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AUTHOR Rossmiller, Richard A.
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ABSTRACT

Reading and mathematics achievement and student self-concept were studied in 28 IGE elementary schools (schools using the system of Individually Guided Education). The data comprised 134 variables--input variables (student characteristics, teacher background, and expenditures for instruction); process variables (teaching time and school characteristics); and output variables (student achievement and self-concept). Several variables were consistently related to student achievement in reading or mathematics: (1) enrollment of teachers in a degree program (reading and mathematics achievement); (2) years of teaching experience (reading); (3) sex of the teacher (mathematics); (4) social maturity of students (reading); (5) social confidence of students (mathematics); (6) teachers' perception of the principal's leadership (reading and mathematics); (7) job satisfaction expressed by teachers (reading); and (8) teacher involvement in decision making (mathematics). A set of 12 independent variables accounted for 78 percent of the variance in reading achievement, and a similar set of 12 variables accounted for 71 percent of the variance in mathematics achievement. All of these variables were susceptible to control by teachers and administrators. Further research is needed before claims are made regarding implications for instructional practice. (Author/GDC)

Technical Report No. 451

INPUT-OUTPUT RELATIONSHIPS IN IGE SCHOOLS

by Richard A. Rossmiller

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Wisconsin Research and Development Center for Individualized Schooling

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Richard A. Rossmiller
Faculty Associate

Wisconsin Research and Development
Center for Individualized Schooling
The University of Wisconsin
Madison, Wisconsin

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TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF TABLES (cont.)

LIST OF TABLES (cont.)

LIST OF FIGURES

ABSTRACT

This study examined input-output relationships in reading and mathematics in IGE schools. Education production functions were used to investigate the input and process variables that were most closely related to student self-concept and to student achievement in reading and mathematics. Data for the study comprised 134 variables describing: resource inputs (student self-concept, teacher characteristics, and expenditures for instruction); resource input mixes (allocation of time by teachers and organizational variables); and outcomes of schooling (student achievement in reading and mathematics and student self-concept). The data were obtained during the 1975-76 school year from Instruction and Research (I & R) units in a random sample of 41 IGE elementary schools, 28 of which provided data sufficiently complete to be included in the present study. Stepwise linear regression analysis using a backward selection procedure was employed to examine the relationships among each subset of variables and the measures of school output.

Several variables were found to be related consistently to student achievement in reading or mathematics. Among them were (1) whether teachers were currently involved in a program of study leading to a degree (reading and mathematics), (2) years of teaching experience (reading), (3) sex of the teacher (mathematics), (4) social maturity of students (reading), (5) social confidence of students (mathematics), (6) teachers' perception of the principal's leadership (reading and mathematics), (7) job satisfaction expressed by teachers (reading), and (8) teacher involvement in decision making (mathematics) were among the variables found most useful in explaining variance in student achievement in reading and mathematics.

A set of 12 independent variables was identified that accounted for 78 percent of the variance in reading achievement. A similar set of 12 variables was found that accounted for 71 percent of the variance in mathematics achievement. All of the variables included in these two sets were variables susceptible to control by teachers and administrators.

I

INTRODUCTION

The nature of the human and material resources employed in the process we call schooling, and the manner in which they are combined, have long been thought to affect the outcomes of schooling. The cost-quality studies conducted between 1930-60 by Paul Mort and his associates are evidence that the educational production process has long been of interest to scholars of the economics of education (Mort, Reusser, & Polley, 1960). More recently, several input-output studies of schooling have been undertaken, with Coleman's Equality of Educational Opportunity (EEO) study attracting the greatest attention (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966). One of the methodological contributions of recent investigators has been the application of production function analysis to the study of the educational production process.

PRODUCTION FUNCTIONS IN EDUCATION

Production function analysis stems from the discipline of economics and has been applied extensively in the field of business. It is based on the assumption that productivity can be maximized by measuring and comparing mathematically the results obtained from various combinations of resource inputs. These results then serve as a basis for resource allocation decisions. An equation that describes the transformation of a set of resource inputs into the desired outputs is known as a production function (Cohn, 1972, pp. 237-40). Theoretically, at least, application of production function analysis should enable one to identify the particular combination of inputs that will maximize the desired output (or outputs) of the educational process. The following equation represents a generalized educational production function:

$$A_{it} = g\,(F_{i(t)}, S_{i(t)}, P_{i(t)}, I_{i(t)})$$

where A_{it} = the educational outcomes for the ith student at time t,

$F_{i(t)}$ = the student's family background characteristics cumulative to time t,

$S_{i(t)}$ = school inputs relevant to the ith student cumulative to time t,

$P_{i(t)}$ = peer or fellow student characteristics cumulative to time t, and

$I_{i(t)}$ = the initial or innate endowments of the ith student at time t (Levin, 1974).

The equation postualtes that the educational outcomes exhibited by a student (i) at a point in time (t) are a function (g) of the student's family background, formal schooling, associations with peers, and innate endowments. Note that school are only one of the four factors; the other three factors--family background, peers, and the student's innate ability--are not within the control of the school.

A number of studies in which production function analysis was used have been reported during the past 10 years. A portion of the Coleman report (the section dealing with pupil achievement and motivation) employed an input-output framework to measure the effect of various inputs on pupil achievement (Coleman et al., 1966, pp. 217-333). Coleman found that school inputs contributed relatively little to the variance in achievement when environmental and socioeconomic variables were taken into account.

Many researchers were unwilling to accept the proposition that school resources had little or no effect on academic achievement. Critics of Coleman's work suggested that the relationship between school resources and academic achievement had been substantially understated because of defects in the measurement of school resources, inadequate control for social background, and the use of inappropriate statistical techniques.

A number of researchers have reanalyzed the EEO data and, although hampered by limitations of the original data, have been able to clarify some of the problems involved in applying the production function concept to the learning process. In one of the first reanalyses, Hanushek (1968) developed a conceptual model to estimate educational production functions for black and white sixth graders in northern metropolitan schools. Hanushek's results indicated that certain teacher characteristics, such as verbal ability and years of experience, were significantly related to student achievement.

Bowles (1970) presented a comprehensive treatment of educational production functions in his reanalysis of a subset of the EEO data concerning twelfth grade black male students. Bowles' work reaffirmed the importance of teacher characteristics and suggested that certain other school inputs, for example, the average amount of time a teacher spent in guidance activities and the number of days school was in session during the school year, were also important. Bowles argued that student characteristics such as attitude and motivation can be viewed as either inputs to or outputs of the learning process and he developed a model using a set of simultaneous equations to determine the relative effects of such variables.

Levin (1970) also used the EEO data base. He examined the data from a sample of 600 white sixth grade students drawn from 36 schools in a large northeastern city. Levin obtained statistically significant relationships between student achievement, teacher experience, and the quality of undergraduate institutions attended by teachers. Levin pointed out that some factors affecting student achievement are simultaneously affected by achievement. To investigate this interactive process, Levin developed a conceptual model to illustrate the interdependence of student achievement, student motivation, student efficacy, and parental attitudes and presented a methodology for solving the complex system of simultaneous equations that differed from the technique employed by Bowles.

Kiesling conducted several studies in which production function analysis techniques were employed. In 1967, he reported the results of an analysis of data collected in conjunction with the New York State Quality Measurement Project.

Kiesling found that per [illegible] expenditures were associated positively with student performance a[illegible] the relationship was strongest in urban school districts and weakest [illegible] school districts. He observed that an additional expenditure of $[illegible] student was associated with 2.6 months of achievement gain at the low end of the expenditure range and with 1.4 months at the high end of the range. Kiesling also found that school district size and student performance were not related.

In another study, Kiesling (1969) investigated the relationship of school inputs to school performance in 97 New York State school districts. The school inputs were 17 independent variables such as teacher/pupil ratio, median teacher salary, average daily attendance, and school property valuation per pupil. The dependent measure was sixth grade achievement test scores. The sample was divided into five subgroups based on the occupation of the head of the family, and the school districts were categorized as urban or nonurban. It was found that the occupation index was significantly related to student achievement for all subgroups in both the urban and nonurban categories. In the urban districts, most of the associations between achievement and per pupil expenditures were negative, while in the nonurban districts, per pupil expenditures had no effect.

In a third study, Kiesling (1970) investigated the relationship of several school and community characteristics to student achievement in a sample of fifth and eighth grade pupils in 86 New York school districts. Data were obtained from the Basic Educational Data System which was established in New York in 1967 to collect detailed information on the state's school system. The variables he used in the analyses were similar to those employed in his previous studies. Kiesling reported that the amount of school resources devoted to central administration and supervision was most consistently related to pupil achievement. In addition, the level of teacher certification, especially at the fifth grade level, and the number of students per classroom were also related positively to student achievement.

Several input-output studies in individual states or school districts were published in 1968. Katzman (1968) used cross-sectional data from 56 elementary schools in Boston to examine the importance of home background factors and school variables in explaining change in student achievement between second and sixth grades. Using a stepwise multiple regression technique, statistically significant relationships were obtained between gains in reading scores and the percentage of students in noncrowded classrooms, and the number of students in the attendance area, and the percentage of teachers with one to ten years of teaching experience. In addition to providing further evidence that teachers do affect pupil performance, Katzman also pioneered the use of several noncognitive measures of school output such as school holding power with regard to students and student aspirations.

Cohn (1968) investigated input-output relationships in 377 public high school districts in Iowa using data from the Iowa State Department of Public Instruction. An attempt was made to control statistically for geographic and population differences with a set of eight school district variables serving as measures of input. The output measure was the gain in student achievement scores between tenth and twelfth grades. Employing multiple regression techniques, Cohn found that higher teacher salaries and fewer different teaching assignments were associated with larger growth increments in test scores. Cohn also estimated the optimal school size for Iowa to be about 1,500 students in average daily attendance.

Summers and Wolf (1975) conducted an in-depth analysis in the Philadelphia School System using longitudinal data to study the academic progress of approximately 2,000 students at various grade levels in 150 schools. Data were related to the achievement growth of individual pupils between the end of the third and sixth grades, the sixth and eighth grades, and the ninth and twelfth grades. Socioeconomic factors and specific school resources were tied to data on individual pupils. Based on multiple regression analyses of the data at each level of schooling examined, the authors concluded that school inputs, such as teachers and class size, and school climate variables, such as racial composition, achievement mixture, and disruptive incidences, did influence student achievement. All types of students at all grade levels scored higher in achievement the more days they attended school. All groups of elementary students also learned more in schools where 40 to 60 percent of the student body was black and in schools with a larger percentage of high achievers.

Elementary school students also did better in smaller classes and with teachers who were graduates of higher rated colleges. Junior high school students learned more in schools that were part of an elementary school and in schools where there were more high achievers. These students also did better with teachers who graduated from higher rated colleges and with mathematics teachers who were trained in the new math. Senior high school students displayed higher achievement in smaller schools and in schools with fewer dropouts.

In addition, Summers and Wolf found that specific groups of students can benefit if particular resources are targeted to them. Black students, for example, did better in the smaller elementary schools and in junior high schools with larger black populations. Low achieving elementary students did better with relatively less experienced teachers, in smaller classes, and in schools with more high achievers. Low achieving junior high school students did better with relatively less experienced English teachers and in schools with more high achievers. High achievers, however, did better with more experienced teachers.

Murnane (1975) conducted an input-output study to investigate the impact of school resources, particularly teachers, on the cognitive achievement of inner-city children in New Haven, Connecticut. The sample consisted of 875 black children in 15 elementary schools. Data were gathered over a two-year period (second and third grades) for one group and over a one-year period (third grade) for another group. The data base was divided to three subgroups and each subgroup was followed over the period of [illegible]ool year. After examining the effect of the classroom as a whole on achievement of children, Murnane concluded that there are important differences in the amount of learning that occurs in different classrooms within the same school and among different schools. The effects of such classroom related variables as teacher, peer group, and student turnover were carefully considered. After determining that teachers exerted a crucial impact on student achievement, Murnane explored the relationship between specific teacher characteristics and teacher effectiveness in math and reading instruction with certain groups of pupils. He found that background factors and previous experience had a greater influence upon student reading achievement than upon math achievement. Differences in the quality of classroom environments were found to exert a greater effect on student math achievement than on reading achievement. Murnane also found that black teachers with less than six years of experience were more effective in teaching reading to black children than were white teachers with similar teaching experience. At the same time, a high rate of

student turnover in a class was found to have an adverse affect on children's reading achievement, particularly on the progress of high achievers.

Although the production function approach holds promise of identifying ways of varying resource inputs to increase the efficiency of schools, one should not become overly optimistic regarding this approach. A number of problems impose limitations on the usefulness of production function analyses. Garms, Guthrie, and Pierce (1978, pp. 253-57) have identified four major problems associated with the production function approach: (1) the validity of applying the basic assumptions of the technical-industrial model to the educational process, (2) disagreement over the goals of schooling, (3) limitations of the available measurement technology, and (4) the inability to control for outside influences.

With regard to the first problem, it is alleged by some that, because schooling is at such a low level of technological development, application of an industrial model for assessing productivity is inappropriate. It is at least possible that every school is unique and has its own unique production function. Unlike many manufacturing operations, public schools can exercise little, if any, quality control over one of their most important inputs, namely, the pupils who attend the school.

Production function analysis rests on the assumption that a clearly defined set of outputs has been agreed upon. In education, however, there is a great deal of disagreement over the goals of schooling, particularly with regard to its specific outcomes and priorities. Although consensus may exist with regard to the broad goals of schooling, the broad goals are not amenable to measurement and, when specific measurable goals and objectives are sought, the consensus rapidly breaks down.

Assuming that agreement on goals and priorities could be obtained, one is confronted then with the problem of measuring the extent to which goals have been attained. Great reliance has been placed on standardized norm-referenced tests to measure outcomes; yet such tests indicate only whether an individual pupil scored higher or lower than other students. Production function analyses can be no stronger than the instruments used to measure the variables of interest.

As was noted with regard to the production function presented earlier, only one of the four factors in that equation involved school inputs. Family background, innate ability, and peer group relationships are almost entirely beyond the control of the school. Yet there is ample evidence that family, peer group, and innate intellectual capacity are related to a child's school achievement. Despite these limitations the production function approach is useful in helping to understand relationships among the many variables that enter into the process of schooling.

PURPOSE OF THE STUDY

The purpose of this study was to apply production function analysis to an extensive array of data concerning background, input, process, and output variables gathered from a small sample of elementary schools in which the system of Individually Guided Education (IGE) was being used. Answers were sought to the following questions:

1. Which input and process variables are most closely related to student achievement in reading?
2. Which input and process variables are most closely related to student achievement in mathematics?
3. Which input and process variables are most closely related to student self-concept?

INDIVIDUALLY GUIDED EDUCATION

Because the data were obtained from IGE schools, a brief description of Individually Guided Education is in order. Individually Guided Education offers a major alternative to the traditional age-graded, self-contained classroom form of schooling at the elementary level (Klausmeier, Rossmiller, & Saily, 1977). The IGE system consists of seven major components: (1) a model for organizational-administrative arrangements, i.e., the multiunit school, (2) a model for instructional programming, (3) a model for measurement and evaluation, (4) appropriate curricular materials and instructional procedures, (5) a program of home-school-community relations, (6) a network of facilitative environments, and (7) continuing research and development.

The organizational structure of the multiunit elementary school (MUS-E) is designed to facilitate open communication among school personnel and to promote instructional programming designed to meet the needs of individual students. Designed to provide a supportive environment for all components of IGE, the organizational hierarchy of the multiunit school consists of three interrelated groups: the instruction and research (I&R) unit at the classroom level, the instructional improvement committee (IIC) at the building level, and the system-wide program committee (SPC) at the district level. Schools in which the multiunit organizational model is fully implemented will make use of differentiated staffing, team teaching, multiage grouping, continuous progress monitoring of students, and a sharing of responsibility for decision making by teachers and administrators.

The key component of the IGE system is the Instructional Programming Model (IPM) for the individual student. The IPM is designed to assess each student's beginning level of performance, rate of progress, style of learning, and other behavioral characteristics. The model is used with explicitly stated instructional objectives and specified criteria that are used to assess progress toward the attainment of the objectives.

The third major component, a model for evaluation, was developed to facilitate instructional decision making by teachers. The model for evaluating student learning involves five steps: (1) formulate instructional objectives, (2) set performance criteria, (3) measure progress toward objectives (4) compare measurement to criteria, and (5) make decisions. The IIC, interacting with the staff of the I&R units, is responsible for determining objectives for the entire school, and the I&R unit is responsible for determining objectives for the unit and for individual students within the unit.

The success of IGE depends upon the availability of curricular materials and instructional procedures compatible with the IPM. Curricular materials developed to accommodate a variety of individual differences among pupils should have four main attributes: (1) they should be accurate and reliable, (2) they should be learnable, (3) they should be teachable, and (4) they should be accessible to the staff and usable in an instructional setting.

The success of an IGE school also depends on an effective program of home-school-community relations. The IGE system purposely encourages meaningful parental and citizen involvement in the school organization at all levels.

The sixth component, a supportive network of facilitative environments, seeks to maintain and strengthen each IGE school. The intraorganizational facilitative environment is provided by the multiunit structure; extraorganizational facilitative environments are provided by state education agencies, intermediate education agencies, teacher education institutions, and other groups such as teachers' associations and parent-teacher organizations.

The final component of IGE is a program of continuing research and development to generate knowledge that will contribute to the continuing development and refinement of the IGE system.

CONCEPTUAL FRAMEWORK

Earlier work by this project produced a conceptual framework for economic analysis of education (Rossmiller & Geske, 1977b) that provides a heuristic framework for examining the sequence in which variables are involved in the process of formal schooling. The conceptual framework presented in Figure 1 views the educational production process as a system subject to economic analysis. The model consists of four major components: (1) the inputs to the educational system, including policies that constrain or control the system's operation, (2) the formal educational system (school) and the processes associated with that system, (3) the outputs of the educational system, and (4) a feedback mechanism. The framework enables one to follow the resources that are provided to the formal educational system from its external environment (the school community, school district, state, and nation), through the eudcational process that occurs within the school, and on to the educational outcomes. The feedback component ties system outputs to both the educational process and the system inputs. Changes can be made to modify either the process or inputs to more efficiently accomplish the objectives.

