs School A t	Hall vs School B t
Reading Time During The School Day Is	26.0	6.4	21.9	8.1	22.7	9.1	2.46*	1.88
Going To School Is	29.1	5.7	24.3	7.5	23.7	9.8	3.16**	2.98**
Going To The School Library Is	27.2	7.1	23.7	7.2	28.9	7.7	2.19*	-1.08
Math Time During the School Day Is	30.3	3.9	23.7	8.3	26.2	8.5	4.12**	2.68**
I Am	27.2	4.0	29.2	6.1	29.5	6.2	-1.68	-1.98*
At Reading I Am	25.2	5.3	27.3	4.7	25.5	8.1	-1.91	-0.19
At Math I Am	27.0	4.8	26.8	5.9	28.5	6.7	0.17	-1.18

*.05 level

**.01 level

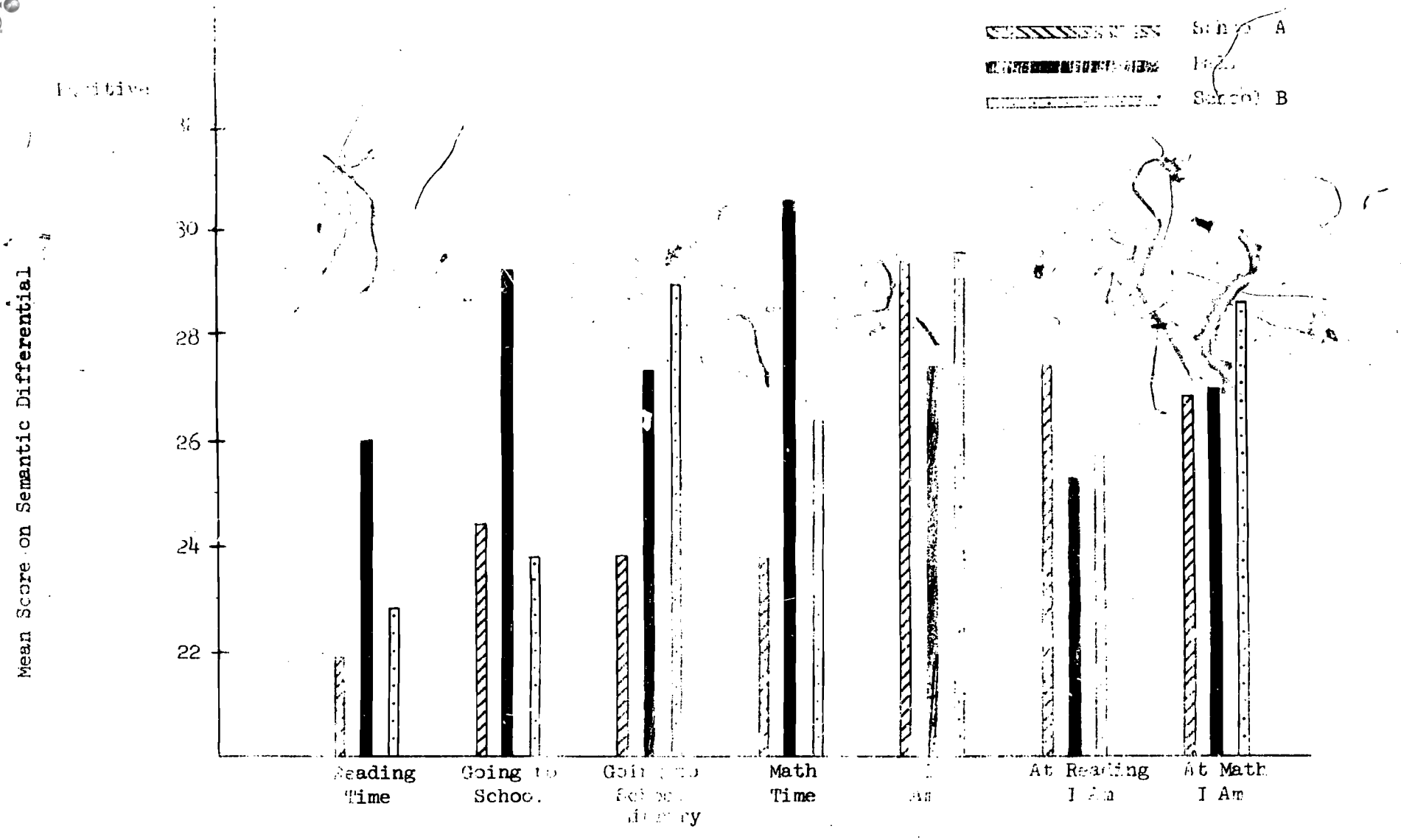


Figure 2. Fifth Graders' Attitudes Toward School at Hall and Two Comparison Schools

Table 13

Mean Scores, Standard Deviations, and t-test Contrasts on the Semantic Differential for Fourth Graders at Hall and Two Comparison Schools

Concept	Hall N=49 Mean	Hall N=49 SD	School A N=54 Mean	School A N=54 SD	School B N=79 Mean	School B N=79 SD	Hall vs School A t	Hall vs School B t
Reading Time During The School Day Is	28.1	6.0	26.9	6.7	23.6	7.6	0.94	3.46**
Going To School Is	28.5	6.5	28.1	5.5	26.3	7.4	0.34	1.72
Going To the School Library Is	30.5	4.4	29.7	4.1	29.3	6.3	0.94	1.14
Math Time During the School Day Is	28.0	7.4	27.2	6.4	24.5	8.8	0.59	2.31*
I Am	29.6	5.8	29.6	3.9	29.4	5.9	0.00	0.19
At Reading I Am	27.6	5.7	28.7	5.6	26.8	7.4	-1.03	0.64
At Math I Am	28.2	6.4	28.6	5.9	27.4	6.6	-0.35	0.87

