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RESEARCH AND DEVELOPMENT ACTIVITIES IN R AND I UNITS OF TWO ELEMENTARY SCHOOLS OF MILWAUKEE, WISCONSIN, 1966-1967.

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REVIEWED ARE (1) THE ACTIVITIES OF RESEARCH AND INSTRUCTION (R AND I) UNITS IN TWO MILWAUKEE SCHOOLS DURING THE 1966-67 SCHOOL YEAR, AND (2) THE RESULTS OF FIELD TESTING OF R AND I UNITS. PART 1 PROVIDES A DESCRIPTION OF THE ACTIVITIES OF THE PROGRAM. PARTS 2 AND 3 REPORT AND EVALUATE THE RESULTS OF TWO CONTROLLED EXPERIMENTS OF MOTIVATIONAL PROCEDURES AND INDIVIDUALIZATION OF INSTRUCTION CONDUCTED IN THE UNITS. IN ONE STUDY, ALTHOUGH NO SIGNIFICANT DIFFERENCE WAS FOUND BETWEEN TWO METHODS OF TEACHING FOURTH-GRADERS ARITHMETIC, BOTH GROUPS OF STUDENTS MADE PROGRESS AS GREAT AS OR GREATER THAN THEIR AVERAGE RATE OF PROGRESS SINCE ENTERING SCHOOL. IN THE OTHER STUDY, FIRST-GRADERS WHO HAD SIXTH-GRADE HELPERS (MODELS) IN ARITHMETIC PERFORMED SIGNIFICANTLY BETTER THAN PUPILS WHO DID NOT HAVE HELPERS. PART 4 REPORTS A SUMMARIZATION OF THE FIELD TESTING OF R AND I UNITS. CONCLUDED WAS THAT THE TOTAL RESULTS OF THE RESEARCH AND DEVELOPMENT ACTIVITIES OF THE UNITS CLEARLY INDICATE THAT THIS TYPE OF ORGANIZATION IN ITS FIRST YEAR PERFORMED ITS INSTRUCTIONAL, RESEARCH, AND DEVELOPMENT ACTIVITIES EXCEEDINGLY WELL. (DS)

RESEARCH AND DEVELOPMENT ACTIVITIES IN R & I UNITS OF TWO ELEMENTARY SCHOOLS OF MILWAUKEE, WISCONSIN, 1966-1967

WISCONSIN RESEARCH AND DEVELOPMENT

CENTER FOR COGNITIVE LEARNING

Technical Report No. 46

RESEARCH AND DEVELOPMENT ACTIVITIES IN R & I UNITS OF TWO ELEMENTARY SCHOOLS OF MILWAUKEE, WISCONSIN

1966–1967

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Report from Project MODELS
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PREFACE

A major objective of the Wisconsin Research and Development Center for Cognitive Learning is to develop an environment in local school buildings and systems which facilitates both student learning and research, development, and innovative activities. This report is concerned with the description and evaluation of such facilitative organizations and their activities in several elementary schools in the Milwaukee Public School system. The report further demonstrates how instructional and supervisory personnel in the public schools, working with personnel at the Center who possess specialized knowledge in various disciplines, cooperate to extend knowledge and improve educational practice through research and development activities.

Many people, other than those denoted as authors, contributed their skills in planning, executing, or evaluating the activities reported herein. In the Milwaukee Schools Miss Lillian Paukner, Executive Director of Elementary Curriculum and Instruction, and Miss Adeline Hartung and Mrs. Doris Stout, Coordinators of Elementary Curriculum and Instruction, gave generously of their time to aid in the planning of the experiment. Miss Maryanne Kearney and Mrs. Virginia Moore, helping teachers, also worked closely with the Unit leaders. Mr. Dwight Rowe, Coordinator of Educational Research, Dr. William Ashbaugh, Executive Director of Psychological Services, and Miss Anne Kennard of the Psychological Services staff planned with Dr. Glenn Tagatz, a postdoctoral fellow at the Center, the field testing program.

Professor Herbert J. Klausmeier, Principal Investigator of Project MODELS, initiated the idea of R & I Units and continues to assume primary responsibility for the conceptualization of the total R & I program and, with school officials and Professor Richard Morrow, for the broad implementation strategies in the local schools. Professor Klausmeier wrote the introductory and concluding sections of this report. Mrs. Doris Cook assumed primary responsibility for working with the building personnel during the year. She and Mrs. Mary Quilling served as consultants for the experiments reported. Other Center personnel who assisted in data collection and analyses include Mrs. Barbara Kennedy, Mr. James Bavry, and Mr. Louis Pingel. The authors acknowledge with appreciation the contributions of the above.

Thomas E. Romberg
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ABSTRACT

Activities of R & I (Research and Instruction) Units in two Milwaukee Schools during the 1966-67 school year are reviewed. Results of two controlled experiments conducted in the Units are reported and evaluated. In one study, although no significant difference was found between two methods of teaching fourth-graders arithmetic, both groups of students made progress as great as or greater than their average rate of progress since entering school. First-graders who had sixth-grade helpers in arithmetic performed significantly better than pupils who did not have helpers.

I
INTRODUCTION

Securing more efficient pupil learning in the cognitive domain continues to be the main focus of the research and development activities conducted jointly by the Wisconsin Research and Development Center for Cognitive Learning and several school systems as part of Project MODELS. One possible means for accomplishing this is to replace the graded, self-contained classroom with a Research and Instruction Unit (R & I Unit). R & I Units functioned in two elementary schools of Milwaukee throughout the 1966-1967 academic year. In each Unit the attempt was made (1) to provide excellent instruction for children, (2) to carry out research which is essential for improving instruction, (3) to develop new instructional procedures, materials, or ideas for improving instruction, and (4) to bring into the Unit promising educational innovations. The R & I Units are hypothesized to be more effective than self-contained classrooms in achieving these purposes.

In order to be more effective, the role of the building principal, Unit leader, classroom teacher, and teaching aide are being refined, and new relationships involving representatives of the central staff, the school building, and other agencies are being established. Thus, the concept of improving instruction through research and development in R & I Units is complex, involving an attempt to utilize time, space, equipment, supplies, instructional methods, instructional personnel, subject-matter content and sequence, and evaluation procedures in a more effective manner to achieve an efficient total educational program for each child.

When dealing with a total program, more time is required to get the various components integrated. However, the possibility for making significant improvements is also large. During the first year, the major effort is necessarily upon achieving a smooth operating instructional Unit and gaining familiarity with research, development, and innovative procedures. While this is being done, large gains in student learning should not be expected. Once the instructional staff and children operate as a unit and better materials and methods are developed, researched, and utilized, we may anticipate substantial improvement in student learning.