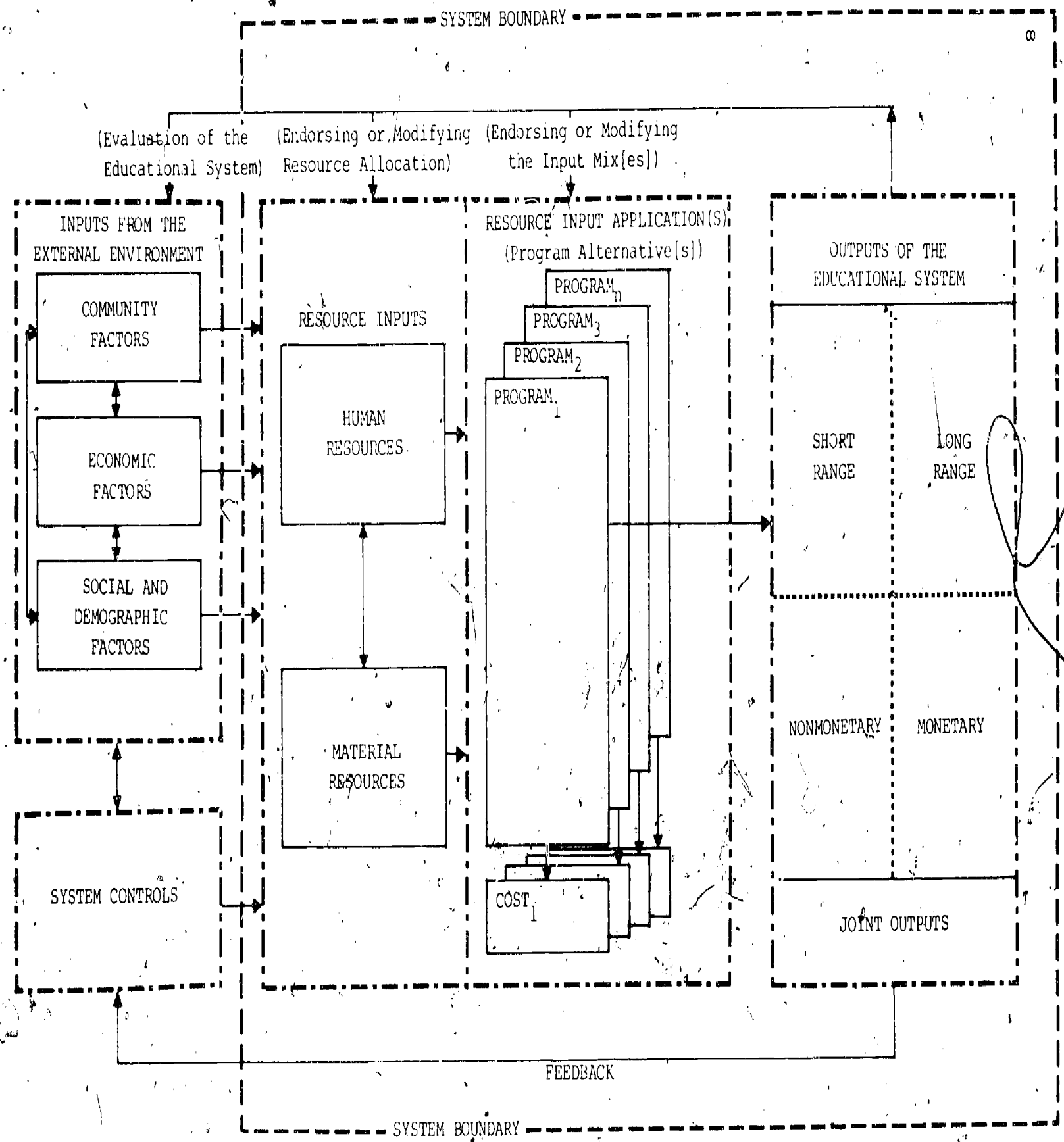

Figure 1. A conceptual framework of the educational production process under school conditions.

II.

DESIGN AND METHODOLOGY

This study involved a synthesis and analysis of data obtained from IGE schools during the 1975-76 school year. During this period the Organization and Administrative Arrangements (R3) component of the Wisconsin Research and Development Center for Individualized Schooling conducted a major study involving a national sample of IGE schools. Previous reports dealing with the results of this effort examined data concerning student self-concept, student achievement, organizational structure, decision involvement, job satisfaction, and leader behavior (Bocain, 1976; Feldman, 1977; Mendenhall, 1977; Sigurdson, 1976). In addition, data on expenditures for instruction and time allocation by teachers and administrators in IGE and non-IGE schools have been examined (Rossmiller & Geske, 1977a). The same data base was used for the analysis of the production function in IGE schools and the results are summarized in this report.

This section will delineate the design and methodology of the study. It will include a description of the population and sample selection procedures, the instruments and techniques employed in gathering data, and the statistical procedures employed in analyzing the data.

THE SAMPLE

The sample used in the present study was a subsample of the schools from which data were gathered in 1975-76. Using the R & D Center's Multiunit Elementary School Directory for 1973-74, 959 schools that had used the IGE system for at least two years were identified. Of these schools, 20 percent were located in urban areas and 80 percent in suburban and rural areas. The schools were classified as city and other, the former comprising schools located in urban areas with a population of at least 200,000 and the latter comprising those schools in areas with a population under 200,000 in 1970. A stratified random sample was drawn and a telephone survey was conducted to solicit additional information from the schools and to seek their agreement to participate in the study.

The telephone interview schedule was designed to determine whether a school met the following minimal criteria established for participation in the study:

1. The entire school conformed to the multiunit organizational pattern.
2. The school utilized multi-aged grouping in each of its I&R units.
3. The instructional programming model had been in use for at least two years in reading and for at least one year in math.
4. The school's I&R units met at least once a week, and its instructional improvement committee met at least twice a month.
5. The unit leader was not a newcomer to the selected I&R unit, nor were more than one-half of the teachers new to the selected unit.

A sample consisting of 41 schools from 13 states was obtained by calling in order the randomly selected schools in each group. Approximately 100 schools calssified as other were called to obtain 33 schools, and 50 city schools were called to obtain eight urban schools. Within each of the schools one intermediate I&R unit in which the data concerning students and teachers would be gathered was randomly chosen. For the present study, the data provided by 28 of the orginal 41 schools were sufficiently complete for them to be included in the analysis.

INSTRUMENTATION AND DATA COLLECTION

Two instruments were designed specifically for the resource allocation portion of the study, the School Expenditure Data form, and the Time Allocation of Instructional Personnel form. They were designed to learn how teachers and administrators spent their money and their time in IGE schools.

The School Expenditure Data form was used to obtain data concerning the expenditures made by a specific school. The form included only those categories considered to be most directly related to instruction and most likely to be available for the individual schools within the district. It included four major expenditure categories: (1) Instruction, (2) Operation of Plant, (3) Repairs to Plant and Equipment, and (4) Capital Outlay. Usable expenditure data were obtained from 28 of the 41 schools.

The Time Allocation of Instructional Personnel form was developed to obtain data concerning the way in which instructional personnel in IGE schools spent their time. The respondents were asked to divide their total time on the job between direct instruction of pupils and those activities other than direct instruction of pupils. Direct instruction was further partitioned by curricular areas, i.e., reading language arts, mathematics, science, social studies, and other; and by mode of instruction, i.e., independent study, one-to-one, small group (3-5 pupils), class size (25-35), and large group (75-105). Similarly, personnel were requested to allocate their non-instructional time to eight subcategories: (1) supervision of pupils, (2) planning, (3) testing/assessing/evaluating, (4) record keeping, (5) inservice training, (6) clerical/secretarial, (7) administrative, and (8) other. The time allocation data used in this study were obtained from 28 principals, 28 unit leaders, 82 IGE teachers, and 12 aides.

Several other instruments designed for studies of the organizational arrangements in IGE schools also provided information used in the present study are briefly described as follows:

Personal background. This form was used to obtain data on the education, experience, and related professional activities of the participating staff members in each school. It was completed by principals, unit leaders, and unit teachers.

Decision-involvement. This form was used to obtain data on the decision making processes in the school. It was completed by unit leaders and unit teachers and was used to assess their level of involvement in the decision process and their satisfaction with that level of involvement.

Principal leadership. This form was designed to determine the satisfaction of teachers with the leadership behavior and characteristics of the principal.

Job satisfaction. This form was used to determine the degree of job satisfaction expressed by personnel in IGE schools. It was completed by the principal, unit leader, and unit teachers.

Pupil outcomes. The Self Observation Scales (SOS), Intermediate Level, Form C, were used to obtain a measure of the self-concept of pupils. Student achievement in reading and mathematics was assessed with the Comprehensive Test of Basic Skills, Expanded Edition, Level 2. These instruments were completed by pupils in the intermediate I&R unit selected at each school. The self-concept survey was administered to one-third of the students in the unit, the mathematics test to another one-third of the pupils, and the reading test to the remaining one-third. No student took more than one test.

After a school was selected for possible participation in the study a general information letter was sent to the principal to explain the nature of the research project. After a school had agreed to participate in the research, the intermediate unit in which pupils would be tested was randomly selected and a letter explaining the testing procedures was sent to the school. The various research instruments were included in a packet that was mailed to the school about one month before the scheduled on-site visit and pupil testing by members of the research team. Participants were asked to complete the instruments before the researchers' scheduled visit to the school during January or February, 1976. During the on-site visits the researchers met with the principal and members of the instructional staff to deal with their questions, collected the completed instruments, and administered tests to the pupils in the appropriate I&R unit.

DATA ANALYSIS

Data were available concerning 134 variables in the 28 schools that comprised the sample for this study. The variables were classified according to the conceptual framework for economic analysis of education as elaborated by Rossmiller and Geske (1977b). The 134 variables, together with descriptive statistics for each and their placement within the conceptual framework, are shown in Appendix A.

The first step in analyzing the data was to compute product moment correlations for the matrix of 134 variables. The correlation matrix was examined to identify (1) the correlations among variables classified within the same category of the conceptual framework and (2) the correlation of each variable with the output measures in reading, mathematics and student self-concept. A subset of variables from each category was selected for use in stepwise multiple regression analyses. The variables in each subset were selected on the basis of completeness and accuracy of the original data, the strength of their correlation with the output measures, and their relative independence from other variables in the original set. Appendix B and Appendix C contain product moment correlations of selected variables with reading, mathematics, and self-concept measures.

Stepwise linear regression analysis was used to examine the relationships among each subset of variables and the measures of school output, achievement in reading and mathematics, and student self-concept. A backward selection procedure was employed in which all variables were entered and then removed selectively based on the contribution of each variable to the reduction of the residual variance. A significance criterion of .10 was established to determine whether a variable would leave the equation. All analyses were

performed at the Academic Computing Center of the University of Wisconsin-Madison using the STEPREG1 program (1973).

The independent variables from each subset that were found to explain the greatest amount of variance in the dependent variable under study were identified and used in a second stepwise regression analysis to isolate the set of independent variables that most efficiently explained the variance of the dependent variable.

It should be noted that the unit of analysis was an Instruction and Research (I&R) unit in an IGE school, not an individual teacher or pupil. Where data were obtained for individuals (e.g., staff background variables and pupil achievement scores), it was necessary to calculate mean scores for the I&R unit on such variables. For example, the value for years of experience of teachers is the average number of years of teaching experience of the teachers comprising the I&R unit selected for study in each school. Similarly, the achievement score for reading and mathematics used in the analyses was the mean achievement score of the pupils in the unit who took the examination. Thus the analyses dealt with the I&R unit as a whole, not with the individual pupils or subgroups of pupils that comprise the unit.

It also should be noted that data for some variables, for example, discrete elements of expenditures within the broad expenditure categories, were often found to be incomplete or of questionable accuracy. Such problems became evident when descriptive statistics for each variable were examined at the first stage of the data analysis. Such variables were eliminated from the analysis at that stage.

III

PRODUCTION FUNCTIONS FOR READING, MATHEMATICS, AND SOCIAL CONFIDENCE

The results of the analyses of the data are reported in this section. Production functions were calculated for reading achievement, mathematics achievement, and social confidence. Social Confidence was selected as the subscale of greatest interest among the seven subscales of the Self-Observation Scales because of its significance as a predictor of both reading and mathematics achievement. Social Confidence also was chosen as a proxy measure of student self-concept because of its high, positive correlation with all other subscales of the Self-Observation Scales except School Affiliation.

THE PRODUCTION FUNCTION FOR READING ACHIEVEMENT

Staff Background Variables

Examination of the descriptive statistics for the 20 variables that measured background characteristics of the I&R unit teachers and examination of the product moment correlations between each variable and reading achievement resulted in our eliminating nine of the 20 variables. The remaining 11 variables were employed in a stepwise multiple regression analysis to ascertain their relationship to reading achievement scores. The results of this analysis are shown in Table 1. The coefficient of multiple correlation for the 11 variables, .6438, accounted for 41 percent of the variance in reading achievement. The associated F-ratio was not statistically significant. Only Variable No. 2, present enrollment in a degree program (BIQ2), approached statistical significance at the .10 level.

The backward stepwise regression procedure removed nine variables from the equation. Number of years of teaching in the present school (BIQ9) was the first variable removed and sex (BIQ5) was the last variable removed. The sequence of steps is summarized in Table 2.

The final regression equation is summarized in Table 3. Two variables were retained in the final equation: (1) presently enrolled in a degree program (BIQ2), was statistically significant at the .015 level and exhibited a partial correlation of -.462 with reading achievement; and (2) age (BIQ15), was statistically significant at the .007 level and showed a partial correlation of .506 with reading achievement. These two variables accounted for about 34 percent of the variance in reading achievement, compared with 41 percent of the variance when all 11 variables were included in the analysis. The partial correlation coefficients of the other background variables with reading achievement were uniformly low, the highest being sex (BIQ5) at .173.

TABLE 1

REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 16 d.f.)	Observed Sig. Level
1	BIQ1	.0940	.097	.15352	.7004
2	BIQ2	-.4178	-.397	2.98512	.1033
5	BIQ5	.1787	.191	.60486	.4481
6	BIQ6	.1840	.193	.61753	.4434
7	BIQ7	.0971	.064	.06566	.8010
9	BIQ9	-.0323	-.026	.01093	.9180
11	BIQ11	-.0327	-.038	.02303	.8813
12	BIQ12	.1755	.157	.40492	.5336
14	BIQ14	-.2316	-.222	.82916	.3760
15	BIQ15	.4249	.370	2.53143	.1312
16	BIQ16	-.0458	-.041	.02652	.8727

CONSTANT TERM = 43.30107

R = .6438

R^2 = .4145

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	376.56512	11	34.23319
Residuals from regression	531.97354	16	33.24835
Corrected total	908.53866	27	

F-Ratio = 1.03 (with 11 and 16 d.f.)

Significance level = .4656

TABLE 2

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON READING ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.6438	.4145			12
1	BIQ9	.6435	.4141	-.0004	.918	11
2	BIQ11	.6429	.4134	-.0007	.887	10
3	BIQ16	.6417	.4118	-.0015	.831	9
4	BIQ7	.6400	.4096	-.0022	.792	8
5	BIQ1	.6307	.3978	-.0118	.534	7
6	BIQ12	.6224	.3874	-.0104	.554	6
7	BIQ6	.6137	.3766	-.0108	.539	5
8	BIQ14	.5973	.3568	-.0198	.401	4
9	BIQ5	.5804	.3369	-.0199	.398	3

TABLE 3

FINAL EQUATION: REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON READING ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 25 d.f.)	Observed Sig. Level
1	BIQ1		.071		.7294
2	BIQ2	-.4346	-.462	6.79305	.0152
5	BIQ5		.173		.3977
6	BIQ6		.131		.5238
7	BIQ7		-.047		.8181
9	BIQ9		-.024		.9084
11	BIQ11		.009		.9659
12	BIQ12		.046		.8227
14	BIQ14		-.142		.4877
15	BIQ15	.4892	.506	8.60691	.0071
16	BIQ16		.022		.9144

CONSTANT TERM = 55.8964

R = .5804

R^2 = .3369

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	306.07831	2	153.03915
Residuals from regression	602.46035	25	24.09841
Corrected total	908.53866	27	

F-Ratio = 6.35 (with 2 and 25 d.f.)

Significance level = .0059

Time Allocation Variables

A total of 52 measures of time allocation by subject area, instructional mode, and noninstructional activity were available. Examination of the descriptive statistics for these 52 variables and of the product moment correlation between each variable and reading achievement resulted in selection of 12 variables for inclusion in the initial regression equation. Table 4 shows the relationship of these 12 variables to reading achievement. The coefficient of multiple correlation for the initial regression equation, .665, accounted for 44 percent of the variance in reading achievement. The associated F-ratio was not statistically significant at the .10 level. Of the individual variables, only total time spent in language (TLANG) was statistically significant at the .10 level.

The backward stepwise regression procedure removed six variables in the following sequence: time spent in large group instruction in reading (RLARGE), time spent in inservice training (IIIE), time spent in administration (IIIG), time spent in record keeping (IIID), time spent in 1:1 instruction in language (L1TO1), and time spent in small group instruction (LSMALL). The sequence of steps is summarized in Table 5.

The final regression equation is shown in Table 6. Six variables were retained in the final equation: time spent in 1:1 instruction in reading (R1TO1), time spent in small group instruction in reading (RSMALL), time spent in class size instruction in reading (RCLASS), time spent in supervision (IIIA), total time spent in reading instruction (TREAD), and total time spent in language instruction (TLANG). The coefficient of multiple correlation of these six variables with reading achievement was .613. The six variables accounted for about 38 percent of the variance in reading achievement, compared with 44 percent when all 12 variables were included in the regression equation.

Expenditure Variables

Although data were gathered for 38 variables measuring various aspects of expenditures for instructional purposes, inspection of the descriptive statistics for these variables revealed that reasonably accurate data were available only for six categories of expenditure: instructional salary, instructional supplies, books, other expenditures for instruction, expenditures for physical plant, and expenditures for capital outlay for instruction. Table 7 shows the relationship of these six instructional expenditure variables to reading achievement as revealed by the multiple regression analysis. The coefficient of multiple correlation for the six variables, .4128, accounted for only 17 percent of the variance in reading achievement. The associated F-ratio was not statistically significant at the .10 level. Of these six variables, only expenditures per pupil for instructional salaries (SALARY) approached statistical significance at the .10 level.

The stepwise regression procedure removed all variables except instructional salaries (SALARY), with expenditure for capital outlay (CAPITAL) being the first variable removed, and expenditures for supplies (SUPPLY) the last one removed. The only variable retained in the final equation, instructional salaries (SALARY), was significant at the .08 level. The sequence of steps in the backward stepwise regression procedure is summarized in Table 8.

TABLE 4

REGRESSION OF SELECTED TIME ALLOCATION VARIABLES
ON READING ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 15 d.f.)	Observed Sig. Level
22	R1TO1	-5.6204	-.202	.63680	.4373
23	RSMALL	-6.8797	-.217	.74020	.4031
24	RCLASS	-7.2088	-.210	.69121	.4188
25	RLARGE	.0428	.023	.00800	.9299
27	L1TO1	-.2208	-.161	.39929	.5370
28	LSMALL	-.3364	-.288	1.35625	.2624
53	IIIA	-.3633	-.343	1.99820	.1779
56	IIID	.1541	.162	.40630	.5335
57	IIIE	-.0433	-.051	.03859	.8469
59	IIIG	.1622	.134	.27376	.6085
61	TREAD	9.0109	.212	.70411	.4146
62	TLANG	.5960	.413	3.09087	.0991

CONSTANT TERM = 41.8327

$R = .6651$

$R^2 = .4424$

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	401.89349	12	33.49112
Residuals from regression	506.64516	15	33.77634
Corrected total	908.53866	27	

F-Ratio = .99 (with 12 and 15 d.f.)

Significance level = .4979

TABLE 5

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON READING ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.6651	.4424			13
1	RLARGE	.6649	.4421	-.0003	.930	12
2	IIIE	.6635	.4403	-.0018	.824	11
3	IIIG	.6551	.4292	-.0111	.569	10
4	IIID	.6436	.4142	-.0149	.501	9
5	[illegible]LTOL	.6397	.4092	-.0050	.692	8
6	LSM[illegible]L	.6129	.3756	-.0336	.299	7

TABLE 6

FINAL EQUATION: REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 21 d.f.)	Observed Sig. Level
22	R1TO1	-6.9768	-.497	6.89076	.0158
23	RSMALL	-8.3263	-.514	7.55929	.0120
24	RCLASS	-8.7616	-.506	7.23388	.0137
25	RLARGE		-.080		.7241
27	L1TO1		.014		.9500
28	LSMALL		-.232		.2988
53	IIIA	-.3616	-.361	3.15194	.0903
56	IIID		.088		.6974
57	IIIE		-.069		.7605
59	IIIG		.039		.8642
61	TREAD	10.9597	.504	7.15610	.0142
62	TLANG	.4035	.413	4.31226	.0503

CONSTANT TERM = 45.617

$R = .6129$

$R^2 = .3756$

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	341.26316	6	59.87719
Residuals from regression	567.27550	21	27.01312
Corrected total	908.53866	27	

F-Ratio = 211 (with 6 and 21 d.f.)