*.05 level

**.01 level

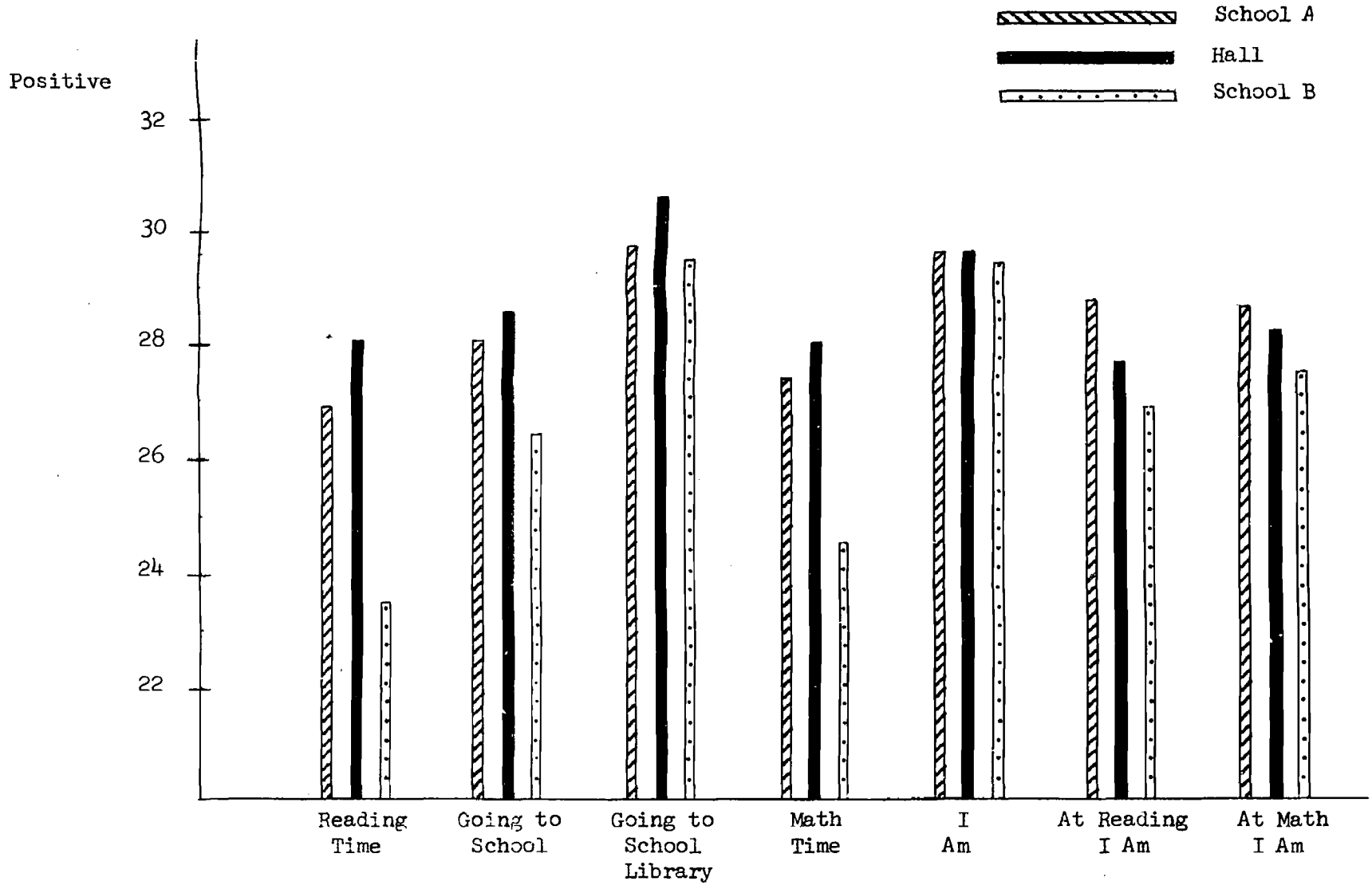


Figure 3. Fourth Graders' Attitudes Toward School at Hall and Two Comparison Schools

of 25.9. Although a number of other factors could be related to this difference, the fourth grade classroom with the more positive attitude toward math operated in a very individualized manner, while the fourth grade classroom with the lower score on math attitude used a less individualized approach that emphasized seminars and group instruction. There was no difference between these two fourth grade classrooms on any of the other concepts included in the semantic differential.

Teacher Reactions to the IPI Project

Eleven of the twelve teachers in grades 1-6 were individually interviewed by the evaluator. The sixth grade teacher who began in the middle of the school year was not interviewed. Most teachers were at least somewhat acquainted with the interviewer. It is the interviewer's opinion that the teachers responded candidly to all questions.

Would the teachers like to see IPI continued at Hall next year? All eleven teachers interviewed said "Yes, the IPI math project should be continued." Nine of the 11 teachers were judged to be enthusiastically positive. One of these nine teachers said she would be "crushed" if IPI were discontinued.

The two teachers who responded less enthusiastically taught at the primary level. One teacher felt there might be a better approach for first grade children. The first graders spent the first half of the year learning vocabulary and reading skills to prepare them for work in the STS booklets. She felt that it might be better to work out of another math sequence that presents math concepts to the children the entire year. She also felt there were too many skills to do in Level A when the first graders began to work in the STS booklets, and that, perhaps, if the children were introduced to some math concepts before they began the individual booklets, they would test out of many of the skills.

Why do the teachers endorse the IPI project so positively? One of the two most frequently given reasons was individualization. The teachers stated that traditional programs do not meet the wide range of pupil differences, while IPI takes the child from where he is, without losing the lower pupils and without holding back the top pupils.

The other most frequently given reason was positive student attitude. The interviewer felt that the teachers were very enthusiastic about this point. The teachers indicated that the children, both high and low achievers, exhibited pride in their work. The pupils were able to observe their own progress and expressed satisfaction in reaching their goals. As one teacher stated, "Math period is a happy time, not a sad time."