The two main instructional phenomena dealt with in the Units centered on individualizing instruction and motivation. Generalists from the R & D Center worked with the staff of the schools. Subject-matter consultants from the R & D Center or the central staff of the local school participated in decision-making where subject-matter specialization was called for in connection with the program of individualization.

The approach to individualization employed in the R & D Center is one of arranging a program of instruction for each child that will meet the various objectives of the educational program. This, in turn, calls for some instruction on a one-to-one basis, some small-group, and some large-group instruction.

In instruction on a one-to-one basis, the child proceeds at a rate appropriate to him. This type of individualized work with the teacher and independent study are required to meet those objectives concerned with the acquisition of independent skills. Some educational objectives require instruction in small groups. Pupils may be brought together in groups of 3 to 15 or more to work on specific activities of a fairly homogeneous type; for example, 5 to 15 children from a total group of 100 may be brought together for specific instruction related to acquisition of certain concepts or processes in arithmetic. Small groups also may be brought together to deal with the same word recognition skills. Small groups may be formed on the basis of interest, friendship, neighborhood residence, and the like in social studies in connection with achieving certain objectives related to communication skills and attitude

development. The extent to which large groups of 75 to 150 children may be brought together effectively has not been tested systematically. It is known that large numbers of students may engage in individual study activities simultaneously in large groups. In the Units in the elementary school, the principal reason for bringing all the students within the Unit together into the same group for part of the instructional day is to achieve better utilization of teacher time. Children participating in independent study or some other large group activity can proceed without all of the instructional staff of the Unit being present. This, in turn, frees part of the instructional staff during that period of time for planning, conferring, and executing other activities essential for making the small group and one-to-one instructional activities work effectively.

Attention was also given throughout the year to research and development regarding motivation. Getting a larger number of students to want to learn and also to behave well is a continuing responsibility of R & I Units. We appear to have sufficient knowledge about the means of controlling behavior of young children so that few discipline problems should emerge in the elementary school. Devising procedures for applying this knowledge and testing out some of the procedures is a continuing activity in R & I Units. From the preceding it may be properly inferred that no systematic attempt was made to improve instruction in any one subject-matter field in each Unit. This task was projected for the 1967-1968 school year.

In addition to improving the instructional program, a plan for field testing the R & I Units in 1966-67 was developed by Wardrop and Tagatz, and reported in Working Paper No. 4 of the Wisconsin Research and Development Center for Cognitive Learning. Only part of the total plan for field testing was executed during the 1966-67 school year. Also, the attempt was made to utilize the local resources of each school system in the field of testing, including each school's testing program; therefore, the amount of information obtained regarding the Units varied within a school system and across school systems. In some of the elementary R & I Units field testing data were gathered dealing with pupil achievement as measured by standardized tests. Instruments were developed and tested to secure opinions of pupils regarding the Units, and also the opinions of teachers and principals as to how well the research, development and innovation functions were being achieved. In the main, then, field testing procedures and instruments were tried out during the year, and the data obtained yielded some preliminary information about the functioning of R & I Units.

One of the three instruments which was developed was an opinion scale to secure opinions of teachers and building principals regarding the instructional research, development, and innovation functions of the Unit and also to determine the effects of the Unit organization on teachers, students, and instructional practices. In the same opinion scale information was secured regarding the utilization of resource persons and knowledge of individual students by the instructional staff. Another instrument, a check list, was developed for the purpose of determining the adequacy of the facilities, equipment, and supplies with respect to accomplishing the objectives of the R & I Units. A pupil questionnaire was developed for the purpose of securing information about the child, home, and neighborhood background, and opinions about a variety of matters associated with schooling. Finally, the field testing provided information regarding adequate control groups for R & I Units and also the extent to which different strategies for ascertaining pupil achievements were appropriate for this type of field study.

An attempt was made to establish four Units in Milwaukee in the fall of 1966—a primary and a fourth-grade Unit each at Oliver Wendell Holmes and Cass Street Schools. The Unit leader of the fourth grade at Holmes left the system in the first semester and the Unit was not continued the second semester.

The attempts to replace a self-contained classroom with any new organizational pattern involve cooperative teaching and planning. Whether these attempts are accepted or rejected depends a great deal upon the teachers involved and the physical facilities. The typical self-contained classroom teacher is somewhat isolated from other teachers in a school. The isolation represents the kind of security some teachers require. Teachers who will be successful, so to speak, in an R & I Unit are those who enjoy working and sharing their strengths with others and who enjoy both following and leading.

Many of the older school buildings do not lend themselves to cooperative teaching. The typical box-like school structure often hinders any organizational pattern other than the self-contained classroom, especially when classrooms utilized by the Unit are distributed throughout the building rather than being adjacent.

Two of the R & I Units, then succeeded in reaching the objectives initially set forth. The primary Unit at Holmes School and the fourth-grade Unit at Cass Street School functioned well throughout the school year, providing an atmosphere simultaneously conducive to exemplary instruction and to innovations stimulated by research or development activities.

II

SIXTH GRADE AS MODELS FOR PRIMARY CHILDREN, PRIMARY UNIT, HOLMES SCHOOL

BACKGROUND

The primary Unit at Holmes School initially included the Unit leader, Mrs. Ruth Baldwin, and three certified teachers who were responsible for 90 children. Four adjacent rooms were used and all pupils could meet simultaneously in one or two of them. The typical daily pattern was for pupils to meet in more than one room and for teachers to meet with more than one group; however, teachers remained in one classroom all day. The school, which was new, was well supplied with high quality instructional equipment and materials except for a noted lack of available tape recorders. Study carrels or other facilities for individual study were not available. The Unit leader met an average of 5-10 times each month with the building principal, central staff personnel, and the other Unit teachers. Meetings of Unit personnel with parents of the children were also this frequent. The central staff, building principal and vice-principal, Dr. Helfert and Mr. Cowles, respectively, and teachers cooperated jointly in forming the Unit. Teachers were given an option regarding their participation. The Unit leader and several teachers chose to continue their role in this type of organization in the following year, but funds were not available.

The student population of 44 boys and 46 girls, most of whom were Negro, came from the Inner City. Most of the youngsters in the primary Unit met the criteria for participating in a Title I program.

The task of the teachers of these children was to set up an exemplary program for each child. All teachers in the Unit, including the Unit leader, had the adjustment to make from working in a self-contained classroom to cooperatively planning and working as a unit.