Significance level = .0958

TABLE 7

REGRESSION OF SELECTED EXPENDITURE VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 21 d.f.)	Observed Sig. Level
106	SALARY	.3694	.323	2.439	.133
107	SUPPLY	-.1777	-.095	.190	.667
108	BCOKS	.2419	.143	.440	.514
109	OTHEREXP	-.1607	-.080	.135	.717
110	PLANT	.1351	.117	.290	.596
111	CAPITAL	-.0205	-.014	.004	.948

CONSTANT TERM = 41.7534

$R = .4128$

$R^2 = .1704$

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	154.7968	6	25.7995
Residuals from regression	753.7419	21	35.8925
Corrected total	908.5387	27	

F-Ratio = .72 (with 6 and 21 d.f.)

Significance level = .639

TABLE 8

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED EXPENDITURE VARIABLES ON READING ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.4128	.1704	--	--	7
1	CAPITAL	.4126	.1702	-.0002	.949	6
2	OTHEREXP	.4049	.1639	-.0063	.688	5
3	PLANT	.3911	.1530	-.0110	.588	4
4	BOOKS	.3454	.1193	-.0337	.338	3
5	SUPPLY	.3320	.1102	-.0091	.616	2

The final regression equation is shown in Table 9. Instructional salary (SALARY) alone accounted for about 11 percent of the variance in reading achievement, compared with the 17 percent accounted for when all six variables were included in the regression equation. Obviously, none of the expenditure variables were very useful predictors of reading achievement.

Student Self-Concept Variables

The Self-Observation Scales provide seven measures of student self-concept: self-acceptance (ACCEPT), security (SECURITY), social maturity (MATURITY), social confidence (CONFIDNT), school affiliation (SCHAFFIL), teacher affiliation (TCHAFFIL), and peer affiliation (PEERAFFL). Examination of the product moment correlation of each variable with total reading achievement scores revealed that only security was not significantly correlated with reading achievement. School affiliation was negatively correlated (-.405) with reading achievement at a statistically significant level and the remaining five variables all were positively correlated with reading achievement at statistically significant levels with social maturity exhibiting the highest correlation (.800).

The relationship of the seven student self-concept variables to reading achievement is shown in Table 10. The coefficient of multiple correlation for the seven variables, .8143, accounted for 66 percent of the variance in reading achievement, and the associated F-ratio was statistically significant at the .001 level. However, the partial correlations of the individual variables with reading achievement did not approach statistical significance.

The backward stepwise regression procedure resulted in removal of all variables except social maturity from the equation. The sequence in which variables were removed from the equation is summarized in Table 11.

Table 12 shows the final regression equation. The only variable retained in the final equation, social maturity, was statistically significant beyond the .001 level. This variable alone accounted for approximately 64 percent of the variance in reading achievement, compared with 66 percent when all seven variables were included in the equation. Thus, social maturity was almost as useful as the entire set of seven variables in terms of predicting the reading achievement score.

Organizational Variables

Several variables measuring various aspects of organizational climate and administrative arrangements were available. Examination of the product moment correlations of these variables with reading achievement revealed that none were statistically significant. All of the variables except the teachers' perception of the extent of IPM implementation in mathematics (IPMMATH) were included in a regression equation in which reading achievement was the dependent variable.

The results of the initial regression equation are shown in Table 13. The coefficient of multiple correlation for the eight variables was .6702, which accounted for about 45 percent of the variance in reading achievement. The F-ratio was not statistically significant at the .10 level. Three of the variables exhibited partial correlation coefficients significant at the .05 level: teachers' perception of the principal's leader behavior (PRLDRSHP), teachers' total job satisfaction (TOTJSAT), and teachers' total decision involvement (DIATOTQ3).

TABLE 9

FINAL EQUATION: REGRESSION OF SELECTED EXPENDITURE VARIABLES ON READING ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 26 d.f.)	Observed Sig. Level
106	SALARY	.3320	.332	3.221	.084
107	SUPPLY		-.101		.616
108	BOOKS		.072		.723
109	OTHEREXP		-.080		.693
110	PLANT		.154		.443
111	CAPITAL		-.035		.863

CONSTANT TERM = 43.8974

R = .3320

R^2 = .1102

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	100.1432	1	100.1432
Residuals from regression	808.3955	26	31.0921
Corrected total	908.5387	27	

F-Ratio = 3.22 (with 1 and 26 d.f.)

Significance level = .084

TABLE 10

REGRESSION OF STUDENT SELF-CONCEPT VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 20 d.f.)	Observed Sig. Level
112	ACCEPT	.0465	.021	.009	.926
113	SECURITY	-.0304	-.030	.018	.894
114	MATURITY	.5099	.200	.835	.372
115	CONFIDNT	.2652	.217	.990	.332
116	SCHAFFIL	-.1269	-.090	.162	.692
117	TCHAFFIL	.1005	.053	.056	.815
118	PEERAFFL	-.0902	-.034	.023	.880

CONSTANT TERM = -.0915996

R = .8143

R^2 = .6631

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	602.4083	7	86.0583
Residuals from regression	306.1304	20	15.3065
Corrected total	908.5387	27	

F-Ratio = 5.62 (with 7 and 20 d.f.)

Significance level = .001

TABLE 11

SUMMARY OF STEPS: STEPWISE REGRESSION OF STUDENT SELF-CONCEPT VARIABLES ON READING ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8143	.6631	--	--	8
1	ACCEPT	.8142	.6629	-.0001	.926	7
2	PEERAFFL	.8140	.6627	-.0003	.901	6
3	TCHAFFIL	.8132	.6614	-.0013	.774	5
4	SCHAFFIL	.8120	.6593	-.0020	.714	4
5	SECURITY	.8097	.6557	-.0036	.618	3
6	CONFIDNT	.7998	.6396	-.0161	.290	2

TABLE 12

FINAL EQUATION: REGRESSION OF STUDENT SELF-CONCEPT VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 26 d.f.)	Observed Sig. Level
112	ACCEPT		-.075		.709
113	SECURITY		-.040		.844
114	MATURITY	.7998	.800	46.1481	.000
115	CONFIDNT		.211		.290
116	SCHAFFIL		-.040		.843
117	TCHAFFIL		-.006		.977
118	PEERAFFL		-.030		.880

CONSTANT TERM = -2.2972

R = .7998

R^2 = .6396

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	581.1288	1	581.1288
Residuals from regression	327.4098	26	12.5927
Corrected total	908.5386	27	

F-Ratio = 46.15 (with 1 and 26 d.f.)

Significance level = .000

TABLE 13

REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES
ON READING ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 19 d.f.)	Observed Sig. Level
132	IPMREAD	.1803	.087	.14611	.7065
134	IRTOTAL	-.7236	-.275	1.55304	.2278
128	DIASC3Q3	-.5486	-.267	1.46123	.2416
129	DIATOTQ3	.9591	.477	5.58892	.0289
130	DIASC3Q4	.5946	.240	1.15929	.2951
131	DIATOTQ4	-.4210	-.174	.59029	.4518
127	TOTJSAT	1.0372	.471	5.40290	.0313
126	PRLDRSHP	-.9447	-.496	6.20260	.0222

CONSTANT TERM = 42.369

R = .6702

R^2 = .4491

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	408.04679	8	51.00585
Residuals from regression	500.49187	19	26.34168
Corrected total	908.53866	27	

F-Ratio = 1.94 (with 8 and 19 d.f.)

Significance level = .1132

Table 14 summarizes the results of the backward stepwise regression procedure. Five variables were removed and three were retained in the final equation.

The final regression equation is shown in Table 15. The final regression equation yielded a coefficient of multiple correlation of .5743 and accounted for approximately 33 percent of the variance in reading achievement. The decision involvement of teachers (DIATOTQ3) exhibited a partial correlation of .403 with reading achievement, teachers' total job satisfaction (TOTJSAT) had a partial correlation of .466, and teachers' perception of the principal's leader behavior (PRLDRSHP) exhibited a partial correlation of -.512.

Composite Variables

The preceding analyses identified some variables in each of the five categories that were more useful than others in predicting reading achievement. The variables from each category that appeared to be most useful were selected for inclusion in a composite set of variables and were regressed against reading achievement. Four background variables, five time allocation variables, one expenditure variable, one student self-concept variable, and two organizational variables were included in the composite set.

Table 16 shows the relationship of the first composite set of 13 selected variables with reading achievement. The coefficient of multiple correlation for the 13 variables, .8308, accounted for 69 percent of the variance in reading achievement. The associated F-ratio was statistically significant at the .058 level. Of the 13 variables, however, only social confidence (CONFIDNT) was statistically significant at the .05 level.

Application of the backward stepwise regression procedure removed from the equation all variables except time spent in large group instruction in reading (RLARGE) and social confidence (CONFIDNT). Table 17 summarizes the sequence in which variables were removed from the equation.

The final regression equation is shown in Table 18. The two variables which were retained, RLARGE and CONFIDNT, had partial correlation coefficients that were statistically significant at the .07 and .0001 levels, respectively. The coefficient of multiple correlation was .7489, and they accounted for about 56 percent of the variance in reading achievement compared with 69 percent when all 13 variables were included in the equation.

Because student self-concept may be viewed conceptually as either an input to the process or as an output of schooling, and because reading achievement and the subscales of the Self-Observation Scale, such as social confidence are likely to be interrelated (and thus covariates), a second set of variables was chosen for inclusion in the regression analysis. Three variables were removed from the first composite set: participation in IGE staff development workshops (BIQ6), time spent in large group instruction in reading (RLARGE), and social confidence (CONFIDNT). Two variables not included in Set 1 were added: school size (SCHSIZ) and teachers' total job satisfaction (TOTJSAT).

The results of the regression of this set of 12 selected variables against reading achievement are shown in Table 19. The coefficient of multiple correlation for the 12 variables, .8475, accounted for over 71 percent of the variance in reading achievement, a slight improvement over the results obtained from composite Set 1. The F-ratio was statistically significant at the .018 level.

TABLE 14

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES ON READING ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.6702	.4491			9
1	IPMREAD	.6670	.4449	-.0042	.707	8
2	DIATOTQ4	.6552	.4293	-.0156	.462	7
3	DIASC3Q4	.6430	.4135	-.0158	.454	6
4	DIASC3Q3	.6319	.3992	-.0142	.473	5
5	IRTOTAL	.5743	.3298	-.0694	.117	4

TABLE 15

FINAL EQUATION: REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES ON READING ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 24 d.f.)	Observed Sig. Level
132	IPMREAD		-.260		.2102
134	IRTOTAL		-.322		.1167
128	DIASC3Q3		-.077		.7160
129	DIATOTQ3	.4665	.403	4.65686	.0412
130	DIASC3Q4		-.145		.4883
131	DIATOTQ4		-.164		.4344
127	TOTJSAT	.8509	.466	6.64694	.0165
126	PRLDRSHP	-1.0301	-.512	8.54170	.0075

CONSTANT TERM = 34.676

$R = .5743$

$R^2 = .3298$

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	299.67412	3	99.89137
Residuals from regression	608.86453	24	25.36936
Corrected total	908.53866	27	

F-Ratio = 3.94 (with 3 and 24 d.f.)

Significance level = .0204

TABLE 16

REGRESSION OF SELECTED VARIABLES ON READING ACHIEVEMENT (SET 1)

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 14 d.f.)	Observed Sig. Level
2	BIQ2	-.1951	-.228	.76886	.3954
5	BIQ5	-.1865	-.237	.83209	.3771
6	BIQ6	.0045	.005	.00039	.9845
7	BIQ7	.0782	.076	.08106	.7800
22	R1TO1	.1349	.199	.57839	.4596
23	RSMALL	-.1973	-.269	1.09270	.3136
24	RCLASS	-.1492	-.128	.23318	.6366
25	RLARGE	.2231	.299	1.37796	.2600
62	TLANG	.1727	.231	.79089	.3889
106	SALARY	.1089	.120	.20308	.6591
115	CONFIDNT	.5714	.551	6.09964	.0270
126	PRLDRSHP	-.1744	-.195	.55066	.4703
129	DIATOTQ3	.2618	.258	1.00129	.3340

CONSTANT TERM = -1.127213

R = .8308

R^2 = .6902

Analysis of Variance Summary

Source of Variation	Sum of Squares		Mean Square
Linear regression	627.11645	13	48.23973
Residuals from regression	281.42221	14	20.10159
Corrected total	908.53866	27	

F-Ratio = 2.40 (with 13 and 14 d.f.)

Significance level = .0584

TABLE 17

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED VARIABLES ON READING ACHIEVEMENT (SET 1)

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8308	.6902			14
1	BIQ6	.8308	.6902	-.0000	.985	13
2	BIQ7	.8297	.6884	-.0018	.771	12
3	SALARY	.8279	.6853	-.0031	.696	11
4	RCLASS	.8262	.6826	-.0028	.704	10
5	R1TO1	.8173	.6679	-.0147	.374	9
6	BIQ5	.8102	.6565	-.0115	.428	8
7	PRLDRSHP	.8034	.6454	-.0110	.433	7
8	RSMALL	.7969	.6351	-.0104	.442	6
9	BIQ2	.7850	.6161	-.0189	.297	5
10	TLANG	.7759	.6020	-.0142	.366	4
11	DJATOTQ3	.7489	.5608	-.0412	.128	3

TABLE 18

FINAL EQUATION: REGRESSION OF SELECTED VARIABLES ON READING ACHIEVEMENT (SET 1)

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 25 d.f.)	Observed Sig. Level
2	BIQ2		-.003		.9867
5	BIQ5		.012		.9527
6	BIQ6		-.029		.8872
7	BIQ7		-.051		.8037
22	R1TO1		.246		.2254
23	RSMALL		-.121		.5563
24	RCLASS		-.134		.5141
25	RLARGE	.2522	.356	3.62018	.0687
62	TLANG		.247		.2229
106	SALARY		.152		.4574
115	CONFIDNT	.7007	.726	27.94145	.0000
126	PRLDRSHP		.065		.7520
129	DIATOTQ3		.306		.1283

CONSTANT TERM = -21.38998

R = .7489

R^2 = .5608

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	509.50833	2	254.75417
Residuals from regression	399.03032	25	15.96121
Corrected total	908.53866	27	

F-Ratio = 15.96 (with 2 and 25 d.f.)

Significance level = .0000

TABLE 19

REGRESSION OF SELECTED VARIABLES
ON READING ACHIEVEMENT (SET 2)

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 15 d.f.)	Observed Sig. Level
2	BIQ2	-.3279	-.412	3.07281	.1000
5	BIQ5	.0533	.073	.08078	.7801
7	BIQ7	.4874	.512	5.32919	.0356
22	R1TO1	-.0814	-.127	.24658	.6267
23	RSMALL	-.2342	-.348	2.06802	.1710
24	RCLASS	-.6242	-.532	5.90672	.0281
62	TLANG	.1782	.243	.94509	.3464
105	SCHSIZ	-.1198	-.157	.37912	.5473
106	SALARY	.3244	.369	2.35825	.1454
126	PRLDRSHP	-.9621	-.623	9.50646	.0076
127			.638	10.30764	.0058
129	DJATOTQ3	.1394	.145	.32346	.5780

CONSTANT TERM = 45.570060

R = .8475

R^2 = .7183

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	652.57101	12	54.38092
Residuals from regression	255.96765	15	17.06451
Corrected total	908.53866	27	

F-Ratio = 3.19 (with 12 and 15 d.f.)

Significance level = .0185

Partial correlation coefficients statistically significant at the .01 level were obtained for two of the variables, teachers' perception of the principal's leader behavior (PRLDRSHIP) and teachers' total job satisfaction (TOTJSAT), and two other variables, years of teaching experience (BIQ7) and time spent in class size instruction in reading (RCLASS), exhibited partial correlation coefficients significant at the .05 level.

Application of the backward stepwise regression procedure resulted in eliminating seven variables from the equation. Table 20 summarizes the sequence in which variables were removed from the equation.

The final regression equation is shown in Table 21. Five variables were retained: years of teaching experience (BIQ7), time spent in class size instruction in reading (RCLASS), instructional salaries per pupil (SALARY), teachers' perception of principal's leader behavior (PRLDRSHP), and teachers' total job satisfaction (TOTJSAT). These five variables produced a coefficient of multiple correlation of .7573, accounting for 57 percent of the variance in reading achievement. Removal of seven variables from the equation thus reduced the amount of variance accounted for by nearly 15 percent. The partial correlation coefficients of time spent in reading instruction in class size groups (RCLASS) and teachers' perception of the principal's leader behavior (PRLDRSHP) were related negatively to reading achievement; the partial correlations of the other three variables were related positively to reading achievement.

It should be noted that this analysis accounted for nearly 72 percent of the variance in reading achievement scores using those input and process variables that are subject (in varying degrees) to the control of teachers and administrators. Years of teaching experience, for example, may be considered when filling staff vacancies. The time allocated to various modes of instruction (small group, class size, etc.) can be controlled by teachers. Instructional salaries can also be controlled, at least within limits, although one may speculate that this variable may serve as a proxy for the socioeconomic environment of the school or school district. The behavior of principals may be modified and there is reason to believe that actions can be taken to increase teachers' job satisfaction. Although one is reluctant to generalize based on the results obtained from this limited sample, the results of the analysis provide some reason for optimism that students' reading achievement can be improved by giving conscious attention to input and process variables that clearly are within the control of teachers and administrators.

THE PRODUCTION FUNCTION FOR MATHEMATICS ACHIEVEMENT

The same five groups of variables: staff background, time allocation, expenditures, student self-concept and organization, used in the analysis of reading achievement were used as independent variables in regression equations where the dependent variable was mathematics achievement as measured by the Comprehensive Tests of Basic Skills. A backward stepwise regression procedure was employed with the independent variables being removed from the equation one at a time starting with the variable with the least relationship to the dependent variable. The criterion for retention of a variable in the final equation was statistical significance at the .10 level. After the regressions for the five groups of variables were analyzed, two sets of composite variables were selected and subjected to multiple regression analysis.

TABLE 20

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED VARIABLES ON READING ACHIEVEMENT (SET 2)

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8475	.7183			13
1	BIQ5	.8466	.7167	-.0015	.780	12
2	R1TO1	.8444	.7130	-.0038	.651	11
3	DIATOTQ3	.8402	.7059	-.0071	.527	10
4	SCHSIZ	.8321	.6923	-.0136	.374	9
5	TLANG	.8082	.6531	-.0392	.136	8
6	BIQ2	.7847	.6157	-.0374	.158	7
7	RSMALL	.7573	.5734	-.0423	.143	6

TABLE 21

FINAL EQUATION: REGRESSION OF SELECTED VARIABLES ON READING ACHIEVEMENT (SET 2)

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 22 d.f.)	Observed Sig. Level
2	BIQ2		-.282		.1927
5	BIQ5		.280		.1962
7	BIQ7	.6182	.572	10.67129	.0035
22	R1TO1		-.057		.7971
23	RSMALL		-.315		.1432
24	RCLASS	-.7274	-.602	12.51213	.0019
62	TLANG		.166		.4485
1[illegible]	SCHSIZ		-.133		.5461
106	SALARY	.6241	.633	14.72354	.0009
126	PRLDRSHP	-.9067	-.559	10.01185	.0045
127	TOTJSAT	.9639	.593	11.94675	.0022
129	DJATOTQ3		.089		.6860

CONSTANT TERM = 28.63945

R = .7573

R^2 = .5734

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	520.98710	5	104.19743
Residuals from regression	387.55156	22	17.61598
Corrected total	908.53866	27	

F-Ratio = 5.91 (with 5 and 22 d.f.)