Teachers gave the following other advantages of the IPI program: the one-to-one emphasis allowed the teacher to pinpoint individual difficulties, the teacher was happier, very little reading was necessary, a lot of help was in the room, the sequence of skills was good, and teacher preparation time was spent on more meaningful activities such as prescriptions rather than digging around for math materials.

The following disadvantages and suggestions for improvement were noted by the teachers: it was difficult to get to everyone that needed help, immature students cannot handle independence, there were not enough "fun" things in the STS booklets, the teacher aides needed more training, and there was a need for more problem solving activities.

Is there a need for more in-service training? Most teachers in the upper elementary grades do not think in-service sessions are necessary. They particularly do not want to spend more time clarifying the goals and procedures of the IPI project. About half of the grade 4-6 teachers would be interested in training sessions devoted to the use of manipulative devices.

Teachers in the primary grades expressed greater interest in in-service training. Most teachers appeared very receptive to sessions on the use of manipulative devices in relation to IPI. Several teachers thought grade level or primary level meetings devoted to sharing ideas regarding IPI would be a valuable use of time.

Are teachers satisfied with the staffing? Overall, yes. Most teachers felt there was a need for at least two other people in the classroom who could work with students at an instructional level.

However, some personal conflicts between staff members did exist. Where conflicts did exist, they usually resulted from differing opinions as to how the classroom should be organized and who should be in control

of the classroom, the classroom teacher or the floating teacher. Occasionally these conflicts were brought into the open, while at other times they were suppressed rather than risk damage to the IPI project.

Most teachers felt the coordination and leadership of the IPI project was effective, although some teachers thought the coordinator should be given more authority so that he would be in a position to provide more direction to the program. In 1971-72 he was paid on a teacher's salary schedule and was viewed by teachers as being on the same level as a classroom teacher.

Although the teachers expressed the need for some improvements in the IPI project, the teachers' predominant, and almost fervent, opinion was that the IPI project is successful. They want it continued at Hall School.

Summary and Discussion

The Title I IPI mathematics project at Hall School has been in operation since the fall of 1969. Has it been a successful project during these three years?

Achievement. It does appear that IPI students at Hall School have made progress in mathematics achievement. The evidence indicates that math achievement at Hall has improved during the three years of IPI, and that Hall students have made similar or slightly better gains than students in other Title I schools.

1. The fall to spring gains on standardized tests at intermediate grade levels have been one grade equivalent month for each month of the project for each of the three years. These gains are similar to gains made by average students in the test publisher's normative sample and somewhat better than expected gains for students who started below average on the publisher's norms, such as most of the students at Hall. The percentile ranking at each grade level in the spring has ranged from two to eleven points higher than in the fall in each of the three years of the project.
2. Students in grades three and four had higher percentile ranks on the

ITBS Modern Math Supplement than did students in grades five and six. In May 1972, the percentile ranks were 56, 41, 34, and 28 for grades 3, 4, 5, and 6, respectively. Since the third and fourth graders have received most of their formal mathematics instruction with IPI materials, the better test results at grades 3 and 4 than at grades 5 and 6 could be cited as evidence that IPI is having a positive effect on mathematics achievement. On the other hand, perhaps the students have not been in school long enough to fall behind. Or perhaps the children were better prepared to begin formal mathematics instruction as a result of other factors, such as educational television programs. Whatever the major cause, a trend has appeared where the percentile rank at each grade level has increased in each successive year of the project. For example, the May 1972 Modern Math Supplement percentiles were 7, 6, 5, and 10 percentile points higher than the May 1971 percentiles at grades 6, 5, 4, and 3, respectively.