Getting to know the children was the first order of business. Since Holmes School is a new school, pupils' cumulative folders were traced and gathered from several school buildings. Some of the children could not give names, addresses, or former school attended intelligibly which made the job even more difficult.

In the meantime, it was planned that each teacher should have the opportunity to teach all the children. In order to get a better feeling of belonging to a whole unit, children and teachers in the Unit started the day in one room where attendance was taken, lunch and milk money collected, and opening exercises for the day (Pledge of Allegiance and good morning song) were conducted.

Team meetings for cooperative planning were scheduled semi-weekly during the noon hour. At many of these meetings subject-matter consultants from the central office were present to help with curriculum planning. Mrs. Doris Stout, elementary supervisor, provided continuous support and interest.

Early in the fall one of the teachers requested a transfer to another school. Replacement was difficult. Substitute teachers filled in for a while and the Unit leader assumed an extra teaching load. When a regular teacher was secured, teaming in the area of reading got underway. The teacher's observations along with Pintner Cunningham Test scores served as the basis for grouping children in one of four groups for reading instruction:

1. Readiness—an extension of kindergarten readiness activities.

2. Chart study—more directed reading of charts in children's language and based on children's experience.

3. Readiness to read preprimers—It was felt that children would experience more pleasure and less frustration if their book reading were delayed until they could really read them.

This group was able to study work attack skills in their chart stories and work with surprise stories.

4. Chart study and reading in preprimers.

In addition to the above groupings, the Unit leader worked with smaller groups in reading at other times of the day. It was intended that these groupings would be flexible and would be changed as some pupils progressed.

In the middle of the second semester one of the teachers indicated a preference to return to a self-contained classroom. Hence, the Unit was reorganized to include two teachers, Mrs. Pat Unterholzmer and Mrs. Jacqueline Chrisien along with the Unit leader, Mrs. Ruth Baldwin. The three staff members were enthusiastic about participating in a motivation experiment, a description of which follows.

The multiple effects of cultural deprivation are manifest in the cognitive and affective behaviors of many of the pupils in Milwaukee's Holmes School. As achievement in various school subjects is typically below grade level, motivational techniques were frequently discussed by the staff of the primary R & I Unit. It was decided to conduct a controlled experiment using older children as models. The use of models is discussed by Bandura and Walters (1963). Also, Klausmeier and Goodwin (1966) have outlined a model for motivation in school settings. Few studies have been conducted, however, to evaluate the effectiveness of various procedures, including the assignment of older children as models for younger children in the elementary school.

To focus the activities of models with primary children, the subject-matter area of arithmetic was selected. Thus, it was possible to assess the effects models had on the younger children's arithmetic skills and on their attitudes toward school in general and arithmetic in particular. Also of interest was the effect that assuming the role of model had on the older pupils' behavior. Such an experience, it was hypothesized, might positively affect a model's self-concept and attitude toward school.

SUBJECTS

The younger subjects used in the experiment were 57 six- and seven-year-olds, classified as primary one or two students and assigned to the R & I Unit. Many of these children were Negro, and most came from a low socioeconomic background. The school is located in an inner-city area.

Twenty-two sixth-grade pupils at the same school, half boys and half girls, were randomly chosen from two classrooms to serve as models. These students came from the same type of environment as the younger subjects and shared with them related characteristics, such as below average academic performance.

TREATMENTS

All primary age children received the same type of instruction in mathematics for four days of each week. A televised mathematics program, Patterns in Arithmetic, Grade I, developed by the R & D Center under the direction of Professor Henry Van Engen, was used with both experimental and control groups. Teachers drew material for lessons complementing the TV presentation from the manual designed for the televised lessons, from the Milwaukee Public Schools kindergarten and primary arithmetic guide, and from the SRA teachers' guide for kindergarten and grade one. Many concrete objects were used in the teacher presentations. Teacher-made mimeographed worksheets were used to supplement the workbook which accompanied the TV series. Individual instruction was given to pupils who had difficulty grasping the TV presentation. In addition, children in the experimental group were randomly assigned to a sixth-grade "helper" of the same sex. Each sixth grader spent one-half hour per week with "his" pupil playing arithmetic games, manipulating concrete objects, and helping with problem solving.

Sixth-grade models met for one-half hour each week for briefing on techniques of reinforcing the skills which the primary students were practicing.

PROCEDURES

The primary student population was stratified according to sex and randomly assigned to one of three groups. Twenty-two pupils, eleven boys and eleven girls, made up the experimental group. The remaining 35 pupils were assigned to one of the control classes.

Sixth-graders were stratified by sex and homerooms before being randomly assigned to experimental or control conditions. Again, twenty-two pupils, eleven girls and eleven boys, were selected for the experimental treatment. For scheduling lessons, the models reported in two groups, at times which were convenient to the particular homeroom teacher.

The three teachers were rotated at three-week intervals, so that each teacher worked with two control groups and the experimental group twice during the second semester.

DATA COLLECTED

Before the experiment began, the primary children were administered a teacher-constructed test which had a sample of items from nine concepts presented during the first semester. At the conclusion of the experiment, another teacher-made test, with items measuring understanding of concepts presented during the second semester was administered. A teacher-made questionnaire was used to measure the pupils' attitudes toward school and toward arithmetic.

The sixth-grade models and the control group were given the Self-Social Symbols Tasks.[1] Subscores of particular interest to the hypotheses of this study included the following: Individuation, power, esteem, centrality, grouping, identification, dependency, complexity.

ANALYSIS OF DATA

Three analyses were performed. The first examined the effect of the treatments upon the arithmetic understanding of the primary children. Secondly, attitudinal differences between groups of primary children were considered. Finally, performance of the two sixth-grade groups—models and non-models—on the Self-Social Symbols Task were analyzed.

An analysis of covariance was performed on the younger children's arithmetic test scores. The teacher-constructed posttest was used as the dependent variable with the pretest as the covariate. Data for both tests were available for 45 subjects. Because the comparison of principal interest was that between the experimental and two control groups, the sum of squares for treatment was partitioned to isolate this particular contrast.

Table 1 indicates that when scores are adjusted for pre-experimental achievement, the group who worked with the models each week performed significantly better than did the control groups. This effect was significant beyond the six percent level of significance. The significant sex effect reflects the superior performance of girls.

Figure 1, a graph of subgroup means on the posttest, portrays both the difference between boys' and girls' performance and the superior achievement of the experimental group.