Significance level = .0013

Staff Background Variables

Data were available on 20 background variables reflecting various aspects of the training and experience of the teaching staff. After inspecting the descriptive statistics for the 20 variables and the matrix of correlations of the variables with mathematics achievement, 11 were selected for inclusion in the multiple regression analysis. Table 22 shows the relationship of these 11 variables to mathematics achievement. The coefficient of multiple correlation, .7056, accounted for nearly 50 percent of the variance in mathematics achievement. The F-ratio, however, was not statistically significant at the .10 level. Of the 11 variables, only the variable, presently enrolled in a degree program (BIQ2), was statistically significant at the .10 level.

The results of the backward stepwise regression procedure are summarized in Table 23. Eight of the 11 variables were removed from the regression equation with the number of district committees of which one is a member (BIQ11) being removed first. Table 24 shows the final equation with three variables that were retained: presently enrolled in a degree program (BIQ2), sex (BIQ5), and years of teaching experience (BIQ7). The coefficient of multiple correlation obtained with these three variables was .6806 and they accounted for about 46 percent of the variance in mathematics achievement, compared with 49 percent when all 11 variables were included. The partial correlation coefficients for sex (BIQ5) and years of teaching experience (BIQ7) were positively related to mathematics achievement and that of presently enrolled in a degree program (BIQ2) was negatively correlated. It should be noted, however, that the negative correlation favors enrollment in a degree program because of the way in which responses to the question were scored.

Time Allocation Variables

Examination of the descriptive statistics and correlation matrix for the 52 time allocation variables resulted in the selection of 12 variables for inclusion in the regression equation. The results of the analysis are shown in Table 25. The multiple coefficient of correlation obtained for the 11 variables was .6152 and they accounted for approximately 38 percent of the variance in mathematics achievement. The F-ratio was not statistically significant at .10. Application of the backward stepwise regression procedure resulted in eliminating all variables, since none met the exclusion criterion. Further analysis of the model was abandoned.

Expenditure Variables

Six expenditure variables were selected for inclusion in the regression analysis. Although expenditure data were gathered for 38 variables, inspection of the data revealed that data for many of the variables were either missing or were obviously estimates. Consequently, it was decided to use the major standard accounting categories of expenditures for instructional salaries, supplies and books; other expenses of instruction; and expenditures for school plant and capital outlay. Table 26 shows the relationship of these six expenditure variables to mathematics achievement. These variables produced a coefficient of multiple correlation of .4110 and accounted for only about 17 percent of the variance in mathematics achievement. The F-ratio was not statistically

TABLE 22

REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 16 d.f.)	Observed Sig. Level
1	BIQ1	-.0317	-.036	.02040	.8882
2	BIQ2	-.4579	0.455	4.18257	.0577
5	BIQ5	.3075	.340	2.08777	.1678
6	BIQ6	.1002	.115	.21372	.6501
7	BIQ7	.3583	.247	1.04222	.3225
9	BIQ9	-.0708	-.062	.06113	.8079
11	BIQ11	-.0032	-.004	.00026	.9872
12	BIQ12	.0711	.069	.07756	.7842
14	BIQ14	.0620	.066	.06931	.7957
15	BIQ15	.2027	.201	.67214	.4244
16	BIQ16	-.0203	-.020	.00609	.9387

CONSTANT TERM = 46.30530

R = .7056

R^2 = .4979

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	340.64926	11	30.96811
Residuals from regression	343.52449	16	21.47028
Corrected total	684.17375	27	

F-Ratio = 1.44 (with 11 and 16 d.f.)

Significance level = .2454

TABLE 23

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON MATHEMATICS ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.7056	.4979			12
1	BIQ11	.7056	.4979	-.0000	.987	11
2	BIQ16	.7055	.4977	-.0002	.936	10
3	BIQ1	.7051	.4972	-.0005	.892	9
4	BIQ9	.7036	.4950	-.0022	.778	8
5	BIQ12	.7020	.4928	-.0022	.770	7
6	BIQ14	.6999	.4899	-.0029	.733	6
7	BIQ6	.6935	.4809	-.0090	.541	5
8	BIQ15	.6806	.4632	-.0177	.384	4

TABLE 24

FINAL EQUATION: REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 24 d.f.)	Observed Sig. Level
1	BIQ1		-.031		.8819
2	BIQ2	-.4111	-.462	6.72472	.0159
5	BIQ5	.3562	.423	5.22159	.0314
6	BIQ6		.125		.5511
7	BIQ7	.3970	.471	6.82756	.0153
9	BIQ9		-.056		.7915
11	BIQ11		-.004		.9862
12	BIQ12		.009		.9660
14	BIQ14		.052		.8047
15	BIQ15		.182		.3844
16	BIQ16		.014		.9460

CONSTANT TERM = 49.3106

R = .6806

R^2 = .4632

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	316.90227	3	105.63409
Residuals from regression	367.27148	24	15.30298
Corrected total	684.17375	27	

F-Ratio = 6.90 (with 3 and 24 d.f.)

Significance level = .0016

TABLE 25

REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON MATHEMATICS ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 15 d.f.)	Observed Sig. Level
32	M1TO1	123.6729	.378	2.50181	.1346
33	MSMALL	101.9972	.376	2.47641	.1364
34	MCLASS	126.1553	.378	2.50186	.1346
35	MLARGE	2.3184	.395	2.76995	.1168
37	SC1TO1	.0288	.019	.00562	.9412
38	SCSMALL	.3820	.320	1.71119	.2105
53	IIIA	-.1630	-.178	.49325	.4932
56	IIID	.3800	.324	1.75358	.2053
57	IIIE	-.1065	-.114	.19922	.6617
59	IIIG	-.3210	-.215	.72803	.4069
63	TMATH	-115.8323	-.377	2.48789	.1356
64	TSCI	.0944	.078	.09095	.7671

CONSTANT TERM = 42.6717

R = .6152

R^2 = .3785

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	258.96906	12	21.58076
Residuals from regression	425.20469	15	28.34698
Corrected total	684.17375	27	

F-Ratio = .76 (with 12 and 15 d.f.)

Significance level = .6791

No variables could be retained and analysis of the model was abandoned.

TABLE 26

REGRESSION OF SELECTED EXPENDITURE VARIABLES
ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 21 d.f.)	Observed Sig. Level
106	SALARY	.3427	.301	2.09509	.1625
107	SUPPLY	-.1881	-.100	.21268	.6494
108	BOOKS	.5070	.290	1.92989	.1793
109	OTHEREXP	-.2633	-.130	.36266	.5535
110	PLANT	-.0122	-.011	.00236	.9617
111	CAPITAL	-.0904	-.063	.08249	.7768

CONSTANT TERM = 43.348411

R = .4110

R^2 = .1689

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	115.55821	6	19.25970
Residuals from regression	568.61554	21	27.07693
Corrected total	684.17375	27	

F-Ratio = .71 (with 6 and 21 d.f.)

Significance level = .6444

No variables could be retained and analysis of the model was abandoned.

significant at the .10 level. Application of the backward stepwise regression procedure resulted in all variables being removed from the equation. Consequently, analysis of the model was abandoned. As was true in the case of reading achievement, the expenditure variables were not useful as predictors of mathematics achievement.

Student Self-Concept Variables

The Self-Observation Scale yields seven subcategories of student self-concept measurements. All were included in the regression analysis. Results of the initial analysis are shown in Table 27. The seven variables produced a coefficient of multiple correlation of .7694 and accounted for about 59 percent of the variance in mathematics achievement. The F-ratio was statistically significant at the .01 level. Of the individual variables, only social confidence (CONFIDNT) was statistically significant at the .05 level.

The backward stepwise regression procedure eliminated all variables except social confidence (CONFIDNT) from the equation. The variables eliminated at each step of the backward regression procedure are identified in Table 28.

The final equation (containing only social confidence) is shown in Table 29. This equation produced a coefficient of multiple correlation of .7497 accounting for approximately 56 percent of the variance, compared to the 59 percent accounted for when all seven variables were included.

Organizational Variables

Data were available for several measures of organizational climate and administrative arrangements. These variables were regressed against mathematics achievement and the results are shown in Table 30. The eight variables produced a coefficient of multiple correlation of .6048 and accounted for over 36 percent of the variance in mathematics achievement. The associated F-ratio was not statistically significant at the .10 level. Of the eight variables, only teachers' perception of the extent of IPM implementation in mathematics (IPMMATH) was statistically significant at .05 level.

The sequence of steps in the backward stepwise regression procedure is summarized in Table 31. The first variable removed from the equation was teachers' satisfaction with decision involvement in the I&R unit (DJASC3Q4). Only two variables, teachers' perception of the extent of IPM implementation in mathematics (IPMMATH) and teachers' total decision involvement (DJATOTQ3), were retained in the final equation.

The final regression equation for this group of variables is displayed in Table 32. The equation produced a coefficient of multiple correlation of .4845 and accounted for about 23 percent of the variance in mathematics, compared with the 36 percent explained by the initial equation. The F-ratio was significant at the .05 level.

Composite Variables

The analyses reported in the preceding sections revealed variables among each of the five groups that were more useful than others in predicting reading achievement. From among the five groups of independent variables (staff background, time allocation, expenditures, student self-concept, and organizational

TABLE 27

REGRESSION OF STUDENT SELF-CONCEPT VARIABLES
ON MATHEMATICS ACHIEVEMENT

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 20 d.f.)	Observed Sig. Level
112	ACCEPT	.2236	.033	.17521	.6800
113	SECURITY	.1509	.135	.37342	.5480
114	MATURITY	-.0933	-.034	.02310	.8807
115	CONFIDNT	.6527	.445	4.95117	.0377
116	SCHAFFIL	-.2195	-.140	.39952	.5345
117	TCHAFFIL	.1047	.050	.05058	.8243
118	PEERAFFL	-.2101	-.072	.10445	.7499

CONSTANT TERM = -12.802976

R = .7694

R^2 = .5920

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	405.00835	7	57.85834
Residuals from regression	279.16540	20	13.95827
Corrected total	684.17375	27	

F-Ratio = 4.15 (with 7 and 20 d.f.)

Significance level = .0057

TABLE 28

SUMMARY OF STEPS: STEPWISE REGRESSION OF STUDENT SELF-CONCEPT VARIABLES ON MATHEMATICS ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.7694	.5920			8
1	MATURITY	.7691	.5915	-.0005	.881	7
2	TCHAFFIL	.7687	.5909	-.0006	.866	6
3	PEERAFFL	.7669	.5881	-.0028	.700	5
4	SECURITY	.7635	.5830	-.0051	.598	4
5	SCHAFFIL	.7546	.5694	-.0136	.386	3
6	ACCEPT	.7497	.5621	-.0073	.521	2

TABLE 29

FINAL EQUATION: REGRESSION OF STUDENT SELF-CONCEPT VARIABLES ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 26 d.f.)	Observed Sig. Level
112	ACCEPT		.129		.5211
113	SECURITY		.141		.4832
114	MATURITY		.178		.3742
115	CONFIDNT	.7497	.750	33.37634	.0000
116	SCHAFFIL		-.127		.5294
117	TCHAFFIL		.096		.6338
118	PEERAFFL		.160		.4247

CONSTANT TERM = -16.71369

R = .7497

R^2 = .5621

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	384.58444	1	384.58444
Residuals from regression	299.58931	26	11.52267
Corrected total	684.17375	27	

F-Ratio = 33.38 (with 1 and 26 d.f.)

Significance level = .0000

TABLE 30

REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES
ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 19 d.f.)	Observed Sig. Level
131	IPMMATH	-.7764	-.442	4.61075	.0449
134	IRTOTAL	.4006	.203	.82031	.3764
128	DIASC3Q3	-.1135	-.053	.05440	.8181
129	DIATOTQ3	.5729	.289	1.73682	.2032
130	DIASC3Q4	-.0277	-.011	.00237	.9617
131	DIATOTQ4	-.0495	-.019	.00715	.9335
127	TOTJSAT	.4814	.223	.99316	.3315
126	PRLDRSHP	-.6546	-.345	2.56732	.1256

CONSTANT TERM = 52.181

R = .6048

R^2 = .3658

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	250.27000	8	31.28375
Residuals from regression	433.90375	19	22.83704
Corrected total	684.17375	27	

F-Ratio = 1.37 (with 8 and 19 d.f.)

Significance level = .2711

TABLE 31

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES ON MATHEMATICS ACHIEVEMENT

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.6048	.3658			
1	DIASC3Q4	.6047	.3657	-.0001	.962	8
2	DIATOTQ4	.6043	.3652	-.0005	.897	7
3	DIASC3Q3	.5986	.3583	-.0069	.637	6
4	TOTJSAT	.5865	.3210	-.0373	.270	5
5	PRLDRSHP	.5248	.2754	-.0456	.227	4
6	IRTOTAL	.4845	.2347	-.0407	.257	3

TABLE 32

FINAL EQUATION: REGRESSION OF SELECTED ORGANIZATIONAL VARIABLES ON MATHEMATICS ACHIEVEMENT

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 25 d.f.)	Observed Sig. Level
131	IPMMATH	-.5357	-.471	7.12446	.0132
134	IRTOTAL		.231		.2570
128	DIASC3Q3		-.064		.7551
129	DIATOTQ3	.3913	.363	3.80190	.0625
130	DIASC3Q4		.051		.8033
131	DIATOTQ4		.013		.9501
127	TOTJSAT		-.023		.9101
126	PRLDRSHP		-.223		.2740

CONSTANT TERM = 56.015

R = .4845

R^2 = .2347

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	160.5796	2	80.28988
Residuals from regression	523.59399	25	20.94376
Corrected total	684.17375	27	

F-Ratio = 3.83 (with 2 and 25 d.f.)

Significance level = .0353

variables), the variables that remained in the final regression equation, or that were among the last to be stepped out, were selected for inclusion in a composite set of variables that were regressed against mathematics achievement. Four background variables, five time allocation variables, one expenditure variable, one self-concept variable, and two organizational variables were included in Set 1.

Table 33 displays the relationship to mathematics achievement of the 13 variables included in the composite set. The coefficient of multiple correlation for this set of variables, .8762, accounted for nearly 77 percent of the variance in mathematics achievement. The F-ratio was statistically significant at the .01 level.

Application of the backward stepwise regression procedure, summarized in Table 34, resulted in removing eight variables from the equation. Instructional salaries per pupil (SALARY) was the first variable removed and time in one-to-one mathematics instruction (M1TO1) was the eighth variable removed.

The final regression equation is shown in Table 35. The five variables retained in the final equation produced a coefficient of multiple correlation of .8550 and accounted for 73 percent of the variance in mathematics achievement. The F-ratio was significant at the .02 level. These five variables were nearly as useful as the entire set of 13 variables in accounting for the variance in mathematics achievement. Social confidence (CONFIDNT) exhibited a partial correlation coefficient of .797 that was statistically significant at beyond the .0001 level. Time spent in large group instruction in mathematics (MLARGE) was statistically significant at the .01 level. The partial correlation coefficient of years of teaching experience (BIQ7) was statistically significant at the .05 level, and those of total time devoted to reading instruction (TREAD) and teachers' perception of the principal's leader behavior (PRLDRSHP) were statistically significant at the .10 level.

Recognizing that a measure of student self-concept such as social confidence may be considered as either an input to the educational process or an output of schooling, and because mathematics achievement and social confidence may themselves be covariates, a second set of variables (Set 2) from which all measures of student self-concept were eliminated was chosen for another regression analysis. Three variables were removed from the first set: extent of participation in IGE staff development workshops (BIQ6), time allocated to large group instruction in mathematics (MLARGE), and social confidence (CONFIDNT); two variables were added, school size (SCHSIZ) and teachers' total job satisfaction (TOTJSAT). The relationship of these twelve variables to mathematics achievement is shown in Table 36. The coefficient of multiple correlation obtained for these 12 variables, .8438, accounted for 71 percent of the variance in mathematics achievement. The F-ratio was significant at the .02 level. This set of 12 variables yielded a slightly lower coefficient of multiple correlation than the first set and explained about 6 percent less of the variance in mathematics achievement.

The backward stepwise regression procedure removed eight of the original 12 variables. Time allocated to mathematics instruction in class size groups (MCLASS) was the first variable removed, and teachers' perception of the principal's leader behavior (PRLDRSHP) was the eighth variable removed (Table 37).

The final regression equation for this set of variables is presented in Table 38. The four variables retained in the final equation produced a coefficient of multiple correlation of .7480 and accounted for about 56 percent of the variance in mathematics achievement, compared with 71 percent of the variance accounted for by the entire set of 12 variables. The F-ratio was

TABLE 33

REGRESSION OF SELECTED VARIABLES
ON MATHEMATICS ACHIEVEMENT (SET 1)

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 14 d.f.)	Observed Sig. Level
2	BIQ2	.0741	.085	.10173	.7545
5	BIQ5	.0941	.157	.35609	.5602
6	BIQ6	-.0669	-.093	.12215	.7319
7	BIQ7	.2156	.288	1.26443	.2797
32	M1TO1	-.2078	-.241	.86003	.3694
33	MSMALL	.0502	.075	.07984	.7817
34	MCLASS	-.0706	-.087	.10588	.7497
35	MLARGE	.4112	.493	4.49519	.0523
61	TREAD	-.1746	-.282	1.20511	.2908
106	SALARY	-.0342	-.059	.04912	.8278
115	CONFIDNT	.7820	.678	11.90429	.0039
126	PRIDRSHP	-.2804	-.355	2.01282	.1779
129	DIATOTQ3	.0886	.106	.16009	.6951

CONSTANT TERM = 13.9241030

R = .8762

R^2 = .7677

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	525.22214	13	40.40170
Residuals from regression	158.95161	14	11.35369
Corrected total	684.17375	27	

F-Ratio = 3.56 (with 13 and 14 d.f.)

Significance level = .0125

TABLE 34

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED VARIABLES OF MATHEMATICS ACHIEVEMENT (SET 1)

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8762	.7677			
1	SALARY	.8757	.7669	-.0008	.828	13
2	MSMALL	.8748	.7652	-.0016	.752	12
3	DIAGOTQ3	.8738	.7635	-.0018	.733	11
4	BIQ6	.8717	.7599	-.0036	.617	10
5	BIQ2	.8686	.7545	-.0054	.533	9
6	BIQ5	.8651	.7483	-.0061	.499	8
7	MCLASS	.8578	.7358	-.0125	.330	7
8	M1TO1	.8550	.7310	-.0048	.542	6

TABLE 35

FINAL EQUATION: REGRESSION OF SELECTED VARIABLES ON MATHEMATICS ACHIEVEMENT (SET 1)

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 22 d.f.)	Observed Sig. Level
2	BIQ2		.012		.9560
5	BIQ5		.108		.6229
6	BIQ6		-.177		.4196
7	BIQ7	.2685	.427	4.91467	.0373
32	M1TO1		-.134		.5425
33	MSMALL		.216		.3223
34	MCLASS		-.129		.5577
35	MLARGE	.3414	.532	8.70208	.0074
61	TREAD	-.2226	-.362	3.31998	.0821
106	SALARY		-.063		.7752
115	CONFIDNT	.7025	.797	38.35974	.0000
126	PRLDRSHP	-.2076	-.366	3.40968	.0783
129	DIATOT03		.136		.5367

CONSTANT TERM = -4.63494

R = .8550

R^2 = .7310

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	500.11691	5	100.02338
Residuals from regression	184.05684	22	8.36622
Corrected total	684.17375	27	

F-Ratio = 11.96 (with 5 and 22 d.f.)