3. Although there have been no intensive studies comparing IPI with other math programs in the school system, comparisons with two other Title I schools tended to favor the IPI program. Between February 1971 and May 1972 the Hall fifth graders made somewhat greater gains than fifth graders at the other two schools. Between February 1970 and October 1971 Hall sixth graders made gains similar to sixth graders at the other schools. It seems possible that greater differences will show up in subsequent years.

Student attitudes. Students at Hall have expressed positive attitudes towards math during each year of the IPI project. Mathematics was ranked as either the first, second, or third favorite subject by students in grades 2-6 during the first two years. When mathematics was not number one, it was outranked by art or/and gym. In March 1972, using a semantic differential scale, Hall fifth graders had more positive attitude towards "Math Time During the School Day" than did fifth graders at two comparison schools. Hall fourth graders had a more positive attitude toward "math time" than one of the two comparison schools.

Teachers. With one exception, the teachers at Hall School enthusiastically

supported the IPI project. The teachers stressed the positive aspects of the individualized approach and the development of positive attitudes in the students. The teacher who was not so positive was uncertain about the appropriateness and timing of the IPI materials for children in first grade.

IPI activities and procedures. A systematic survey of the IPI project activities indicated wide variations among individual classrooms regarding the use of instructional materials, the use of group instructional methods, and the types of prescriptions being made. In some classes, the large group activities were so extensive, it might be unfair to make judgments about the value of IPI materials (i.e. the IPI program was not being followed according to suggested guidelines).

Recommendations

The following recommendations are made with the knowledge that the IPI project at Hall school may be discontinued after the 1972-73 school year because of cost considerations.

1. If IPI is discontinued, the school system should investigate the possibility of using or developing individualized materials and approaches similar to IPI. The students appeared to be achieving satisfactorily, they enjoyed mathematics, and the teachers believed in the project.
2. More attention should be given to procedural activities in the classrooms, with provisions for open discussion and action when conflicts arise or when activities appear to contradict the individualized philosophy of the IPI approach. A process evaluation indicated extensive use of whole-class activities (contrary to the IPI approach) in some classes.
3. Provisions should be made for in-service training for interested teachers. Many of the teachers, particularly in the primary grades, expressed an interest in training regarding the use of games and manipulative devices in conjunction with the IPI materials.
4. If the IPI project is to be phased out in 1972-73, do not allocate evaluation resources to the project.

Appendix A

Basic Operational Skills Tests for Grades Four and Six

Minneapolis Public Schools

Grade 4 Basic Arithmetic Operational Skills

1. Count by threes

3, 6, 9, _____, _____, _____, _____

2. In the number 7348

What number is in the tens place? _____

What number is in the hundreds place? _____

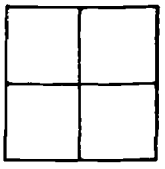
3. Rewrite these numbers from smallest to largest

33
17
104
37
89

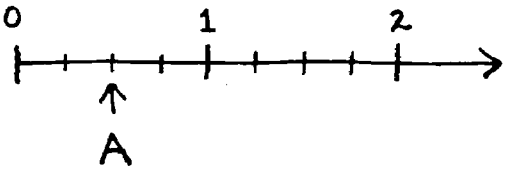
_____ _____ _____ _____ _____

smallest largest

4. Shade in $\frac{1}{4}$ of this figure



5. What fractional number is shown by point A?

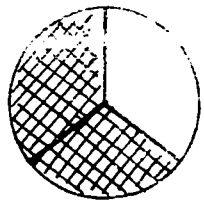


6. Circle the correct answer. In the number 472, the 4 means

a. 40 c. 400

b. 4 d. 4000

7. What fractional part of the figure is shaded?_____



8. Fill in the missing numbers

17, _____, 27, 32, _____, _____

Go ahead and do the rest of the problems on the following pages. There is no time limit so be careful.