A multivariate analysis of variance was performed on the subscores of sixth-graders. The difference in self-concept as measured by the Self-Social Symbols Task was not significant. However, the blocking variable of classroom was significant beyond the .001 level, using Wilks' lambda criterion. Not surprisingly, univariate analysis of variance on the subtest "Identification with Teacher" indicated that the classroom blocking was also significant at the .001 level. The classroom factor was not of primary interest, however.

Analysis of the younger pupils' attitude toward school, where total score indicated number of items for which a positive response was indicated, revealed no significant difference between the two groups. Nor did more experimental subjects indicate arithmetic was their favorite subject than did control children.

DISCUSSION

Since the results of primary children's arithmetic tests favored the experimental group, the use of sixth-grade models appears to have been effective. Teachers noted, however, that some pairs were not compatible and worked best when the teacher was near. The models

Table 1

Analysis of Covariance on Primary Students' Arithmetic Scores

Source	SS	df	MS	F	
Treatments	95.609	2			
Experimental-Control	95.241	1	95.241	3.754	$p < 0.060$
Residual	0.368	1	0.368	0.015	
Sex	224.578	1	224.578	8.852	$p < 0.005$
Treatments x Sex	73.798	2	36.899	1.454	
Error	964.033	38	25.369	-	

[1] This test was developed by Robert Ziller, Barbara Long and Edmund Henderson. Ziller (1967) and Long (1967) have reported respectively on its rationale and reliability.

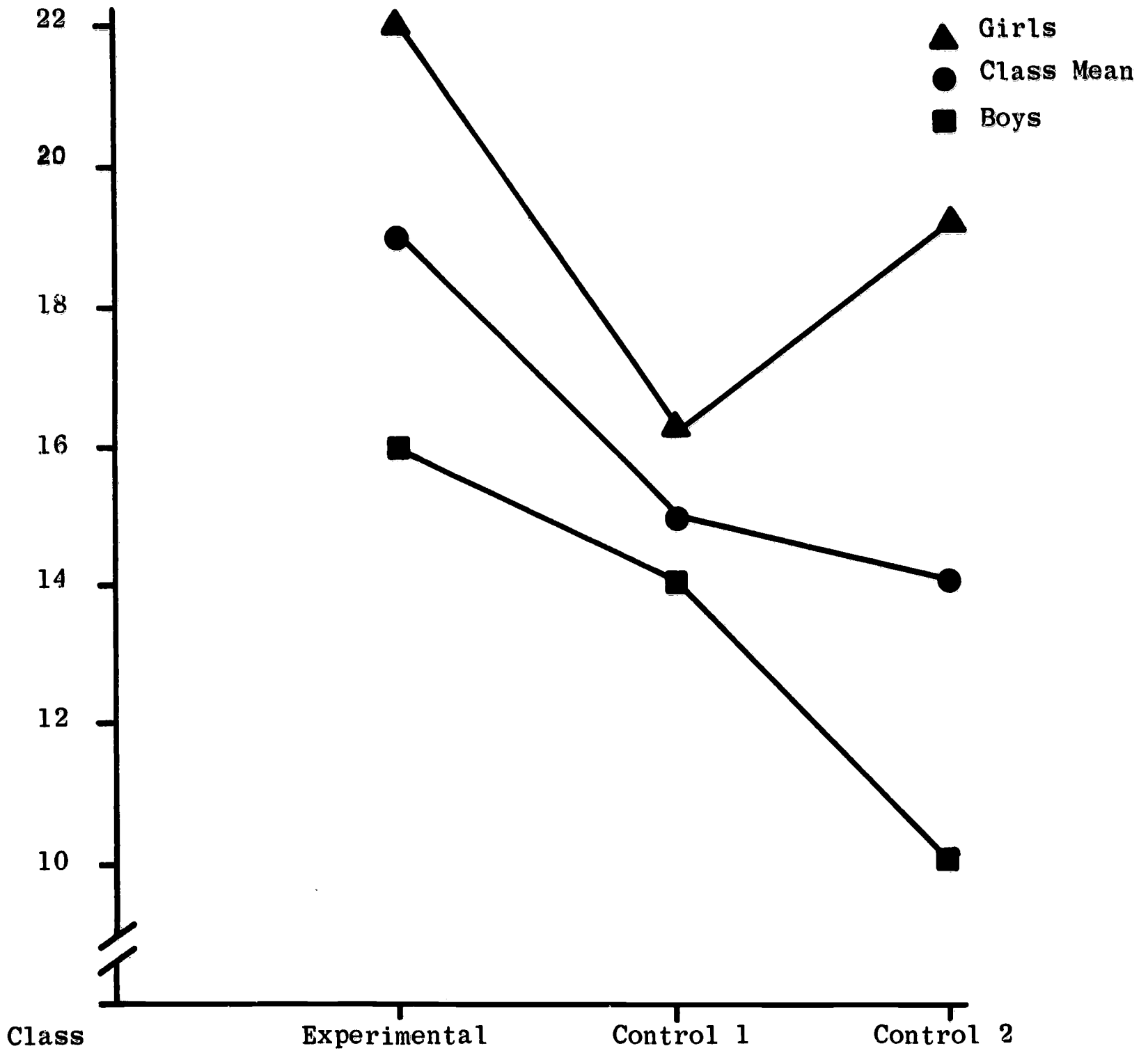

Figure 1

Posttest Means for Subgroups on First Grade Teacher-Constructed Test

had been randomly assigned to younger children. Since one would not wish the experience to be a negative one for either model or primary student, it might have been advisable to switch models between two pairs of children when these difficulties arose. It is altogether possible, too, that some of the sixth graders should not have been models.

The results do not suggest that being a model positively affected the student's self-concept or attitude toward school. Perhaps the instrument was not sufficiently sensitive to any real differences between models and non-models; however, sixth-grade teachers did comment on the improved behavior and school work of several individuals while they were serving as models.

Since the principal result of the experiment involved primary children, future research might be aimed solely at this group. Models could be selected on the basis of merit, rather than randomly. Those who performed unsatisfactorily could be replaced by alternates. In this way, the experience of having an older child as a model could be better controlled. The effect of the treatment might then be greater, resulting in a greater difference between means of the experimental and control groups on both arithmetic tests and attitudinal inventories.

III

INDIVIDUALIZATION IN MATHEMATICS, FOURTH-GRADE UNIT, CASS STREET SCHOOL

BACKGROUND

The Unit leader of the Fourth-Grade Research and Instruction Unit at Cass Street School was Mrs. Caroline Loose. Other staff members included Mrs. Patrice Peterson, Miss Edith Kahn, and Miss Frances Romano. There were ninety-six students in the Unit, most of whom come from disadvantaged homes. Mr. James Klimt, Principal, and Miss Adeline Hartung, Elementary Supervisor, provided continuous enthusiasm and support to the efforts of this staff.