Significance level = .0000

TABLE 36

REGRESSION OF SELECTED VARIABLES
ON MATHEMATICS ACHIEVEMENT (SET 2)

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 15 d.f.)	Observed Sig. Level
2	BIQ2	-.4841	-.596	8.27005	.0115
5	BIQ5	.2672	.407	2.98670	.1045
7	BIQ7	.4295	.556	6.70996	.0205
32	MITO1	.2153	.254	1.03047	.3261
33	MSMALL	.2101	.224	.79227	.3875
34	MCLASS	.0350	.039	.02256	.8826
61	TREAD	-.3447	-.448	3.75908	.0716
105	SCHSIZ	-.3326	-.368	2.35229	.1459
106	SALARY	-.0400	-.056	.04738	.8306
126	PRLDRSHP	-.7832	-.501	5.02615	.0405
127	TOTJSAT	.7352	.474	4.35404	.0544
129	DJATOTQ3	.0487	.047	.03311	.8581

CONSTANT TERM = 56.358443

R = .8438

R^2 = .7120

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	487.11167	12	40.59264
Residuals from regression	197.06208	15	13.13747
Corrected total	684.17375	27	

F-Ratio = 3.09 (with 12 and 15 d.f.)

Significance level = .0210

TABLE 37

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED VARIABLES ON MATHEMATICS ACHIEVEMENT (SET 2)

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8438	.7120			
1	MCLASS	.8435	.7115	-.0004	.883	12
2	DIATOTQ3	.8433	.7112	-.0003	.895	11
3	SALARY	.8427	.7101	-.0011	.801	10
4	MSMALL	.8279	.6853	-.0248	.231	9
5	M1TO1	.8093	.6550	-.0304	.192	8
6	TREAD	.7848	.6159	-.0391	.148	7
7	TOTJSAT	.7514	.5645	-.0513	.109	6
8	PRLDRSHP	.7480	.5595	-.0051	.617	5

TABLE 38

FINAL EQUATION: REGRESSION OF SELECTED VARIABLES ON MATHEMATICS ACHIEVEMENT (SET 2)

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 23 d.f.)	Observed Sig. Level
2	BIQ2	-.4256	-.518	8.44224	.0080
5	BIQ5	.3978	.495	7.48152	.0118
7	BIQ7	.3283	.430	5.20499	.0321
32	M1TO1		.181		.3981
33	MSMALL		-.043		.8429
34	MCLASS		-.091		.6713
61	TREAD		-.180		.3996
105	SCHSIZ	-.3225	-.423	5.02646	.0349
106	SALARY		-.060		.7823
126	PRLDRSHP		-.107		.6173
127	TOTJSAT		.082		.7032
129	DIATOTQ3		.065		.7639

CONSTANT TERM = 52.913672

R = .7480

R^2 = .5595

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	382.77125	4	95.69281
Residuals from regression	301.40250	23	13.10446
Corrected Total	684.17375	27	

F-Ratio = 7.30 (with 4 and 23 d.f.)

Significance level = .0006

significant at the .001 level. The four variables retained in this equation consisted of three staff background variables: present enrollment in a degree program (BIQ2), sex (BIQ5), and years of teaching experience (BIQ7), plus school size (SCHSIZ). Only years of teaching experience (BIQ7) was retained in the final equation for both Set 1 and Set 2.

Most of the variables retained in the final equation for both Set 1 and Set 2 represent conditions that are amenable to control of modification by teachers or administrators. Staff background characteristics can be considered when recruiting personnel to fill vacant positions, time allocated for various subject areas and modes of instruction can be varied by teachers, school size can be varied (at least over time), and the principal's leadership can be modified (or the principal can be replaced). It is worth noting that the 13 variables in Set 1 explained 77 percent of the variance in mathematics achievement and the 12 variables in Set 2 explained 71 percent of the variance. The results of these analyses suggest that achievement in mathematics can be influenced significantly by variables that are within the control of school personnel.

The results obtained from these two sets of variances also signal the need for caution in interpreting the results of production function analyses. Variables retained in the final equation for Set 1 were not retained in Set 2 and vice-versa. These results clearly indicate the sensitivity of multiple regression analyses to the particular variables included in the set under analysis, particularly with a small sample. The results of a multiple regression analysis depend on the particular set of variables included in the regression equation and the specific sample from which the variables are drawn, and must be interpreted with great caution. A slight change in the sample, in the set of variables included in the regression equation, or in the dependent variable that serves as the criterion, may alter substantially the results obtained in a multiple regression analysis. Nevertheless, the results obtained in the foregoing analyses afford some reason for optimism for those who believe that schools can and do make a difference in the achievement of students.

THE PRODUCTION FUNCTION FOR SOCIAL CONFIDENCE

The self-concept of a student may be viewed as an input to the educational production process because it may affect a student's receptivity to the process and content of schooling. Student self-concept also may be viewed as a product, or output, of schooling. That is, one's experiences in school may alter one's self-concept. Consequently, it was decided to investigate the relationship of various input variables to one measure of student self-concept, namely, social confidence.

Social confidence is one of the seven subscales which together comprise the Self-Observation Scale. Social confidence ranked second only to the social maturity subscale in its relationship to reading achievement and was the most useful subscale for predicting mathematics achievement. Product moment correlations of each of the Self-Observation Scale subscales with reading achievement and mathematics achievement are shown in Appendix A. The intercorrelations of the seven subscales that comprise the Self-Observation Scale are shown in Table 39.

The same procedure as employed in the analysis of student achievement in reading and mathematics was employed in examining social confidence. Variables from each of four categories--staff background, time allocation, instructional expenditures, and organization--were employed in separate stepwise regression

TABLE 39

INTERCORRELATIONS OF SUBSCALES OF THE SELF-OBSERVATION SCALES
(N=28)

Variable	Self Accept.	Secur.	Social Matur.	Social Confi.	School Affil.	Teacher Affil.	Peer Affil.
Self Acceptance	1.000						
Security	.533	1.000					
Social Maturity	.732	.450	1.000				
Social Confidence	.582	.302	.783	1.000			
School Affiliation	.107	-.010	-.480	-.242	1.000		
Teacher Affiliation	.894	.446	.774	.676	.099	1.000	
Peer Affiliation	.880	.715	.853	.774	-.174	.809	1.000

analyses. A composite set of variables from among the four categories was then employed in a final regression analysis (see Table 40).

Staff Background Variables

Eleven of the 20 staff background variables were selected for inclusion in the initial regression equation. The results of the initial equation are shown in Table 40. The 11 variables yielded a coefficient of multiple correlation of .7776 and accounted for over 60 percent of the variance in social confidence. The F-ratio was statistically significant at the .10 level. However, only one of the 11 variables, present enrollment in a degree program (BIQ2), exhibited a statistically significant partial correlation with social confidence.

Application of the backward stepwise regression procedure resulted in removal of seven variables from the equation. Number of offices held in professional organizations (BIQ14) was the first variable removed and number of district committee memberships (BIQ11) was the seventh variable removed. The results of the stepwise procedure are shown in Table 41.

The final regression equation is shown in Table 42. The four variables remaining in the equation yielded a coefficient of multiple correlation of .6680, accounting for nearly 45 percent of the variance in social confidence in comparison with the 60 percent accounted for by all 11 variables. The F-ratio for the final equation was statistically significant at the .01 level. Present enrollment in a degree program (BIQ2) had a partial correlation coefficient significant at the .01 level and participation in an IGE staff development workshop within the past two years (BIQ6), years of teaching experience (BIQ7), and overall feeling about the school (BIQ20), had partial correlation coefficients significant at the .05 level.

Time Allocation Variables

Ten variables measuring various aspects of the way teachers reported allocating their time to both instructional and noninstructional activities were selected for inclusion in the regression equation. The results of the initial equation are shown in Table 43. The 10 time allocation variables produced a multiple coefficient of correlation of .6204 and accounted for about 38 percent of the variance in the social confidence score. The associated F-ratio was not significant at the .10 level. Of the 10 variables, only noninstructional time spent in pupil supervision (IIIA) was found to have a partial correlation coefficient significant at the .05 level.

Application of the backward stepwise regression procedure resulted in eliminating nine variables from the equation. The variables removed at each step in the procedure are summarized in Table 44.

The results of the final equation are shown in Table 45. The only variable remaining in the equation, noninstructional time spent in supervision of pupils (IIIA), produced a correlation of .3515 and accounted for about 12 percent of the variance in social confidence scores. The associated F-ratio was significant at the .10 level. The results of the analysis suggest that the way in which teachers allocate their time to instructional and noninstructional activities has little relationship to social confidence scores of pupils.

TABLE 40

REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 16 d.f.)	Observed Sig. Level
1	BIQ1	-.1772	-.225	.84953	.3704
2	BIQ2	-.4775	-.557	7.19297	.0164
5	BIQ5	.1930	.246	1.03196	.3248
6	BIQ6	.3432	.366	2.46718	.1358
7	BIQ7	.3931	.279	1.34754	.2627
9	BIQ9	.2174	.213	.76081	.3960
11	BIQ11	.3006	.390	2.87427	.1094
12	BIQ12	-.2827	-.310	70092	.2106
14	BIQ14	-.0025	-.003	.0018	.9896
15	BIQ15	-.0948	-.070	.07865	.7827
20	BIQ20	.3483	.266	1.21775	.2861

CONSTANT TERM = 4797.525

R = .7776

R^2 = .6046

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	1546800	11	140610
Residuals from regression	1011400	16	63212
Corrected total	2558200	27	

F-Ratio = 2.22 (with 11 and 16 d.f.)

Significance level = .0711

TABLE 41

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON SOCIAL CONFIDENCE

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.7776	.6046			12
1	BIQ14	.7776	.6046	-.0000	.990	11
2	BIQ15	.7763	.6027	-.0019	.776	10
3	BIQ9	.7623	.5811	-.0216	.336	9
4	BIQ1	.7449	.5548	-.0263	.289	8
5	BIQ12	.7358	.5414	-.0134	.446	7
6	BIQ5	.7106	.5050	-.0364	.211	6
7	BIQ11	.6680	.4462	-.0588	.120	5

TABLE 42

FINAL EQUATION: REGRESSION OF SELECTED STAFF BACKGROUND VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 23 d.f.)	Observed Sig. Level
1	BIQ1		-.073		.7343
2	BIQ2	-.5209	-.566	10.81857	.0032
5	BIQ5		.298		.1571
6	BIQ6	.3951	.415	4.78583	.0291
7	BIQ7	.3630	.403	4.46024	.0458
9	BIQ9		.154		.4732
11	BIQ11		.326		.1202
12	BIQ12		-.112		.6030
14	BIQ14		.088		.6833
15	BIQ15		-.053		.8053
20	BIQ20	.3581	.401	4.39764	.0472

CONSTANT TERM = 4998.47

R = .6680

R^2 = .4462

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	1141400	4	285360
Residuals from regression	1416700	23	61597
Corrected total	2558200	27	

F-Ratio = 4.63 (with 4 and 23 d.f.)

Significance level = .0069

TABLE 43

REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 17 d.f.)	Observed Sig. Level
53	IIIA	-.4937	-.493	5.46975	.0318
54	IIIB	-.2792	-.296	1.62844	.2191
55	IIIC	-.1888	-.177	.55118	.4680
56	IIID	.2814	.276	1.40103	.2528
61	TREAD	.0913	.087	.13108	.7218
62	TLANG	.1647	.172	.51648	.4821
63	TMATH	-.0744	-.068	.07961	.7812
65	TSOC	.0991	.114	.22255	.6431
67	T1TO1	.1341	.111	.21070	.6520
68	TSMALL	-.2194	-.230	.95056	.3432

CONSTANT TERM = 5486.635

R = .6204

R^2 = .3849

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	984560	10	98456
Residuals from regression	1573600	17	92565
Corrected total	2558200	27	

F-Ratio = 1.06 (with 10 and 17 d.f.)

Significance level = .4377

TABLE 44

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON SOCIAL CONFIDENCE

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.6204	.3849			11
1	TMATH	.6181	.3820	-.0029	.781	10
2	TREAD	.6160	.3795	-.0025	.789	9
3	TSOC	.6102	.3724	-.0071	.646	8
4	TITOI	.5980	.3576	-.0148	.501	7
5	TTTC	.5788	.3350	-.0226	.400	6
6	TSMALL	.5464	.2985	-.0365	.284	5
7	TLANG	.5065	.2565	-.0420	.253	4
8	IIID	.4568	.2087	-.0478	.226	3
9	IIIB	.3515	.1235	-.0851	.114	2

TABLE 45

FINAL EQUATION: REGRESSION OF SELECTED TIME ALLOCATION VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 26 d.f.)	Observed Sig. Level
53	IIIA	-.3515	-.351	3.66478	.0666
54	IIIB		-.312		.1135
55	IIIC		.075		.7104
56	IIID		.217		.2761
61	TREAD		.067		.7380
62	TLANG		.211		.2906
63	TMATH		.061		.7624
65	TSOC		.177		.3771
67	T1TO1		.291		.1403
68	TSMALL		-.249		.2103

CONSTANT TERM = 5533.11

R = .3515

R^2 = .1235

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	316030	1	316030
Residuals from regression	2242100	26	86236
Corrected total	2558200	27	

F-Ratio = 3.66 (with 1 and 26 d.f.)

Significance level = .0666

Expenditure Variables

The same instructional expenditure variables that were regressed against reading achievement and mathematics achievement scores were also regressed against the social confidence score. The six instructional expenditure variables produced a coefficient of multiple correlation of .5359 and accounted for about 29 percent of the variance in social confidence. The F-ratio was not significant at the .10 level. The results of the analysis are displayed in Table 46.

The results obtained from the backward stepwise regression procedure are summarized in Table 47. All of the instructional expenditure variables except instructional salary (SALARY) were dropped from the equation.

The final equation, in which only instructional salary (SALARY) was retained, is shown in Table 48. Instructional salary correlated at .405 with social confidence which was significant at the .05 level. This variable alone accounted for about 16 percent of the variance in social confidence scores compared with the 29 percent accounted for by the entire set of six expenditure variables. As was the case with time allocation variables, instructional expenditures exhibited little relationship with social confidence.

Organizational Variables

Nine variables reflecting various measures of the school organization were selected for regression against social confidence. The results of the initial regression are shown in Table 49. This set of variables produced a coefficient of multiple correlation of .4471, accounting for about 20 percent of the variance in social confidence. The F-ratio was not significant at the .10 level. None of the variables exhibited partial correlation coefficients significant at the .10 level. Application of the backward stepwise regression procedure revealed that none of the organizational variables met the criterion for retention and further analysis of this model was abandoned.

Composite Variables

Twelve variables were selected from among the four groups of variables analyzed previously. Four measured various aspects of staff background, four measured time allocation, two were organizational measures, one measured expenditure, and one measured school size. The results of the initial regression equation are reported in Table 50. The coefficient of multiple correlation for the 12 variables was .8516 and they accounted for over 72 percent of the variance in social confidence. The F-ratio was significant at the .05 level. Of the 12 individual variables, the partial correlation coefficient of present enrollment in a degree program (BIQ2) was significant at the .05 level and the partial correlation coefficients of noninstructional time spent in supervision of pupils (IIIA) and school size (SCHSIZ) were both significant at the .10 level.

The results obtained from the backward stepwise regression procedure are summarized in Table 51. Five variables were removed from the equation.

The seven variables remaining produced a multiple coefficient of correlation of .8036. The seven variables accounted for about 64 percent of the variance in social confidence compared to the 72 percent accounted for when all 12 variables were included in the equation. The F-ratio was significant at the

TABLE 46

REGRESSION OF SELECTED EXPENDITURE VARIABLES
ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 21 d.f.)	Observed Sig. Level
106	SALARY	.3699	.345	2.84608	.1064
107	SUPPLY	.2048	.118	.29404	.5934
108	BOOKS	.4764	.294	1.98688	.1733
109	OTHEREXP	-.3564	-.189	.77464	.3887
110	PLANT	.0650	.061	.07816	.7825
111	CAPITAL	-.2538	-.187	.75804	.3938

CONSTANT TERM = 4903.4096

R = .5359

R^2 = .2872

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	734780	6	122460
Residuals from regression	1823400	21	86828
Corrected total	2558200	27	

F-Ratio = 1.41 (with 6 and 21 d.f.)

Significance level = .2571

TABLE 47

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED EXPENDITURE VARIABLES ON SOCIAL CONFIDENCE

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.5359	.2872			
1	PLANT	.5335	.2846	-.0027	.783	6
2	SUPPLY	.5260	.2756	-.0089	.605	5
3	OTHEREXP	.5093	.2594	-.0163	.479	4
4	CAPITAL	.4561	.2080	-.0513	.209	3
5	BOOKS	.4045	.1637	-.0444	.248	2

TABLE 48

FINAL EQUATION: REGRESSION OF SELECTED EXPENDITURE VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 26 d.f.)	Observed Sig. Level
106	SALARY	.4045	.405	5.08774	.0327
107	SUPPLY		.098		.6284
108	BOOKS		.230		.2477
109	OTHEREXP		.011		.9579
110	PLANT		.178		.3744
111	CAPITAL		-.023		.9084

CONSTANT TERM = 4986.5805

R = .4045

R^2 = .1637

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	418660	1	418660
Residuals from regression	2139500	26	82288
Corrected total	2558200	27	

F-Ratio = 5.09 (with 1 and 26 d.f.)

Significance level = .0327

TABLE 49

REGRESSION OF SELECTED ORGANIZATION VARIABLES ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 18 d.f.)	Observed Sig. Level
126	PRLDRSHP	-.5147	-.248	1.17958	.2918
127	TOTJSAT	.5227	.216	.87927	.3608
128	DJASCB,3	-.0281	-.012	.00249	.9607
129	DJATOT,3	.3[illegible]	.144	.37906	.5458
130	DJASCB,4	.02[illegible]	.008	.00119	.9729
131	DJATOT,4	.0309	.011	.00207	.9642
132	IPMREAD	.4304	.171	.54004	.4719
133	IPMMATH	-.3395	-.188	.65852	.4277
134	IRTOTAL	-.3213	-.092	.1[illegible]	.7009

CONSTANT TERM = 5121.40

R = .4471

R^2 = .1999

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	511450	9	56828
Residuals from regression	2046790	18	113710
Corrected total	2558240	27	

F-Ratio = .50 (with 9 and 18 d.f.)

Significance level = .8557

No variable could be retained and analysis of the model was abandoned.

TABLE 50

REGRESSION OF SELECTED VARIABLES
ON SOCIAL CONFIDENCE

Variable No.	Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 15 d.f.)	Observed Sig. Level
2	BIQ2	-.4341	-.530	5.85497	.0287
6	BIQ6	.1706	.201	.63074	.4395
7	BIQ7	.2416	.284	1.31833	.2689
20	BIQ20	.2583	.322	1.73805	.2072
32	M1TO1	.2486	.389	2.67008	.1231
33	MSMALL	-.1769	-.185	.53450	.4760
53	IIIA	-.3770	-.422	3.24672	.0917
72	TBLTOT	.1425	.192	.57472	.4601
105	SCHSIZ	-.3622	-.421	3.23312	.0923
106	SALARY	-.0547	-.073	.07986	.7813
126	PRLDRSHP	-.3582	-.237	.89470	.3592
127	TOTJSAT	.2884	.171	.44971	.5127

CONSTANT TERM = 5614.41138

R = .8516

R^2 = .7252

Analysis of Variance Summary

Source of ation	Sum of Squares	d.f.	Mean Square
Linear regression	1655200	12	54600
Residuals from ression	703000	15	46866
Corrected total	2558200	27	

F-Ratio = 3.30 (with 12 and 15 d.f.)