9.)
$$\begin{array}{r} 641 \\ +\ 156 \\ \hline \end{array}$$

10.)
$$\begin{array}{r} 75 \\ +\ 36 \\ \hline \end{array}$$

11.)
$$\begin{array}{r} 936 \\ +\ 408 \\ \hline \end{array}$$

12.)
$$\begin{array}{r} 4 \\ 12 \\ 36 \\ +\ 47 \\ \hline \end{array}$$

13.)
$$\begin{array}{r} 27 \\ 33 \\ 29 \\ +\ 15 \\ \hline \end{array}$$

14.) $55 + 208 =$

15.)
$$\begin{array}{r} 76 \\ -\ 76 \\ \hline \end{array}$$

16.)
$$\begin{array}{r} 459 \\ -\ 255 \\ \hline \end{array}$$

17.)
$$\begin{array}{r} 93 \\ -\ 27 \\ \hline \end{array}$$

18.)
$$\begin{array}{r} 6381 \\ -\ 2523 \\ \hline \end{array}$$

19.)
$$\begin{array}{r} 606 \\ -\ 379 \\ \hline \end{array}$$

20.)
$$\begin{array}{r} 433 \\ -\ 247 \\ \hline \end{array}$$

21.) $\begin{array}{r} 9 \\ \times\ 6 \\ \hline \end{array}$

22.) $\begin{array}{r} 7 \\ \times 8 \\ \hline \end{array}$

23.) $\begin{array}{r} 681 \\ \times\ 2 \\ \hline \end{array}$

24.) $\begin{array}{r} 204 \\ \times\ 4 \\ \hline \end{array}$

25.) $\begin{array}{r} 372 \\ \times\ 5 \\ \hline \end{array}$

26.) $\begin{array}{r} 519 \\ \times 20 \\ \hline \end{array}$

27.) $\begin{array}{r} 134 \\ \times 12 \\ \hline \end{array}$

28.) $\begin{array}{r} 83 \\ \times 42 \\ \hline \end{array}$

29.) $8\overline{)19}$

30.) $5\overline{)355}$

31.) $3\overline{)912}$

32.) $8\overline{)96}$

33.) $6\overline{)458}$

34.) $38\overline{)76}$

35.) $13\overline{)162}$

THE END

Research and Evaluation Department
April 1972

Minneapolis Public Schools

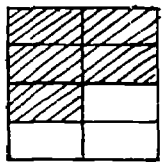
Grade 6 Basic Arithmetic Operational Skills

1. Circle the correct answer. In the number 5612, the number 6 means

a) 60 c) 6

b) 6000 d) 600

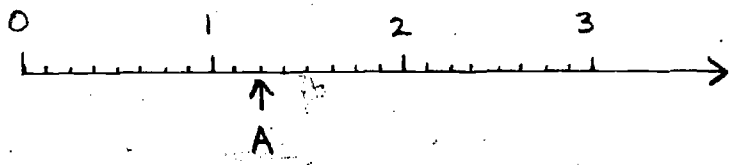
2. What fractional part of the figure is shaded? _____



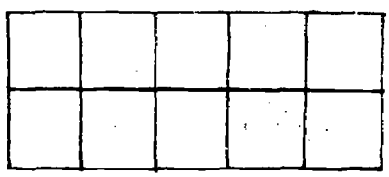
3. Write as a common fraction: .9 = _____

4. Write as a common fraction: .06 = _____

5. What number is shown by point A? _____



6. Shade in $\frac{3}{5}$ of the figure.



Go ahead and do the rest of the problems below. There is no time limit so be careful.