Each member of the Unit staff had a room. One of the rooms was large enough to accomodate all the students at one time. The typical daily pattern was for both students and teachers to be in more than one room and for teachers to meet with more than one group. Available instructional equipment and materials included a 16mm. projector, tape recorder, record player, overhead projector, textbooks and other materials. Non-available materials included a 35mm. projector, listening kits, and facilities for individual study.

The Unit leader met with the building principal and with the Unit teachers an average of more than 11 times a month. Regularly scheduled team meetings were held at least once a week. It was soon evident that these teachers were daily congregating to share and plan. They often ate lunch together and discussed plans. Meetings of Unit personnel with central staff, R & D staff, and parents occurred 1–4 times a month. Initiative for formation of the Unit came from the central staff. Teachers were given an option regarding their participation in the unit during the 1967-68 school year and several chose to continue but funds were not available.

Members of the student population were assigned to one of seven reading groups according to each child's reading ability. The Unit leader provided much additional help to the poor achievers. The Unit leader also worked with individual students on their independent reading. Children were given every opportunity to report on books read via conferences, dramatizations, drawings, cartoons, taped reports, and oral discussions. The teachers also shared teaching in the special subjects, physical education and music.

Of special interest to the students were the well-planned trips and follow up activities. The Unit leader was responsible for organizing these trips as well as the sharing of the experiences following excursions. Many times the "sharing" was an integral part of the language arts program. Students were encouraged to express their ideas and ask questions as well.

The teachers had an opportunity to choose favorite units in social studies and science and assume leadership in developing the instructional activities for the Unit. Plans were then reviewed with other teachers and the actual teaching was shared by all. Reactions from the teachers were very favorable. They felt they had more time to really search for good materials and develop good activities.

Of special mention are the feelings of appreciation expressed by a beginning teacher assigned to this Unit. "At first I was somewhat apprehensive about teaming. Things were confusing and it looked easier to stay within my own four walls and be responsible for the children assigned to me. But soon it was apparent that the team approach was exciting for both children and teachers and I was gaining a wealth of knowledge and experiences by working with the other experienced teachers. The Unit leader had excellent ideas and was a very good organizer. I feel I was most fortunate to have had such an opportunity my first year."

The teachers identified arithmetic as the area in which their research efforts were to be focused because of the fact that many students

were at least one or two years below grade level on relevant portions of the Iowa Tests of Basic Skills administered in October, 1966. Following these tests, the remainder of the first semester was devoted to planning for the controlled experiment to be undertaken during the second semester.

Because of the mobility of the population in the neighborhood served by Cass Street School, the development of basic skills in arithmetic is uneven. Numerous students had apparently missed systematic instruction in several topics because of frequent changes in schools. Therefore, the staff of this R & I Unit believed an individualized mathematics program, in which the weaknesses of each student were diagnosed periodically and relevant instruction was given, might prove superior to the usual curriculum followed in a Milwaukee fourth grade.

SUBJECTS

The subjects were 96 fourth- and fifth-grade students ranging in age from 9 to 12 years. Many subjects were of Spanish-American descent. The degree of mobility of the neighborhood is illustrated by the fact that only 38 of the 65 fourth-graders in the Unit were enrolled when both fall and spring field testing occurred.

TREATMENTS

The program for the experimental groups was planned to overcome the weaknesses of individual students. Eight units of one to three weeks duration were planned. Students were assigned to one of three rooms for each unit, according to their mastery level of that particular topic. Characteristics of each instructional level are presented in Table 2. Reassignment of students was continuous. The slowest group was limited to a maximum of fifteen students.

Midway through each of the longer units, each student's progress was evaluated. Those who needed reteaching of the concepts presented in their group were retained in that group for the remainder of the unit while those who had progressed satisfactorily were placed in an enrichment room. Here students took "side-trips" in arithmetic, playing arithmetic games, taking field trips, and engaging in other mathematics activities. The population of the enrichment center varied from unit to unit and even the "faster" students in the slow group were included.

Materials used in the experimental groups were prepared by the teachers. Work sheets were adapted from a variety of textbooks to meet the needs of the three groups.

There was no change from the first semester in the type of arithmetic instruction given the control group. Students continued using the Grade 4 or 5 textbooks of the Scott Foresman Seeing Through Arithmetic Series. All control students saw the Milwaukee Public Schools Arithmetic TV program for Grade 4A. Material complementing the TV presentations was chosen from both texts. Individual help was provided when needed as time allowed. Such an instructional program is considered similar to that found in a Milwaukee fourth grade.

Table 2

Instructional Levels for Experimental Group

Instructional Level A:	High achieving group Approximately 28 students Teacher-developed materials with emphasis on problem solving Enrichment activities to extend application of basic concepts
Instructional Level B:	Middle achieving group Approximately 26 students Teacher-developed materials Extensive use of blackboard for student practice Games and activities to provide understanding
Instructional Level C:	Low achieving group Approximately 16 students Many manipulative devices Games and concrete experiences Teacher-developed practice materials

PROCEDURES AND DESIGN

The student population was stratified according to sex and reading ability achievement scores (above or below average) so that there were four groups of students. From each of the four blocks students were randomly assigned to experimental or control group. Since the control group was planned to be typical of a Milwaukee intermediate level classroom, thirty students were assigned to the control group, and the remainder to the experimental group.

In December, 1966, all students were administered the Cooperative Primary Tests in Mathematics (Form 23B) published by the Educational Testing Service. This instrument was selected for use because of its non-verbal nature and its emphasis on arithmetic concepts. The achievement level of most students in the Unit made a primary test appropriate.

The responses of the students in the experimental group to each of the major concepts tested were analyzed. Computer output included lists of students missing questions on each concept. The lists were used in conjunction with teacher constructed tests administered at the beginning of each unit to aid in placing experimental subjects in an appropriate instructional group.

The four teachers were rotated between experimental and control groups and between instructional groups within the experimental group. Each teacher taught the control group for four of the sixteen weeks during which the experiment was conducted. Each teacher also assumed leadership for locating materials, organizing lessons and preparing worksheets for a three-week and a one-week unit.

The experiment began on February 6, 1967, and was concluded sixteen weeks later on June 2, 1967. Following the experiment two tests were administered—the Cooperative Primary Test in Mathematics, which had been used as a pretest, and selected subtests of the Stanford Diagnostic Arithmetic Test, Level I, Form W.