Significance level = .016

TABLE 51

SUMMARY OF STEPS: STEPWISE REGRESSION OF SELECTED VARIABLES ON SOCIAL CONFIDENCE

Step No.	Variable	R	R^2	Change in R^2	Observed Sig. Level	No. of Variables in Equation
	ALL FREE VARIABLES	.8516	.7252			13
1	SALARY	.8507	.7237	-.0015	.781	12
2	MSMALL	.8468	.7153	-.0084	.496	11
3	TBLTOT	.8422	.7093	-.0061	.554	10
4	BIQ20	.8207	.6736	-.0357	.155	9
5	BIQ6	.8036	.6458	-.0278	.219	8

.01 level. Six variables exhibited partial correlation coefficients significant at the .05 level: present enrollment in a degree program (BI2L), years of teaching experience (BI27), time spent in one-to-one instruction in mathematics (M1TOI), noninstructional time spent in supervision of pupils (IIIA), teachers' perception of principal's leadership (PRLDRSHP), and total job satisfaction of teachers (TOTJSAT). The partial correlation coefficient for school size (SCHSIZ) was significant at the .10 level (Table 5).

The results of the analyses suggest that this measure of school output, social confidence, can be predicted with considerable accuracy using a set of school input and process variables. The most useful independent variables tended to reflect the ambience of the school rather than specific aspects of the instructional process. Variables such as years of teaching experience, whether teachers were currently enrolled in a degree program, school size, teachers' perception of the principal's leadership, and teachers' total job satisfaction conveyed a picture of the unique qualities within a school rather than revealing specific elements of the instructional process that strongly influenced the social confidence of students. In short, social confidence appeared to be related more to the general atmosphere of a school than to the instructional process variables for which measures were available.

TABLE 52

[illegible] REGRESSION OF FIVE [illegible] VARIABLES
[illegible]

Variable No.	Variable Name	Standardized Regression Coefficient	Partial Correlation Coefficient	Partial F Value (1 and 20 d.f.)	Observed Sig. Level
[illegible]	BI,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	BI,[illegible]		[illegible]		[illegible]
7	BI,7	[illegible]	.436	4.60533	.0425
20	BI,20		.260		.2544
32	MITOL	.2939	.427	4.45124	.0477
[illegible]	M.MALL		[illegible]		.5075
[illegible]	IIIA	[illegible]	-.476	5.[illegible]743	.0245
72	TBLTOT		.231		.3147
105	SCHSIZ	-.2589	-.360	2.97724	.0999
106	SALARY		.060		.7958
126	PRLDRSHP	-.7224	-.472	5.72818	.0266
127	TOTJSAT	.7411	.489	6.29758	.0208

CONSTANT TERM = [illegible].8843

R = .8036

R^2 = .6458

Analysis of Variance Summary

Source of Variation	Sum of Squares	d.f.	Mean Square
Linear regression	[illegible]	7	[illegible]
Residuals from regression	[illegible]	[illegible]	[illegible]
Corrected total	[illegible]	27	

F-Ratio = 5.21 (with 7 and 20 d.f.)

Significance level = .0017

IV

FINDINGS AND IMPLICATIONS

In this concluding section we shall first deal with the findings of the study in the context of the conceptual framework introduced in Chapter I. We shall then discuss the implications of the study for further research.

FINDINGS

It should be noted at the outset that generalizations based on the findings obtained in this research are unwarranted. The limited sample size, the shortcomings of the data base (in terms of both data quantity and quality), and the exploratory nature of the research all emphasize the dangers of developing prescriptions for change in educational policy on the basis of our findings. It is for these reasons that the findings are reported in terms of the percentage of variance accounted for by a set of variables rather than the response of the output to a specified change in input. The findings of the study do, however, suggest some promising avenues of investigation for those interested in the linkages between inputs, processes and outputs in the process of schooling. The conceptual view of the educational production process under school conditions described in Chapter I provides a useful framework for discussing the findings.

Inputs from the External Environment

The data base employed in this study did not contain variables descriptive of the economic, social or demographic characteristics of the school community. An attempt was made to obtain census data that would serve in this regard but it proved impossible to obtain data for the individual schools included in the sample. Census data for an entire school district were available but not for the individual elementary schools within a district. The district-wide data were not considered appropriate for use in a data base where all other data were specific to a single school.

Resource Inputs

Some data were available for three types of resource inputs: students, teachers, and instruction expenditures. The data concerning teachers provided information on the background and characteristics of the teaching staff of the I&R unit, e.g., average academic preparation, teaching experience, and professional activities.

The only data available concerning students were the scores on the Self-Observation Scales, that provided a measure of student self concept. However, these data were not the scores for individual students; they were the average

[illegible] expenditures [illegible] materials, supplies, books, maintenance [illegible], and other expenditures for instruction. Although an attempt was [illegible] broad program [illegible] other [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] were [illegible] and it was necessary to assume that the average expenditure per pupil for the school represented a reasonable approximation of the expenditure pattern of the [illegible] unit in which teacher and pupil data were [illegible].

Staff background. Several variables relating to the background and characteristics of teachers were entered in the stepwise regression analyses. Whether teachers were currently enrolled in a degree program was one of the most useful variables in the [illegible]. Statistically significant partial correlations were found between [illegible] enrolled in a degree program and average student [illegible] in reading [illegible] and mathematics [illegible].

Years [illegible] was also a useful variable, exhibiting a statistically significant partial correlation with student scores in both mathematics and reading achievement. The partial correlation between the sex of teachers and student scores in mathematics was statistically significant, with male teachers favored. Age of teachers was found to have a significant partial correlation of student reading achievement scores, with older teachers favored.

The staff background variables as a group, however, were not particularly useful in explaining variations in student achievement scores. A set of 11 staff background variables explained only about 4 percent of the variance in reading achievement and 6 percent of the variance in mathematics achievement.

Student self-concept. As noted above, student self-concept was measured by the Self-Observation Inventory. It can be argued that, while the self-concept student brings to the learning process is an input, self-concept is also affected by the educational process and is thus an output of schooling. It was, therefore, treated as both a predetermined input and as an output of schooling in separate runs, and in this study. The subscale, social maturity, exhibited a statistically significant partial correlation with reading achievement and accounted for 64 percent of the [illegible] variance. The subscale, social confidence, had a statistically [illegible] partial correlation with mathematics achievement and accounted for 6 percent of the variance in mathematics scores. The seven self-concept variables when [illegible] together accounted for 8 percent of the variance in reading achievement while social maturity alone accounted for 6 percent. In the case of mathematics achievement, the seven variables [illegible] accounted for 4 percent of the variance with social confidence alone accounting for 3 percent.

Expenditure variables. The expenditure variables were not found to be particularly useful in explaining variance in the reading, mathematics, or social confidence scores of students. Of the six instructional expenditure variables for which reasonably complete data were available, only expenditure per pupil for salary was found to have a significant partial correlation with reading achievement and social confidence scores. None of the expenditure variables had statistically significant partial correlations with mathematics achievement scores. The six variables together accounted for only 17 percent of the variance in reading achievement, while expenditure per pupil for salary alone accounted

for [illegible] percent of the variance in mathematics achievement was accounted for by the six expenditure variables. With regard to social confidence, the set of instructional expenditure variables taken together accounted for about 29 percent of the variance with expenditure per pupil for instructional salaries alone accounting for over 16 percent of the variance.

Resource Input Mix

Two sets of variables that measured aspects of the resource input mix were obtained: time allocation of teachers and organizational/administrative arrangements. Teachers reported the allocation of their time to direct instruction and to noninstructional activities. The direct instruction category was further subdivided by time allocated to various subject areas (reading, mathematics, etc.) and by mode of instruction (large group, one-to-one, etc.). The noninstructional category was also subdivided by type of activity (supervision, planning, record keeping, etc.). This procedure yielded a matrix of 52 variables. It should be noted that the time allocation data were obtained from reports submitted by teachers with no external validation. No data on how pupils in the I&R units spent their time were available.

Time allocation. The time allocation variables were of limited use in explaining the variance in reading, mathematics, and social confidence scores. A set of 12 time allocation variables accounted for only 44 percent of the variance in reading achievement scores and the six variables retained in the final equation accounted for only about 37 percent of the variance. The six variables that exhibited statistically significant partial correlation with reading achievement included: time allocated to one-to-one, small group, and class size instruction in reading; total time allocated to instruction in reading and in language arts; and noninstructional time allocated to supervision.

A similar set of 12 time allocation variables accounted for only about 38 percent of the variance in mathematics achievement. None of the 12 variables were found to have a statistically significant partial correlation with reading achievement.

Six variables reflecting the allocation of instructional time by subject area and mode of instruction and four variables reflecting the way teachers allocated their time to noninstructional activities were found to account for only about 38 percent of the variance in social confidence scores. Only time allocated to supervision of pupils (noninstructional) exhibited a statistically significant partial correlation with social confidence scores. This variable alone accounted for 12 percent of the variance in the dependent variable.

Organization. The set of nine variables classified as organizational variables included such items as teachers' ratings of the principal's leadership, teachers' decision involvement and job satisfaction, and teachers' ratings of the extent to which the IGE model for instructional programming actually had been implemented. These variables were assumed to measure various aspects of the instructional climate of the I&R unit in which data were gathered rather than directly measuring the resource input mix. The entire set of organizational variables accounted for about 45 percent of the variance in reading achievement. The three variables that had statistically significant partial correlations with reading achievement (involvement of teachers in decision making, job satisfaction of teachers, and teachers' perception of the principal's leadership) accounted for 33 percent of the variance in this measure, with the principal's leadership exhibiting a negative partial correlation.

[illegible] of graduate-level variables are added [illegible] percent of the variance in mathematics achievement and only two of the variables exhibited statistically significant partial correlations. Implementation of the IPM in mathematics had a negative partial correlation while the partial correlation of teachers' involvement in decision making was positive. These two variables together, however, accounted for only about 1 percent of the variance in mathematics achievement.

With regard to [illegible], the set of organizational variables accounted for only 4 percent of the variance in this dependent variable. None of the organizational variables were found to have a statistically significant partial correlation with [illegible].

Outputs of Schooling

The measures of output employed in this study were somewhat limited, particularly in terms of the range of outputs suggested by the conceptual framework. They involved only short range outputs: measures of student achievement in reading and mathematics as indicated by scores on standardized tests, and a measure of student self-concept as indicated by the subscales of the Self-Observation Scales. Long range outputs, monetary outputs, and joint outputs were not represented in the measures of output employed in this study.

Input/output in reading. Following the analyses discussed in the preceding chapters, a composite set of variables consisting of the most useful variables selected from among each of the categories was analyzed to determine their relationship to reading achievement. It was found that a set of 12 variables accounted for nearly 72 percent of the variance in reading achievement scores. Five of the 12 variables exhibited statistically significant partial correlations with reading achievement and the five together accounted for over 57 percent of the variance. The partial correlations of time allocated to reading instruction in class size groups and leadership of the principal were negative; those of years of teaching experience, instructional salary per pupil, and teachers' total job satisfaction were positive.

When social confidence was treated as an input and included in the set of independent variables, the 13 variables explained 59 percent of the variance in reading achievement. However, only two of the variables in this set were found to have statistically significant partial correlations with reading achievement. These two variables (time allocated to large group instruction in reading and social confidence) explained 56 percent of the variance in reading scores.

Input/output in mathematics. When 12 of the most useful independent variables selected from among the various categories were regressed against mathematics achievement, they were found to account for over 71 percent of the variance in the dependent variable. Four of the 12 variables exhibited statistically significant partial correlations with mathematics achievement and together accounted for 56 percent of the variance. Three staff background variables--enrollment in a degree program, ratio of male to female teachers, and years of teaching experience--were correlated positively with mathematics achievement, while school size was correlated negatively.

When social confidence was treated as an input variable and included in the regression, the set of 13 independent variables accounted for nearly 77 percent of the variance in mathematics achievement. Five of the 13 variables were found

to have statistically significant partial correlations with mathematics achievement and the five together accounted for [illegible] percent of the variance. Total time allocated to reading instruction and leadership of the principal had negative partial correlations; years of teaching experience, time allocated to large group instruction in mathematics, and social confidence had positive partial correlations with mathematics achievement.

Input-output in social confidence. The self-concept of students may be considered as either an input to the process of schooling or as one of the outputs of the schooling process. One of the subscales of the Self-Observation Scales, social confidence, was selected to serve as a proxy measure of student self-concept and was used as the dependent variable in a multiple regression equation in which 12 variables selected from among the various categories served as independent variables. The set of 12 variables accounted for over 72 percent of the variance in social confidence scores. Seven of the 12 variables were found to have statistically significant partial correlations with social confidence. The seven variables together accounted for over 64 percent of the variance. Enrollment in a degree program, years of teaching experience, time allocated to one-to-one instruction in mathematics, and job satisfaction of teachers were related positively to social confidence scores of students; time allocated to supervision of pupils, school size, and the leadership of the principal were related negatively.

IMPLICATIONS

No implications for educational policy or practice are claimed as a result of this research. Although it has been fashionable for researchers who employ the production function technique to suggest (if not to explicate) implications for educational policy or practice drawn from their work, we believe that identifying implications for practice or policy as a result of this research is unwarranted. The limited size of the sample and the limited nature of the data available do not justify generalizations, even to IGE schools.

Studies of this type too frequently are interpreted erroneously, despite the caution sounded by researchers. To discourage the misuse of the results of this research, we have deliberately chosen to publish only the standardized regression coefficients for the regression analyses reported in Chapter III. We hope in this way to avoid the temptation to make statements concerning the effect of a specified change in input on a given output. Such statements are unwarranted on the basis of data obtained from one I&R unit in each of 28 IGE elementary schools. A number of implications for future research may be drawn, however, and they will be identified and described in this concluding section.

Conceptual Framework

The conceptual framework of the educational production process related to formal schooling was useful in classifying the data employed in this study. The framework indicates the logical relationship of input and process variables to educational outcomes; it does not indicate the nature of the linkages through which inputs are transformed into outputs in the educational process. These linkages can be determined only through additional careful research. The framework is heuristic in that it generates questions and suggests testable hypotheses, but it does not provide simple answers.

Unfortunately, no variables were available for the parts of the framework labeled "Inputs from the External Environment" and "System Controls." In view of the importance attached to such variables by previous researchers, and their prominence in the generalized educational production function, it is imperative that they be represented in the data base when future research is designed. The data available concerning pupils were also very limited, consisting solely of scores on the subscales of the Self-Observation Scales. In view of the importance ascribed to individual student endowments in the generalized production function, additional data concerning the characteristics of individual students should be obtained in future research. Additional data concerning the characteristics of other human inputs (teachers, aides, administrators, etc.) would also be desirable.

The useable data concerning material inputs consisted only of expenditures for instructionally related functions and objects. Data concerning the quantity and quality of instructional materials, the adequacy of space and equipment, and other aspects of the material resource inputs were not available. Such data should be obtained in future research.

The measures of the resource input mix used in this study consisted of estimates by teachers of the way in which they allocated their time, and teachers' perceptions of certain aspects of the organizational structure and the climate of the school. Measures of the ways in which pupils spend their time in school are needed and probably can only be gathered by careful observation of individual pupils in classrooms. Also needed are more accurate data regarding the instructional decision making process in classrooms, as well as data concerning the implementation of instructional decisions with individual students and groups of students. Data concerning the use of instructional material by individual students and groups of students also are needed.

The data concerning the outputs of schooling that were available for this study were quite limited, particularly when compared with the wide variety of outcomes suggested by the conceptual framework. Most would agree that student achievement in reading and mathematics are important outputs of formal schooling, but they certainly do not exhaust the possibilities. Additional measures of outcomes need to be obtained in future studies.

The data obtained from the Self-Observation Scale were particularly interesting in that these variables were correlated closely with student achievement in reading and mathematics. Student self-concept is both an input to the educational production process and is, itself, affected by the process. It would appear that longitudinal studies with repeated measurements of individual students will be required to sort out the input- and output-related aspects of student self-concept.

Variables

Several variables were found to be related consistently to student achievement in reading and mathematics. Statistically significant partial correlation coefficients were found between these independent variables and the dependent variable in the final stepwise regression equations. Each variable will be discussed briefly.

Enrollment of teachers in a degree program. Student achievement scores in reading and in mathematics were related positively to the number of teachers in the I&R unit who were involved in a degree program. This finding supports Marinelli's (1976, p. 124) contention that, "one of the keys to the teacher's

effectiveness appears to be the recency of the teacher's latest educational experience." Whether involvement in a degree program acts directly to enhance student achievement or whether it is a proxy for other attributes that have a salutary effect on student achievement are questions not answered by this research. A teacher's involvement in a degree program may reflect a professional attitude, a desire to keep up-to-date with the profession, an aspiration toward upward mobility or some other attitudinal characteristic. The result may be improved professional competence that translates directly into improved pupil performance. The data did not indicate the nature of the degree program in which teachers were enrolled, nor the intensity with which they were pursuing a degree. The data did not indicate whether additional professional training through credit or noncredit courses not directed toward a graduate degree would produce similar results. However, the consistent statistically significant relationship between this variable and student achievement in reading and mathematics merits closer study in future research.

Years of teaching experience. Years of teaching experience was related positively to student achievement in mathematics in the staff background regression, and to both reading and mathematics achievement in the composite regressions. A number of researchers have obtained similar findings, although it generally is argued that additional experience increases teacher productivity only during the early years of a teaching career (Marinelli, 1976, p. 127). The mean years of teaching experience for teachers in this study was 8.12 years, indicating a substantial portion of the teachers were near the beginning of their careers. Additional research is needed to determine whether teaching effectiveness reaches a peak and then declines as one gains additional experience and, if such is found, whether steps can be taken to avert such a decline, e.g., encouraging experienced teachers to become involved in a program of study leading to an advanced degree.

Sex. The sex of the teacher was related to student achievement in mathematics, with I&R units in which there was a larger proportion of male teachers exhibiting higher student achievement in mathematics. Whether male teachers do, indeed, teach mathematics more effectively than female teachers is a question not answered by this study. It has often been noted that girls are less inclined to study mathematics when they reach secondary school. This tendency may be related to the relative effectiveness of male and female teachers at the elementary level which results in stereotyping on the basis of sex.

Expenditures. Expenditures for instructionally-related purposes were found to be of little value in accounting for variance in student achievement. Perhaps the failure to find statistically significant relationships can be attributed to the relatively gross expenditure data that were available. On the other hand, it must be recognized that the amount of money expended may be far less important the the purpose for which it is expended. No measures of the quality, quantity, or appropriateness of instructional materials in the I&R units were availabel in this study. The availability of supporting services could only be conjectured and no data concerning the adequacy of instructional facilities and equipment were available. Future research should attempt to gain more precise information concerning not only the amounts of money that are expended, but the items that are purchased.

Time allocation by teachers. The way in which teachers reported allocating their time bore no relationship to student achievement in mathematics, where none of the time allocation variables exhibited statistically significant partial correlations with achievement in mathematics. Time allocation by teachers was

more closely related to reading achievement, although the variance in reading achievement accounted for by the time allocation variables was relatively small. It is possible that data on how students (as opposed to teachers) spend their time would show a closer relationship to their achievement in reading and mathematics. Future research should attempt to obtain information concerning how students allocate their time. The data on teacher time allocations were taken from self-reports of the teachers. Perhaps independent observers would provide more accurate data on how teachers spend their time.