7.)
$$\begin{array}{r} 23 \\ 17 \\ 34 \\ +\ 25 \\ \hline \end{array}$$

8.)
$$\begin{array}{r} 569 \\ +\ 374 \\ \hline \end{array}$$

9.)
$$\begin{array}{r} 55 \\ 19 \\ 26 \\ +\ 68 \\ \hline \end{array}$$

10.)
$$\begin{array}{r} 852 \\ -\ 333 \\ \hline \end{array}$$

11.)
$$\begin{array}{r} 6370 \\ -\ 4917 \\ \hline \end{array}$$

12.)
$$\begin{array}{r} 5001 \\ -\ 2764 \\ \hline \end{array}$$

13.)
$$\begin{array}{r} 392 \\ \times\ 3 \\ \hline \end{array}$$

14.)
$$\begin{array}{r} 204 \\ \times\ 5 \\ \hline \end{array}$$

15.)
$$\begin{array}{r} 121 \\ \times\ 24 \\ \hline \end{array}$$

16.)
$$\begin{array}{r} 925 \\ \times\ 30 \\ \hline \end{array}$$

17.) $\begin{array}{r} 645 \\ \times\ 67 \\ \hline \end{array}$

18.) $\begin{array}{r} 34 \\ \times\ 43 \\ \hline \end{array}$

19.) $7\overline{)357}$

20.) $8\overline{)104}$

21.) $12\overline{)157}$

22.) $42\overline{)8132}$

23.) $\begin{array}{r} \frac{8}{9} \\ +\ \frac{4}{9} \\ \hline \end{array}$

24.) $4\frac{1}{8} + 3\frac{3}{8} =$

25.) $2\frac{4}{5}$
$3\frac{4}{5}$
$+ 1\frac{3}{5}$

26.) $6\frac{5}{6}$
$- 3\frac{1}{6}$

27.) $2\frac{1}{3} - \frac{2}{3} =$

28.) $\frac{1}{2} + \frac{3}{5} =$

29.) $8\frac{3}{4}$
$+ 3\frac{5}{7}$

30.) $\frac{5}{8}$
$- \frac{2}{5}$

31.) $\frac{3}{4} \times \frac{2}{7} =$

32.) $\frac{4}{9} \times \frac{1}{4} =$

33.) $2\frac{1}{3} \times 3\frac{3}{7} =$

34.) $12.57 + 9.6 =$

35.)
$$\begin{array}{r} 16.2 \\ -\ 9.317 \\ \hline \end{array}$$

Appendix B

The Semantic Differential Scale
Used with IPI in 1971-72

Last Name_____ First Name_____

School_____ Room_____ Boy or Girl____

This is not a test. There are no right or wrong answers to any of the questions. Just answer them as honestly as you can.

The questions ask you to tell how you feel about different things. Your answer to each question should tell how you feel about it.

At the top of each of the following pages there is an unfinished sentence. There are 7 pairs of words that you can use to think about the statement at the top. Finish the sentence by making an X in the place which describes how you feel.

WATCHING TV IS

	very	:	sort of:	neither:	sort of:	very	
GOOD	_____	|	_____ |	_____ |	_____ |	_____	BAD
UGLY	_____	|	_____ |	_____ |	_____ |	_____	BEAUTIFUL
KIND	_____	|	_____ |	_____ |	_____ |	_____	CRUEL
NICE	_____	|	_____ |	_____ |	_____ |	_____	AWFUL
UNPLEASANT	_____	|	_____ |	_____ |	_____ |	_____	PLEASANT
SAD	_____	|	_____ |	_____ |	_____ |	_____	HAPPY
SMART	_____	|	_____ |	_____ |	_____ |	_____	DUMB

Minneapolis Public Schools

Educational Services Division
Planning, Development and Federal Programs

Harry N. Vakos, PhD., Assistant Superintendent
Educaticnal Services

Planning and Development

Lawrence P. Moon, PhD., Director of Planning, Development and Federal Programs

Mary C. Kasbohm, Assistant Director of Planning, Development and Federal Programs

Wallace J. Spolar, Fiscal Manager

Emma N. Hudson, Coordinator, Title I ESEA

Ruby M. Riney, Coordinator, Title I ESEA

Marge Hols, Dissemination Specialist

Rebecca S. Howard, Dissemination Specialist

Research and Evaluation

Richard W. Faunce, PhD., Director for Research

Lary R. Johnson, Research Associate

Robert L. Bergeth, PhD., Title I Evaluator

Sara H. Clark, Title I Evaluator