ANALYSIS OF DATA

Because of enrollment changes complete pre- and post-experiment scores were available for only 74 students. Of these, 24 were members of the control group and 50 were members of the experimental group. The proportion of students in the two groups reflects the fact that approximately two-thirds of the students enrolled when the study was initiated were assigned to the experimental group.

A multivariate analysis of covariance was performed on eight post-test scores obtained for each student. These scores included a total score on the Cooperative Primary Test in Mathematics and seven subtest scores on the Stanford Diagnostic Arithmetic Test as follows:

Number System
Operation
Decimal System
Addition
Subtraction
Multiplication
Division

The pretest score on the Cooperative Primary Test in Mathematics was used as a covariate.

The difference between the experimental and control group was not significant. However, Table 3 indicates the gains of both above and

Table 3

Cooperative Primary Test in Mathematics

	Pretest		Posttest		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference
Experimental					
Above average readers	40.42	8.7	46.96	7.4	6.54
Below average readers	32.96	7.0	41.54	5.8	8.58
Control					
Above average readers	40.50	9.4	45.80	7.9	5.30
Below average readers	35.21	8.1	42.29	8.9	7.08

below average readers in the experimental group were greater than those of the comparable subgroups assigned to the control treatment. It is interesting to note that the greatest gain is for slower students in the experimental group. Presumably these pupils would have participated for several units in the instructional group limited to fifteen students. Unfortunately grade equivalents are not yet available for this test.

A comparison of means in all other subtests used in the multivariate analysis indicates the relative superiority of the experimental group.

The improvement of the students' mathematical skills in both experimental and control groups is evident, however, from a comparison of means on the arithmetic concepts subtest of the Iowa Tests of Basic Skills. This test was administered to students in both treatment groups and to comparable groups of fourth graders in control schools as part of the field-testing of the R & I Unit. The tests were administered fall and spring, the latter test occurring midway through the experiment. The performance of those students enrolled for both testing sessions only is reflected in the statistics given in Table 4. The five-month gain of the Cass Street students in a six-month period is at least as good as this group's average rate of progress since it entered school.

Table 4

Mean Grade Equivalents for Iowa Tests of Basic Skills

	Arithmetic Concepts			
Group	Number	Fall	Spring	Gain
Cass Street	35	3.3	3.8	.5
3 Milwaukee Inner City Schools	81	3.7	4.1	.4

An interesting outcome of the statistical analysis is the significant sex difference. The differences between the adjusted means for the boys and girls on the eight dependent variables are presented in Table 5. A positive difference reflects superior performance on the part of the boys; a negative difference, relative superiority of the girls. The relative contribution of each of the subtest scores in discriminating between boys and girls is further reflected by the standardized coefficients for the discriminant function. The discriminant function, V, is an algebraic statement of the linear function of the eight dependent variables which maximally discriminate scores of boys from those of girls in a least squares sense.

$$V_{sex} = .131\,X_C + .635\,X_N - .629\,X_O + 1.063\,X_D - .891\,X_A - .352\,X_S + .061\,X_M + .037\,X_D.$$

Of those subtests with large coefficients, number system and decimal place value were tests in which the boys' performance was higher, while operations, addition and subtraction were tests in which the girls' achievement was higher. These sex-linked differences are consistent with knowledge accumulating regarding the cognitive styles of boys and girls.

Table 5

Table of Differences Between Means of Adjusted Scores of Boys and Girls

Test	Difference
Cooperative Primary Test (C)	.816
Number System (N)	1.274
Operation (O)	-1.076
Decimal Place Value (D)	2.667
Addition (A)	-1.478
Subtraction (S)	- .846
Multiplication (M)	.178
Division (d)	.472

DISCUSSION

While statistical analysis revealed no significant differences between experimental and control groups, teachers and students alike were satisfied with the program that had been developed. Students in the experimental group liked the weekly changes in teachers and classrooms and were unaware of the ability aspect of the grouping. Teachers who had never developed an arithmetic unit before found the opportunity stimulating and felt they, too, had improved their instructionsl skills.

Despite the lack of significance, the gains made by children in both the control groups are impressive when we consider their mean ability level. While students in the control schools with a higher mean IQ (see section on field testing) made four months progress as measured by the ITBS Arithmetic Concepts subtest, the Cass Street pupils made five months growth. Continued progress at this rate would interrupt the trend for students in schools with the characteristics of Cass Street to continually fall off from city averages as they go through school. The results thus point to success or

narrowing the gap between performance in a particular skill of children in an inner-city school and those in other areas of the city when the instructional team focuses the efforts on teaching that skill.

Several explanations of the lack of significance for treatments suggest themselves:

1. Teacher knowledge of the experimental program and teacher skills resulting from involvement in the experiment affected the treatment that the control group received, mitigating the difference between the two groups. Rotation of teachers between experimental and control groups is likely to have this effect—one that is not altogether unfortunate given an improvement in instruction.

2. The instruments used were insensitive to treatment differences.

3. There is no difference between an individualized program of the sort undertaken and the typical program when taught by teachers who have had the additional experience provided by participation in this program. Alternatively, there is an adequate degree of individualization in the typical classroom arithmetic program.

Finally, the usual program may be highly effective with students of the characteristics found at Cass Street School. Perhaps the visual aspects of a televised presentation and the provision for maintenance of skills in both the text and television program offset the gains attributable to a program of individual diagnosis and ad hoc grouping for instruction.

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IV

FIELD TESTING R & I UNITS

As reported in Working Paper No. 4 (Wardrop et al., 1966), the field testing program in Milwaukee was to be carried out using a regression approach. The procedure can be summarized as follows:

The baseline measures gathered in the fall of 1966 were combined, using multiple regression techniques, to generate predicted scores for each student for each of the criterion measures (from spring, 1967, testing). The next step was to compute a residual score for each student, $Y_{residual} = Y_{observed} - Y_{predicted}$. For each R & I Unit and control group, the mean residual score was then calculated, and a t test used to assess the significance of the difference between means of these residual scores.

If the R & I Unit facilitates classroom learning, and hence academic achievement, the mean residual for this group should exceed that of the control group. If, on the other hand, the R & I Unit inhibits classroom learning, the mean residual for the control group should be greater.

PRIMARY UNITS

Because predictor data were available for fewer than 5% of students at this level, it was decided not to complete this portion of the field-testing program.

FOURTH-GRADE UNIT

An R & I Unit was operated at Cass Street School in Milwaukee for the entire school year. For this Unit, three control schools were selected. These controls were chosen to be as comparable as possible to the R & I group on several variables: population characteristics (race and socioeconomic status), and student characteristics (previous achievement and aptitude).