Student self-concept. Data concerning the self-concept of students were obtained from the Self-Observation Scales. Scores on two subscales of the Self-Observation Scales, social maturity and social confidence, were found to have statistically significant partial correlations with reading achievement and mathematics achievement respectively, and accounted for a substantial portion of the variance in reading scores and mathematics scores. However, social maturity and social confidence clearly are not independent of the experiences a student undergoes during the process of formal schooling and, thus, they also may be viewed as outputs of schooling.

The Intermediate Level of the Self-Observation Scales developed by Katzenmeyer and Stenner (1973) is a direct, self-report, group-administered instrument comprising 60 items that measure seven areas of student affective behavior in grades four through six: self-acceptance, self-security, social maturity, social confidence, school affiliation, teacher affiliation, and peer affiliation. The factor structure of the instrument is highly replicable and satisfactorily invariant across sex and race (Katzenmeyer and Stenner, 1976). Social maturity is described as follows (Katzenmeyer and Stenner, 1973):

> Children with high scores on this scale know how they are supposed to think and feel in a variety of social situations. They have learned the importance of such notions as "fair play," "sharing," "perserverance," "helpfulness," and "generosity." Children with low scores on this scale have not learned these notions and are likely to evidence behaviors that most adults would characterize as selfish, inconsiderate, or immature. Three items highly related to this scale are: I like to play only when I am the leader (-.51); I always have to be the boss (-.46); I like to see other children happy (.31).

Social confidence is described as follows (Katzenmeyer and Stenner, 1973):

> Children with high scores on this scale feel confident of their ability to relate successfully in social situations. They feel confident that they can make friends easily and that they are valued and enjoyed by their friends. Children with low scores have difficulty making friends, do not feel valued by others and see other people as being more socially adept than themselves. Three items highly related to this scale are: People are picking on me (-.71); Other children are often mean to me (-.59); My classmates like me (.56).

The extremely [illegible] relationships between these two subscales and student achievement in reading and mathematics merit further research. The interrelationships of these variables with student academic achievement over time should be investigated through longitudinal studies with repeated measurements of individual students. Questions such as, "Does academic performance affect student self-concept over time?" and, "To what extent are student self-concepts altered by their academic performance?" merit considerably more study by those who seek to understand the educational production process.

Perceived leadership of the principal. One of the most intriguing findings of this study was the statistically significant negative partial correlation between the leadership of the principal as perceived by teachers and student achievement in reading. Although the corresponding partial correlations with mathematics achievement were not statistically significant, they were consistently negative. This finding is similar to that of Boardman (1977).

The Principal Leadership Assessment (PLA) from which the data used in this study were obtained was adopted from the leadership portion of the Survey of Organizations instrument developed at the University of Michigan. The leadership measures were developed by Bowers and Seashore (1966), with leadership defined as, "organizationally useful behavior by one member of an organizational family toward another member or members of the same organization" (Mendenhall, 1977). The scales of the PLA are as follows (Mendenhall, 1977, pp. 67-68):

To what extent is(does) your principal

Scale I--Support

1. ... friendly and easy to approach?
2. ... attentive to what you say?
3. ... willing to listen to your problems?

Scale II--Goal Emphasis

1. ... encourage people to give their best effort?
2. ... maintain high standards of performance?
3. ... show you how to improve your performance?

Scale III--Work Facilitation

1. ... provide the help you need so that you can schedule work ahead of time?
2. ... offer new ideas for solving job-related problems?

Scale IV--Interaction Facilitation

1. ... encourage the persons who work with him/her to work as a team?
2. ... encourage people who work with him/her to exchange opinions and ideas?

Scores for the leadership of the principal were derived by determining the mean score on each scale and summing the mean scores to obtain a total score on leadership for each respondent.

We can only speculate as to the reason why the perceived leadership of principals was related negatively to student achievement. Perhaps, for example, teachers in schools where students do well academically have higher expectations for those with whom they work (both students and administrators) and, therefore, are more likely to be critical of the principal's leadership. In any event, the relationship of the principal's leadership to the outcomes of schooling deserves further study.

The job satisfaction expressed by teachers and the involvement of teachers in decision making also were related to student achievement in reading and mathematics respectively. As one would hypothesize, they also tended to be highly correlated with each other. The relationship of the variables that measure various aspects of school climate to student academic achievement merits further study.

Procedures

The multiple regression procedures employed in this study of educational production functions yielded some clues concerning input and process variables that are most useful in explaining variance in student achievement in reading and mathematics. It should be noted, however, that the equations were very sensitive to changes in the array of dependent variables. This is illustrated, for example, by the changes in the statistical significance of the variables included in composite sets one and two when the array of independent variables was altered slightly. A number of variables that had been statistically significant in one set of variables were not significant when included in a second set of vice versa.

It is important to note that the partial correlation coefficients for variables in a multiple regression equation are unique to the particular set of independent variables included in the equation. They reflect that portion of the relationship of an independent variable to the dependent variable that is independent of all other variables in the equation. Thus, as the composition of the set of independent variables is changed, the partial correlation coefficients of each variable with the dependent variable can be expected to change. Consequently, one should not read too much into any single partial correlation coefficient since it will depend upon the specific set of independent variables under study.

REFERENCES

Boardman, A. E., Davis, A., & Sanday, P. R. A simultaneous equations model of the educational process. Journal of Public Finance, 1977, 7, 23-49.

Bocain, B. H. Effectiveness of the multiunit elementary school's instruction and research unit and student affective behavior in IGE schools. Technical Report No. 389. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1976.

Bowers, D. S., & Seashore, S. E. Predicting organizational effectiveness with a four-factor theory of leadership. Administrative Science Quarterly, 11(2), 1966.

Bowles, S. S. Toward an educational production function. In W. L. Hansen (Ed.), Education, income and human capital. New York: National Bureau of Economic Research, 1970, 11-16.

Cohn, E. The economics of education. Lexington, Mass.: Lexington Books, 1972.

Cohn, E. Economies of scale in Iowa high school operations. Journal of Human Resources, Fall 1968, 422-434.

Coleman, J. S., Campbell, E. Q., Hobson, C. J., McPartland, J., Mood, A. M., Weinfeld, F., & York, R. L. Equality of educational opportunity. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1966.

Feldman, R. H. Involvement in and satisfaction with decision making related to staff and student behavior in IGE schools. Technical Report No. 408. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1977.

Garms, W. I., Guthrie, J. W., & Pierce, L. C. School finance: The economics and politics of public education. Englewood Cliffs, N.J.: Prentice-Hall, 1978.

Hanushek, E. A. The education of blacks and whites. Unpublished doctoral dissertation, Massachusetts Institute of Technology, 1968.

Katzman, M. T. Distribution and production in a big city elementary school system. Yale Economic Essays, Spring 1968, 201-256.

Katzenmeyer, W. G., & Stenner, A. J. Self observation scales--intermediate level. Durham, N.C.: National Testing Service, 1973.

Katzenmeyer, W. G., & Stenner, A. J. Estimation of the invariance of factor structures across sex and race with implications for hypothesis testing. Advance Publication No. 6. Durham, N.C.: National Testing Service, 1976.

Kiesling, H. J. Measuring a local government service: A study of school districts in New York State. Review of Economics and Statistics, August 1976, 356-367.

Kiesling, H. J. The relationship of school inputs to public school performance in New York State. Report No. 4211. Santa Monica, Cal.: The Rand Corporation, 1969.

Kiesling, H. J. A study of cost and quality of New York school districts. Washington, D.C.: U.S. Department of Health, Education and Welfare, 1970.

Klausmeier, H. J., Rossmiller, R. A., & Saily, M. Individually guided elementary education: Concepts and practices. New York: Academic Press, 1977.

Levin, H. M. A new model of school effectiveness. In Do teachers make a difference? Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1970, 55-78.

Levin, H. M. Measuring efficiency in educational production. Public Finance Quarterly, January 1974, 3-24.

Marinelli, J. J. An analytical process model for cost-effectiveness/productivity evaluation of alternative educational programs. Technical Report No. 390. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1976.

Mendenhall, D. R. Relationship of organizational structure and leadership behavior to teacher satisfaction in IGE schools. Technical Report No. 412. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1977.

Mort, P. R., Reusser, W. C., & Polley, J. W. Public school finance. New York: McGraw Hill, 1960.

Murnane, R. J. The impact of school resources on the learning of inner city children. Cambridge, Mass.: Ballinger Publishing Company, 1975.

Rossmiller, R. A., & Geske, T. G. Resource allocation and time utilization in IGE and non-IGE schools. Technical Report No. 410. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1977. (a)

Rossmiller, R. A., & Geske, T. G. Economic analysis of education: A conceptual framework. Theoretical Paper No. 68. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1977. (b)

Sigurdson, C. W. Effectiveness of the instruction and research unit and student achievement in IGE schools. Technical Report No. 385. Madison: Wisconsin Research and Development Center for Individualized Schooling, 1976.

STEPREG1: Stepwise linear regression analysis. Reference Manual for Univac 1110 Series Computers. Madison: Madison Academic Computing Center, August 1973.

Summers, A. A., & Wolfe, B. L. Which school resources help learning? Efficiency and equity in Philadelphia public schools. Federal Reserve Bank of Philadelphia Review, February 1975.

APPENDIX A

DESCRIPTION AND CLASSIFICATION OF 134 VARIABLES

APPENDIX A

DESCRIPTION AND CLASSIFICATION OF 134 VARIABLES

STAFF BACKGROUND INFORMATION	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM VALUE	MAXIMUM VALUE	VARIABLE CLASSIFICATION
1. BI,1 Highest level of in-service professional preparation: 1 = BA, ... = PhD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Resource
2. BI,2 Presently enrolled in a degree program: 1 = Yes, 2 = No	28	1.71	.535	.362	1.25	3.[illegible]	Human Resource
3. BI,3 Articles of presentation in the last 5 yrs. 1 = Yes, 2 = No	28	1.46	.255	.051	1.25	2.00	Human Resource
4. BI,4 Approximate number of articles presented	[illegible]	[illegible]	1.41	1.[illegible]	[illegible]	3.[illegible]	Human Resource
5. BI,5 Sex: 1 = female, 2 = male	28	1.33	.216	.046	1.00	1.80	Human Resource
6. BI,6 Participation in I&E Staff development workshop in past 2 yrs.: 1 = Yes, 2 = No	28	1.31	.263	.082	1.00	2.00	Human Resource
7. BI,7 Years of teaching experience	28	6.12	4.920	24.207	1.75	21.00	Human Resource
8. BI,8 Years teaching in present district	28	5.68	3.046	9.278	1.00	13.00	Human Resource
9. BI,9 Years teaching in present school	28	3.[illegible]	2.102	4.420	1.00	10.50	Human Resource
10. BI,10 Years teaching in I&E schools	28	2.76	.941	.885	1.00	4.67	Human Resource
11. BI,11 Number of district committees of which one is a member	28	1.16	.647	.418	0.00	2.33	Human Resource
12. BI,12 Number of professional organizations to which one is a member	28	2.44	1.046	1.094	.50	5.00	Human Resource
13. BI,13 Number of professional, organizational meetings attended per year	27	5.[illegible]	3.889	15.542	1.00	15.00	Human Resource
14. BI,14 Number of offices held in professional organizations in the last 5 years	28	.[illegible]	.[illegible]	.335	0.00	1.67	Human Resource
15. BI,15 Age	27	32.[illegible]	7.[illegible]	64.[illegible]	0.00	4[illegible]	Human Resource
16. BI,16 Number of meetings of I&R Unit per week	28	[illegible]	1.448	2.097	.67	6.00	Human Resource
17. BI,17 Minutes spent in planning, etc. each week by unit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	360.00	Human Resource

STAFF BACKGROUND INFORMATION continued	NUMBER PHASES	MEAN		VARIANCE	MINIMUM	MAXIMUM	VARIABLE CLASSIFICATION
18. B1q1e Total Years in present unit	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Resource
19. B1q19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Not Used
20. B1q21 Overall feeling about your school: 1 = Feels really good about it; 7 = Feels really bad about it	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Resource
INSTRUCTIONAL TIME INFORMATION							
21. INSTR Total time spent on instruction in hours per week	68	24.348	[illegible]	21.704	14.25	36.00	Resource Input Mix
22. RITO1 Time spent on reading 1 : 1 in hours per week	29	1.97	1.32	1.741	[illegible]	5.50	Resource Input Mix
23. RSMALL Reading small group: Hours week	[illegible]	2.42	1.51	2.283	.33	7.5	Resource Input Mix
24. RCLASS Reading class size: Hours/week	[illegible]	[illegible]	[illegible]	2.699	0.00	6.25	Resource Input Mix
25. RLARGE Reading large group: Hours/week	[illegible]	[illegible]	[illegible]	.006	0.00	.33	Resource Input Mix
26. ROTHER Reading other sized group: Hours/week	[illegible]	[illegible]	[illegible]	[illegible]	0.00	.31	Resource Input Mix
27. LITO1 Time spent on language arts 1 : 1: Hours/week	[illegible]	1.16	1.37	1.88	0.00	6.00	Resource Input Mix
28. LSMALL Language small group: Hours/week	[illegible]	[illegible]	[illegible]	.723	0.00	4.00	Resource Input Mix.
29. LCLASS Language class size: Hours/week	[illegible]	2.48	1.27	1.62	.25	5.33	Resource Input Mix
30. LLARGE Language large group: Hours/week	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.33	Resource Input Mix
31. LOTHER Language other sized group: Hours/week	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Resource Input Mix
32. MITO1 Math 1 : 1: Hours/week	[illegible]	[illegible]	[illegible]	1.79	[illegible]	5.13	Resource Input Mix
33. MSMALL Math small group: Hours/week	[illegible]	[illegible]	[illegible]	1.23	[illegible]	4.17	Resource Input Mix
34. MCLASS Math class size: Hours/week	[illegible]	1.47	[illegible]	1.86	0.00	.13	Resource Input Mix
35. MLARGE Math large group: Hours/week	[illegible]	[illegible]	[illegible]	.0096	0.00	.13	Resource Input Mix
36. MOTHER Math other sized	[illegible]	[illegible]	[illegible]	0.00	0.00	0.00	Resource Input Mix

44.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Resource Input Mix
45.	SOLARGE Social studies large group: Hours/week	[illegible]	[illegible]	[illegible]	0.00	1.50	Resource Input Mix
46.	SOTHER Social studies other sized groups: Hours/week	[illegible]	[illegible]	[illegible]	0.00	0.00	Resource Input Mix
47.	OTHO Other subjects other week	[illegible]	[illegible]	[illegible]	0.00	2.75	Resource Input Mix
48.	OSMALL Other subjects small group: Hours/week	[illegible]	[illegible]	[illegible]	0.00	2.67	Resource Input Mix
49.	OCLASS Other subjects class sized group: Hours/ week	[illegible]	[illegible]	[illegible]	0.00	7.13	Resource Input Mix
50.	OLARGE Other subjects large group: Hours/week	[illegible]	[illegible]	[illegible]	0.00	1.25	Resource Input Mix
51.	OOTHER Other subject other sized group: Hours week	[illegible]	[illegible]	0.00	0.00	0.00	Resource Input Mix
52.	NON Total time on non-instructional activities: Hours/week	[illegible]	[illegible]	32.017	7.25	31.08	Resource Input Mix
53.	IIIA Supervision of pupils: Hours/week	[illegible]	[illegible]	1.347	0.00	4.63	Resource Input Mix
54.	IIIB Planning time: Hours/week	28	6.57	3.77	14.182	2.25	19.00	Resource Input Mix
55.	IIIC Testing/Assessing/ Evaluating: Hours/week	28	3.11	2.97	8.800	.50	17.33	Resource Input Mix
56.	IIID Record keeping: Hours/week	28	2.41	1.19	1.426	.50	6:13	Resource Input Mix
57.	IIIE Inservice training: Hours/week	28	.81	.99	.999	0.00	5.00	Resource Input Mix

INSTRUCTIONAL TIME INFORMATION continued	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM	MAXIMUM	VARIABLE CLASSIFICATION
58. IIIF Clerical/Secretarial: Hours/week	28	3.23	2.18	4.769	0.00	8.17	Resource Input Mix
59. IIIG Administrative: Hours/week	28	.32	.49	.240	0.00	2.00	Resource Input Mix
60. IIIH Other non-instructional time: Hours/week	28	.62	.98	.466	0.00	2.33	Resource Input Mix
61. TREAD Total time in reading per school: Hours/week	28	6.12	2.04	4.170	2.25	10.00	Resource Input Mix
62. TLANG Total time in language per school: Hours/week	28	4.28	1.41	1.99	1.13	7.50	Resource Input Mix
63. TMATH Total time in math per school: Hours/week	28	3.16	1.26	1.578	1.00	8.00	Resource Input Mix
64. TSCI Total time in science per school: Hours/week	28	3.02	1.69	2.84	0.00	8.00	Resource Input Mix
65. TSOC Total time in social studies per school: Hours/week	28	3.19	1.86	3.46	0.00	9.00	Resource Input Mix
66. TOTHCUR Total time on other curricular subjects per school: Hours/week	28	2.60	2.43	5.89	0.00	7.67	Resource Input Mix
67. T1TO1 Total time in 1 : 1 for all instructional areas: Hours/week	28	7.26	5.11	26.158	1.00	21.00	Resource Input Mix
68. TSMALL Total time in small group instruction for all areas: Hours/week	28	5.69	3.12	9.761	1.50	13.33	Resource Input Mix
69. TCLASS Total time in class sized instruction for all areas: Hours/week	28	11.19	5.76	33.156	2.92	21.75	Resource Input Mix
70. TLARGE Total time spent in large group instruction (more than one class) for all areas: Hours/week	28	.20	.33	.112	0.00	1.25	Resource Input Mix
71. TOTHSZ Total time spent on instruction for other sized groups for all areas: Hours/week	28	.01	.06	.003	0.00	.31	Resource Input Mix
72. TBLTOT Total time allocated to instruction per school (the sum of variables 61 through 71)	28	24.36	4.54	20.616	14.25	36.00	Resource Input Mix
EXPENDITURE INFORMATION							
73. PRSAL That part of the principal's salary for instruction/pupil	28	45.15	20.49	419.76	13.68	111.11	Material Resource
74. TCHSAL Teacher salary for instruction/pupil	28	474.71	140.87	19843.00	197.07	797.90	Material Resource

EXPENDITURE INFORMATION continued	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM	MAXIMUM	VARIABLE CLASSIFICATION
75. PROSAL Other certified staff's salary for instruction per pupil	21	295.56	417.27	174120.00	0.00	999.99	Material Resource
76. SECSAL Secretary's salary for instruction pupil	28	21.13	14.81	204.57	1.74	57.30	Material Resource
77. OTHSAL Other staff salaries for instruc'on pupil	23	208.57	376.68	141870.00	0.00	999.99	Material Resource
78. INSTRSUP Cost of instructional supplies/pupil	27	46.19	186.88	34925.00	1.30	999.99	Material Resource
79. OTHSUP Cost of other supplies for pupil	22	217.14	416.32	173320.00	.09	999.99	Material Resource
80. TEXTBOOK Expenditures for textbooks/pupil	24	148.51	354.02	125330.00	.04	999.99	Material Resource
81. LIBBOOK Expenditures for library books/pupil	28	3.84	3.66	13.379	0.00	20.00	Material Resource
82. PERIOD Expenditures for periodicals/pupil	23	179.04	389.80	151940.00	.05	999.99	Material Resource
83. AUDIO Expenditures for audio/ visual materials/pupil	23	145.12	355.41	126320.00	.21	999.99	Material Resource
84. OTHBOOK Expenditures for other books per pupil	14	500.51	508.64	258720.00	0.00	999.99	Material Resource
85. TRAVEL Expenditures related to travel per pupil	25	108.31	314.56	98946.00	0.00	999.99	Material Resource
86. INSERV Expenditures for inservice activities per pupil	15	464.97	507.21	257270.00	0.00	999.99	Material Resource
87. OTHSERV Expenditures for other services/pupil (e.g., field trips, speakers)	12	571.82	503.48	253480.00	0.00	999.99	Material Resource
88. PLANTENG Maintenance supervisor salaries per pupil	11	612.10	491.10	241180.00	0.00	999.99	Material Resource
89. CUST Custodian salaries per pupil	27	74.96	182.59	33340.00	1.52	999.99	Material Resource
90. PLANTSUP Consumable custodial supplies per pupil	22	218.52	415.64	172750.00	.38	999.99	Material Resource
91. PLANTUTL Plant Utility expenditure per pupil	25	132.04	306.67	94049.00	1.89	999.99	Material Resource
92. OTHPLANT Other plant expenditures	11	608.54	495.58	245600.00	0.00	999.99	Material Resource
93. REPAIRS Repairs for plant	21	257.04	436.91	190890.00	1.16	999.99	Material Resource
94. REPLEQIP Expenditures for replacing equipment	19	123.40	474.21	224880.00	.47	999.99	Material Resource
95. ADDEQIP Additional expenditures for equipment	24	145.73	355.56	126140.00	0.00	999.99	Material Resource
96. AVETCH Average Teacher Salary	28	10959	2020.9	4083900.00	7000	15083.00	Material Resource