For all 4B students in these four schools, data were gathered in the fall of 1966 on the following variables: IQ (Lorge-Thorndike) and the 12 subtests of the Iowa Tests of Basic Skills. Criterion data, collected in the spring of 1967, were the Reading Vocabulary, Reading Comprehension, Arithmetic Concepts, and Arithmetic Reasoning subtests of the Iowa.

Adequacy of Control Schools

To evaluate the adequacy of the three schools chosen as controls for Cass Street School, consider the means reported in Table 6.

Inspection of the means reveals that the control schools substantially differed from Cass Street School in average ability and initial achievement level. A nine-point difference in mean IQ's suggests that the average learning rate at the control schools is greater than at Cass Street School, a fact confirmed by achievement test scores. Whereas the achievement of Cass Street students is near the twentieth percentile of fourth-grade students nationally, the average achievement of the three control schools exceeds the thirtieth percentile. One would expect the learning rate, then, of the Cass Street students to be lower, on the average, than that of students at the other schools. In other words, during a given period of time, one would predict fewer months' growth in a subject area for Cass Street students than for the other students.

With these differences between Cass Street School and the control schools in mind, let us turn to the results of field testing.

Results

Reading Vocabulary. The multiple correlation with this criterion was .83, and the raw score regression equation (including only predictors for which the t-value was significant at p = .05) was:

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Table 6

Means and Percentiles of Fall Testing

	Cass Street School		Control Schools	
	Mean Grade Equivalent	Percentile	Mean Grade Equivalent	Percentile
IQ (Lorge-(Thorndike)	87		96	
Vocabulary	2.9	20	3.3	29
Reading	2.9	20	3.4	31
Spelling	2.9	19	3.4	31
Capitalization	2.7	14	3.4	32
Punctuation	2.9	19	3.6	37
Usage	2.7	20	3.5	37
Study Skills				
I	3.1	20	3.5	33
II	3.2	24	3.5	30
III	3.1	19	3.4	30
Arithmetic Concepts	3.3	21	3.7	37
Problem Solving	3.5	31	3.7	38

$\text{Vocabulary}_2 = .39\ (\text{Vocabulary}) - .15\ (\text{Punctuation}) + .16\ (\text{Usage}) - \text{Constant}.$

The standard deviation of the Vocabulary_2 scores was 7.52 and the standard error of regression was 4.40. When the residuals were calculated (observed - computed scores), the results indicated in Table 7 were obtained.

Table 7

FIELD TESTING, MILWAUKEE, RESIDUALS FROM PREDICTION OF IOWA TEST VOCABULARY SCORES

Group	N	Σ of deviations	Avg. deviation
R & I Unit (Cass Street)	38	29.238	.769
Controls	81	-29.238	-.361

A t test was used to determine whether the differences in residuals was significant. Results of the test indicates that the difference, although in the expected direction, was not significant.

Reading Comprehension. The multiple correlation using this criterion was .77, and the raw score regression equation was

$\text{Comprehension}_2 = .28\ (\text{Comprehension}) + .15\ (\text{Vocabulary}_1) + .14\ (\text{Capitalization}) - \text{Constant}.$

The standard deviation of the Comprehension_2 scores was 9.78, and the standard error of regression was 6.59.

Table 8 presents the comparisons of the residuals for this variable.

Table 8

RESIDUALS FROM PREDICTION OF ITBS COMPREHENSION SCORE

Group	N	Σ of Deviations	Avg. Deviation
R & I Unit (Cass Street)	38	-83.332	-2.19
Controls	81	83.332	1.04

A t test revealed that the R & I— Control difference was significant with the Cass Street R & I Unit being poorer on this measure than

the combined controls. The difference in mean deviations for these groups was 3.23 points.

Arithmetic Concepts. For this measure, the multiple correlation was .73, and the raw score regression equation was

$$\text{Concepts}_2 = .21\ (\text{IQ}) + .13\ (\text{Arithmetic Concepts}_1) + .15\ (\text{Arithmetic Reasoning}_1) - \text{Constant}.$$

The standard deviation of the Arithmetic Concepts$_2$ scores was 6.33 and the standard error of regression was 4.02. Table 9 presents the comparisons of residuals for this variable.

Table 9

RESIDUALS FROM PREDICTION OF ITBS ARITHMETIC CONCEPTS SCORES

Group	N	Σ of Deviations	Avg. Deviation
R & I (Cass Street)	35	11.9089	.346
Controls	81	-11.9089	-.147

For this measure, the t-value was less than 1.00, indicating no significant differences between R & I Unit and its control.

Arithmetic Reasoning. In this case, the multiple correlation was only .41. The raw score regression equation (including only predictors which yielded significant regression coefficients) was:

$$\text{Arith. Reasoning}_2 = .06\ (\text{Work Study 3}) - .11\ (\text{Arith. Reasoning}) - \text{Constant}.$$

The standard deviation of the Arithmetic Reasoning$_2$ scores was 2.28 and the standard error of regression was 2.20. Because this relationship was so slight, no further analyses were undertaken for this measure.

Discussion

For one of the three comparisons made in the Milwaukee field testing, a significant difference between an R & I Unit and its control schools was found. This difference favored the combined control schools' students over those at Cass Street School on the Reading Comprehension subtest of the ITBS. The difference between mean residual scores was 3.23 points, reflecting the fact that students in the control group, on the average, exceeded their predicted scores on the measure by 1.04 points, while students in the R & I Unit averaged 2.19 points less than predicted. Although statistically significant, this difference probably has little practical importance, especially since the Cass Street children had the substantially lower mean IQ scores at the outset.

As Figure 2 indicates, the control schools' reading growth rate was unusually high. Control schools, with a mean IQ below average, gained an average of seven months in six months of school. Cass Street students, as predicted, gained at a slower rate. The fact

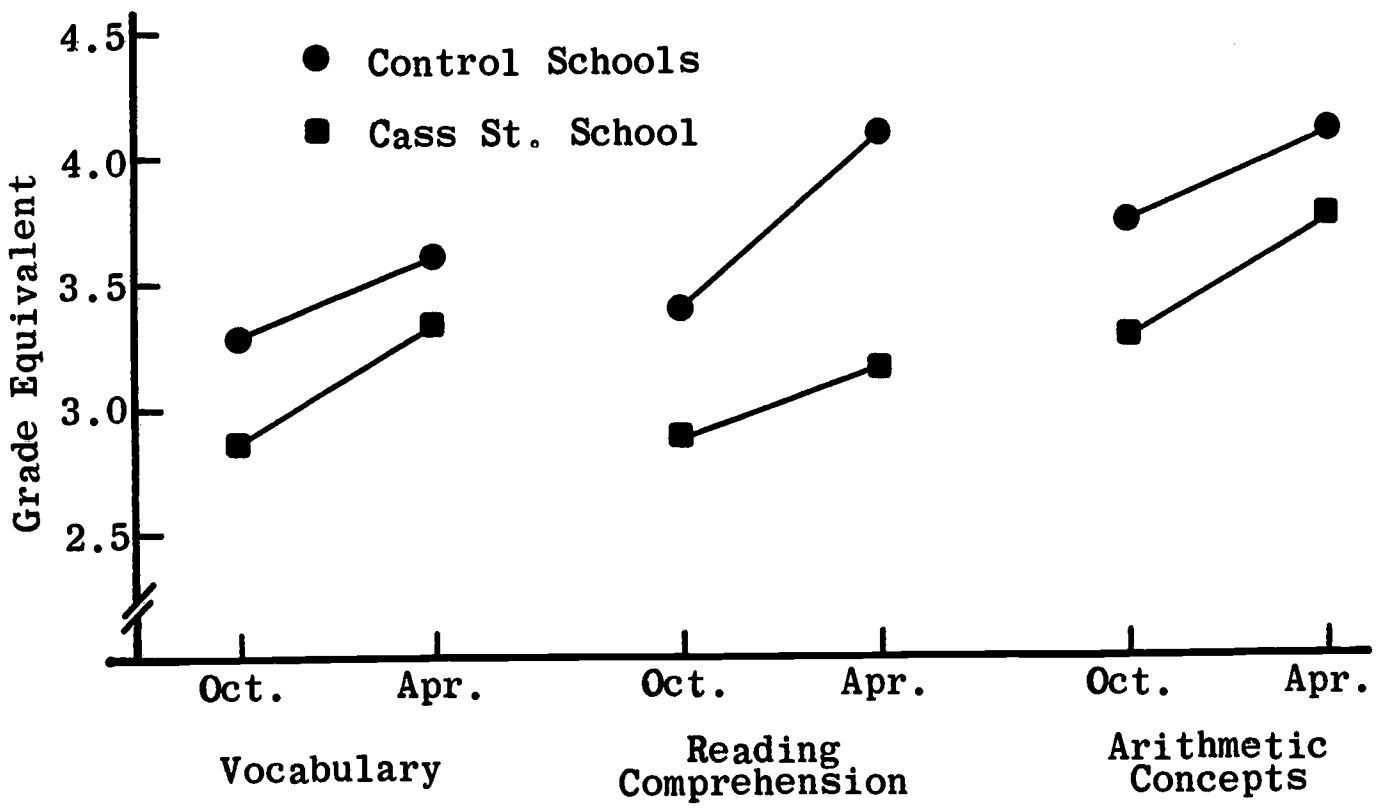

Figure 2. Mean Performance, ITBS, Spring and Fall

that many Cass Street students are bilingual, coming from Spanish-American homes, may also explain the relatively poorer performance of this group in a verbal skill.

On the other hand, Cass Street students outgained the control schools' pupils in vocabulary and arithmetic concepts measured by ITBS. In brief, membership in an R & I Unit seems to have been effective with these children of quite low intellectual ability. In addition, the teaching staff functioned well as an instructional group and gained considerable skill in research and development activities. Observers indicated also that the pupils generally appeared quite enthusiastic about school, particularly the mathematics program.

TEACHER OPINION QUESTIONNAIRE

This instrument was responded to by eight teachers in R & I Units and 12 in the control schools. Several differences were found between these two groups. In the first place, teachers in R & I Units spent an average of 27 percent of their time "designing a model instructional program," as contrasted with an average of 18.5 percent by the control teachers. Similarly, R & I Unit teachers spent an average of 17 percent of their time "discussing the results and/or implications" of research, as contrasted with 4.7 percent by control teachers. On the other hand, control teachers reported spending an average of 40.5 percent of their time "engaging in innovative activities," while R & I Unit members reported spending only 18 percent of their time in such activities.

Teachers in R & I Units were generally less satisfied with the behavior, achievement, and motivation of their students than control group teachers, although when asked to compare their students with others, both groups responded similarly, any slight differences actually favoring R & I Units.

Teachers in R & I Units, as compared to control teachers, felt they had made greater use of their system's consultant and service staff, and also placed greater value on consultant help from outside the school system. (Five of the twelve control teachers reported receiving no help from outside the school system, while none of the R & I Unit members responded in this way.)

One other important difference was that teachers in R & I Units felt they were getting along better than usual with their fellow workers, while all of the control group teachers indicated they were getting along "about as well as in the past" with their fellow workers.

V

CONCLUDING STATEMENT

The use of older children as models and helpers for primary children was associated with higher educational achievement by the primary children. This is remarkable inasmuch as the selection and assignment of models was done randomly, thereby making the experimental treatment most difficult to execute. As noted in the prior discussion of this experiment, had the older models been carefully selected and then assigned to primary children on the basis of compatibility, the results would probably have been even more dramatic. In experiments in R & I Units of other school systems, other motivational procedures also were associated with significantly improved performance.

The individualization in mathematics in the fourth grade was not associated with higher achievement for the experimental groups; however, both the experimental and control groups gained approximately five months on a standardized arithmetic test, whereas pupils in three control schools gained four months during the six month interval. The R & I Unit staff thus did an excellent job of getting themselves organized as a functioning unit, planning a total school program for the children, and individualizing the mathematics program.

The total results of the research and development activities of the Units indicate clearly that this type of organization in its first year performed its instructional, research, and development activities exceedingly well, despite adverse conditions associated with facilities, shortage of instructional staff, lack of prior experience in team teaching, and a transient child population characterized by low intellectual ability and educational achievement. It was also found that the children in the three control schools were quite different in mean IQ and educational achievements as measured by standardized tests. In future field testing, a closer match must be obtained on these criteria and also a description of the instructional programs and test administration procedures in the control schools is essential.

Although the Units performed well, circumstances primarily associated with the use of Title I funds did not permit organizing a complete elementary school into R & I Units in 1967-1968. The results of the research and development activities in Milwaukee and other school systems indicate to the relevant R & D staff that for most effective improvement of pupil learning, the school building should be considered as the functional instruction and decision-making unit, rather than the many separate self-contained classrooms or one or two R & I Units.

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