INSTRUCTIONAL TIME INFORMATION continued	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM	MAXIMUM	VARIANCE CLASSIFICATION
97. AVEPRI Average Principal's Salary	27	17142	3270.1	10693000.00	10000	24000.00	Material Resource
98. AVEAIDE Average Aide's Salary	28	[illegible]	[illegible]	[illegible]75000.00	[illegible].99	6075.0	Material Resource
99. AVESEC Average Secretary's Salary	26	5497.6	[illegible]	1224000.00	4000.0	7500.0	Material Resource
100. FRNGTCH Teacher fringe benefits	25	[illegible].77	[illegible]	98626.00	.0000	999.99	Material Resource
101. FRNGPRI Principal's fringe benefits per pupil	26	75.176	261.23	68242	.00000	999.99	Material Resource
102. FRNGAID Aide's fringe benefits per pupil	23	179.43	389.61	151800	.00000	999.99	Material Resource
103. FRNGSEC Secretary's fringe benefits per pupil	26	72.949	261.84	68559	.00000	999.99	Material Resource
104. ULCOMP Unit leader compensation per pupil	28	.55571	.78101	.60997	.00000	2.2900	Material Resource
105. SCHSIZ School size (total no. of pupils)	28	462.25	197.91	39168	175.00	950.00	Material Resource
106. SALARY Total salary for instruction per pupil	28	616.95	181.25	32853	232.74	940.13	Material Resource
107. SUPPLY Total expenditures for supplies per pupil	28	15.637	14.66	215.08	1.39	81.00	Material Resource
108. BOOKS Total expenditures for books per pupil	28	12.730	10.35	107.15	1.21	53.50	Material Resource
109. OTHEREXP Total other expenditures per pupil	26	76.694	261.6[illegible]	68454	.0000	999.99	Material Resource
110. PLANT Total expend. for physical plant per pupil	27	110.46	177.95	31666	1.9000	999.99	Material Resource
111. CAPITAL Total expend. for capital outlay per pupil	25	112.00	313.30	98159	.4700	999.99	Material Resource

SELF-OBSERVATION SCALES (SOS) VARIABLES--STUDENTS	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM	MAXIMUM	VARIANCE CLASSIFICATION
112. ACCEPT Self-Acceptance	28	5071.3	291.61	85037	4433.0	5551.0	Human Res. Input/Output
113. SECURITY Security	28	4958.6	227.47	51741	4630.0	5664.0	Human Res. Input/Output
114. MATURITY Social Maturity	28	4945.7	434.98	189200	3711.0	5528.0	Human Res. Input/Output
115. CONFIDNT Social Confidence	28	5410.4	307.81	94745	4800	5945	Human Res. Input/Output
116. SCHAFFIL School Affiliation	28	5213.7	341.5[illegible]	116640	4697	5872	Human Res. Input/Output
117. TCHAFFIL Teacher Affiliation	28	[illegible]31.2	320.86	102950	4200	5488	Human Res. Input/Output
118. PEERAFFL Peer Affiliation	28	4994.6	294.34	86639	4347	5476	Human Res. Input/Output

EXPENDITURE INFORMATION continued	NUMBER OF CASES	MEAN	S.D.	VARIANCE	MINIMUM	MAXIMUM	VARIABLE CLASSIFICATION
READING ACHIEVEMENT VAR.							
119. VOCAB Reading vocabulary	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Res. Output
120. COMPREH Reading comprehension	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Res. Output
121. READ Total reading	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Res. Output
MATH ACHIEVEMENT VAR.							
122. MATHCOMP Math computation	28	49.553	4.8128	23.159	39.226	57.253	Human Res. Output
123. MATHCONC Math concepts	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Res. Output
124. MATHAPPL Math applications	28	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Human Res. Output
125. MATH Math total	28	49.624	[illegible]	25.340	38.736	57.456	Human Res. Output
ORGANIZATIONAL VARIABLES INFORMATION							
126. PRLDRSHP Teacher perception of principal's leader behavior: 1 = very little...5 = very great	28	3.6180	.56235	.316	2.43	4.60	Resource Input Mix
127. TOTJSAT Teachers' total job satisfaction: 1 = very little...5 = very great	28	3.42	.43	.189	2.50	4.17	Resource Input Mix
128. DIASC3Q3 Teachers' decision involvement (Unit) 1 = very little... 5 = very great	28	3.70	.63	.392	2.67	4.79	Resource Input Mix
129. DIATOTQ3 Teachers' decision involvement (Total) 1 = very little... 5 = very great	28	2.58	.40	.158	1.85	3.47	Resource Input Mix
130. DIASC3Q4 Teachers' satisfaction with decision involvement (Unit): 1 = very little...5 = very great	28	3.53	.64	.412	2.17	4.83	Resource Input Mix
131. DIATOTQ4 Teachers' satisfaction with decision involvement (Total): 1 = very little...5 = very great	28	2.73	.49	.239	1.71	3.67	Resource Input Mix
132. IPMREAD Teachers' perception of IPM implementation in reading: 1 = very little...5 = very great	28	3.70	.52	.273	2.75	4.76	Resource Input Mix
133. IPMMATH Teachers' perception of IPM implementation in math: 1 = very little...5 = very great	28	3.73	.53	.276	2.89	4.80	Resource Input Mix
134. IRTOTAL Teachers' perception of I&R Unit operation (Total): 1 = very little...5 = very great	28	[illegible]	.48	.228	2.81	[illegible]	Resource Input Mix

APPENDIX B

PRODUCT MOMENT CORRELATIONS OF INPUT AND PROCESS VARIABLES WITH READING AND MATHEMATICS SCORES

APPENDIX B

PRODUCT MOMENT CORRELATIONS OF INPUT AND PROCESS VARIABLES WITH READING AND MATHEMATICS SCORES

VARIABLE NO.		119	120	121	122	123	124	125
No.	Name	R VOCAB	R COMPREH	T READ	M COMP	M CONC	M APPL	T MATH
STAFF BACKGROUND INFORMATION								
1	BIQ1	.142	.174	.164	.195	.211	.190	.219
2	BIQ2	-.314	-.342	-.330	-.444	-.417	-.347	-.441
5	BIQ5	.348	.301	.327	.387	.441	.527	.451
6	BIQ6	.707	.031	.046	.144	-.066	-.035	-.030
7	BIQ7	.165	.160	.167	.288	.372	.232	.307
9	BIQ9	.076	.079	.074	.112	.267	.101	.145
11	BIQ11	-.094	-.121	-.111	-.169	-.049	-.037	-.094
12	BIQ12	-.039	-.113	-.082	-.173	-.073	-.141	-.148
14	BIQ14	-.098	-.148	-.131	-.293	-.126	-.130	.207
15	BIQ15	.369	.396	.396	.250	.298	.313	.293
20	BIQ20	.341	.416	.389	.035	.236	.237	.146
INSTRUCTIONAL TIME INFORMATION								
22	R 1:1	.061	.087	.084	-.257	-.030	-.029	-.133
23	R SMALL	-.187	-.158	-.168	-.100	-.180	-.156	-.131
24	R CLASS	-.062	-.063	-.062	.182	.095	-.007	.122
25	R LARGE	.287	.247	.264	.248	.244	.175	.226
27	L 1:1	.191	.159	.178	-.210	.015	.035	-.084
28	L SMALL	.013	-.033	.003	-.056	000	.028	-.028
32	M 1:1	.272	.260	.283	.030	.269	.275	.164
33	M SMALL	-.334	-.318	-.316	-.115	-.287	-.107	-.147
34	M CLASS	-.031	-.033	-.033	.080	-.048	-.173	-.032
35	M LARGE	.167	.184	.173	.191	.255	.239	.229
37	SC 1:1	.193	.139	.163	-.047	.155	.169	.049
38	SC SMALL	-.018	-.057	-.040	.104	.071	.153	.091
53	IIIA	-.190	-.186	-.183	-.283	-.203	-.237	-.262
54	IIIB	-.084	-.105	-.100	.025	.019	-.013	.013
55	IIIC	.028	.017	.010	-.117	.020	.065	-.049
56	IIID	.109	.105	.105	.146	.218	.278	.216

v = .374 significant at .05 with 26 d. f.

v = .478 significant at .01 with 26 d. f.

VARIABLE NO.		119	120	121	122	123	124	125
No.	Name	R VOCAB	R COMPREH	T READ	M COMP	M CONC	M APPL	T MATH
INSTRUCTIONAL TIME VARIABLES continued								
57	IIIE	-.172	-.152	-.161	-.048	-.057	.056	-.018
59	IIIG	.278	.238	.262	.019	.185	.153	.092
61	T READ	-.133	-.096	-.105	-.079	-.060	-.127	-.071
62	T LANG	.256	.244	.261	-.043	.058	.035	-.001
63	T MATH	-.036	-.015	-.010	-.020	-.015	.014	.014
64	T SCI	.149	.055	.103	.112	.072	.128	.093
65	T SOC	.041	-.024	.002	-.103	-.038	-.051	-.073
67	T 1:1	.261	.231	.248	-.117	.176	.193	.039
68	T SMALL	-.205	-.226	-.208	-.060	-.135	-.045	-.083
72	TBLTOT	.171	.131	.159	.118	.196	.173	.155
EXPENDITURE VARIABLES								
105	SCHSIZ	-.281	-.257	-.273	-.259	-.260	-.264	-.284
106	SALARY	.360	.315	.332	.258	.282	.202	.263
107	SUPPLY	.070	.065	.070	.007	.111	.035	.046
108	BOOKS	.142	.184	.167	.176	.210	.197	.207
109	OTHEXP	-.350	-.264	-.289	-.379	-.466	-.394	-.402
110	PLANT	-.350	-.230	-.282	-.305	-.341	-.268	-.302
111	CAPITAL	-.502	-.480	-.478	-.392	-.560		.146
SELF-OBSERVATION VARIABLES								
112	ACCEPT	.521	.584	.555	.443	.491	.533	.506
113	SECURITY	.327	.347	.339	.496	.339	.434	.457
114	MATURITY	.774	.815	.800	.560	.686	.673	.660
115	CONFIDNT	.696	.711	.705	.676	.772	.733	.750
116	SCH AFFIL	-.414	-.379	-.405	-.213	-.269	-.271	-.263
117	TEACH AFFIL	.578	.650	.617	.447	.560	.610	.554
118	PEER AFFIL	.650	.682	.673	.608	.590	.642	.648

v = .374 significant at .05 with 26 d. f.

v = .478 significant at .01 with 26 d. f.

102

VARIABLE NO.		119	120	121	122	123	124	125
No.	Name	R VOCAB	R COMPREH	T READ	M COMP	M CONC	M APPL	T MATH
ORGANIZATIONAL VARIABLES								
126	PRLDRSHP	-.042	.052	-.001	-.296	.045	-.012	-.135
127	TOTJSAT	.191	.268	.226	-.148	.206	.127	.018
128	DIASC3Q3	.260	.274	.263	-.039	.218	.249	.106
129	DIATOTQ3	.294	.300	.293	-.033	.267	.277	.129
130	DIASC3Q4	.234	.221	.218	-.131	.126	.202	.017
131	DIATOTQ4	.231	.259	.240	-.119	.222	.202	.051
132	IPM READ	-.072	-.085	-.088	-.119	-.052	-.039	-.102
133	IPM MATH	-.112	-.117	-.129	-.389	-.257	-.246	-.344
134	IR TOTAL	-.066	-.089	-.089	-.202	-.078	-.021	-.143

v = .374 significant at .05 with 26 d. f.

v = .478 significant at .01 with 26 d. f.

APPENDIX C

PRODUCT MOMENT CORRELATIONS OF SELECTED VARIABLES WITH SELF-OBSERVATION SCALE VARIABLES

APPENDIX C

PRODUCT MOMENT CORRELATIONS OF SELECTED VARIABLES WITH SELF-OBSERVATION SCALE VARIABLES

VARIABLE NO.		112	113	114	115	116	117	118
No.	Name	ACCEPT	SECURITY	MATURITY	CONFIDNT	SCHAFFIL	TCHAFFIL	PEERAFFL
1	BIQ1	.229	.148	.186	.077	-.086	.183	.205
2	BIQ2	-.364	-.498	-.401	-.451	.111	-.281	-.530
5	BIQ5	.458	.360	.407	.454	-.107	.436	.529
6	BIQ6	.181	.281	.073	.160	.116	.099	.251
7	BIQ7	.024	-.206	.128	.197	.028	.130	-.004
9	BIQ9	-.229	-.239	.032	.193	-.035	-.035	-.199
11	BIQ11	.011	-.247	.044	.076	-.065	.010	.024
12	BIQ12	-.434	-.385	-.196	-.241	-.119	-.417	-.366
14	BIQ14	-.136	.074	-.086	.129	.025	-.135	.004
15	BIIQ15	-.142	-.205	.012	.119	-.015	-.001	-.167
20	BIQ20	.313	.098	.503	.215	-.271	.423	.292
22	BITOI	-.037	-.164	-.023	-.058	-.018	.057	-.105
23	RSMALL	.018	.046	-.134	-.076	.299	-.017	.016
24	RCLASS	-.037	.019	.118	.071	-.167	.030	-.017
25	RLARGE	-.084	-.170	.131	.017	-.106	-.010	-.023
27	LITOI	-.026	-.099	.087	.084	-.173	.021	.001
28	LSMALL	-.081	-.073	-.159	-.082	.043	-.105	-.033
32	MITOI	.275	.131	.177	.241	.051	.278	.204
33	MSMALL	-.193	-.094	-.260	-.233	-.045	-.208	-.125
34	MCLASS	-.108	-.011	-.084	.015	.199	-.122	.110
35	MLARGE	.322	.389	.162	-.031	.144	.184	.229
37	SCITOI	.054	-.004	.063	.237	-.094	.046	.059
38	SCSMALL	-.271	-.062	.103	-.089	-.174	-.210	-.156
53	IIIA	-.228	-.433	-.199	-.351	.066	-.070	-.412
54	IIIB	-.219	-.012	-.123	-.243	-.307	-.306	-.175
55	IIIC	.067	-.004	-.009	.081	.076	.005	-.013
56	IIID	.365	.158	.265	.214	-.073	.317	.315
57	IIIE	.005	.049	-.023	-.152	.089	.110	-.085
59	IIIG	.183	.218	.192	.172	-.039	.103	.214
61	TREAD	-.035	-.058	-.010	-.037	.075	.052	-.064
62	TLANG	.050	-.141	.185	.181	-.216	.095	.113
63	TMATH	.012	.052	.130	.067	.146	-.017	-.008
64	TSCI	-.173	.182	.014	.197	-.235	-.149	.050
65	TSOC	-.013	-.043	.079	.121	-.199	-.016	.011
67	TITOI	.126	-.012	.138	.217	-.134	.137	.098
68	TSMALL	-.192	-.094	-.243	-.164	.052	-.192	-.118
72	TBLTOT	-.090	-.016	.182	.227	-.350	.042	.038
105	SCHSIZ	.019	.030	-.180	-.317	.273	-.060	-.142
106	SALARY	.241	.230	.396	.405	-.326	.227	.368
107	SUPPLY	.169	.087	.276	.267	-.332	.126	.264
108	BOOKS	.266	.050	.299	.325	-.220	.268	.272
109	OTHEREXP	.213	.137	.274	.210	-.317	.170	.293
110	PLANT	.073	-.013	.218	.311	-.353	.123	.161
111	CAPITAL	.174	-.029	.147	.103	-.247	.020	.152
119	VOCAB	.521	.327	.774	.696	-.414	.578	.650
120	COMPREH	.534	.347	.814	.711	-.379	.650	.682
121	READ	.555	.339	.800	.705	-.405	.617	.673
122	MATHCOMP	.443	.496	.560	.676	-.213	.447	.608
123	MATHCONC	.491	.339	.686	.772	-.269	.560	.590
124	MATHAPPL	.533	.434	.673	.733	-.271	.610	.642
125	MATH	.506	.457	.660	.750	-.263	.554	.648
126	PRLDRSHP	.032	-.136	.051	.015	.083	.101	-.088
127	TOTJSAT	.111	-.030	.266	.160	-.069	.248	.019
128	DJASC3Q3	.241	.102	.308	.159	-.093	.281	.204
129	DJATOTQ3	.273	-.048	.236	.158	-.058	.245	.177
130	DJASC3Q4	.118	.115	.254	.099	-.161	.148	.105
131	DJATOTQ4	.110	-.035	.220	.160	-.112	.182	.036
132	IPMREAD	.010	.138	-.112	.010	.120	-.123	-.033
133	IPMMATH	.141	.050	-.112	-.155	.226	-.022	-.013
134	IRTOTAL	.080	.164	-.074	-.048	.097	-.074	.004

NUMBER OF OBSERVATIONS 28

Center Planning and Policy Committee

Richard A. Rossmiller
Wayne Otto
Center Co-Directors

Dale D. Johnson
Area Chairperson
Studies in Reading, Language, and Communication

Marvin J. Fruth
Area Chairperson
Studies of Implementation of Individualized Schooling

Penelope L. Peterson
Area Chairperson
Studies of Instructional Programming for the Individual Student

James M. Lipham
Area Chairperson
Studies of Administration and Organization for Instruction

Thomas A. Romberg
Area Chairperson
Studies in Mathematics and Evaluation of Practices in Individualized Schooling

Associated Faculty

Vernon L. Allen
Professor
Psychology

B. Dean Bowles
Professor
Educational Administration

Thomas P. Carpenter
Associate Professor
Curriculum and Instruction

Louise J. Cherry
Assistant Professor
Educational Psychology

Fred W. Danner
Assistant Professor
Educational Psychology

William J. Davis
Assistant Professor
Educational Administration

W. Patrick Dickson
Assistant Professor
Child and Family Studies

Lloyd E. Frohreich
Associate Professor
Educational Administration

Marvin J. Fruth
Professor
Educational Administration

John L. Harvey
Professor
Mathematics
Curriculum and Instruction

L. Rayfield Hayes
Assistant Professor
Educational Psychology

Frank H. Hooper
Professor
Child and Family Studies

Dale D. Johnson
Professor
Curriculum and Instruction

Herbert J. Klausmeier
V.A.C. Henmon Professor
Educational Psychology

Joseph T. Lawton
Assistant Professor
Child and Family Studies

Joel R. Levin
Professor
Educational Psychology

James M. Lipham
Professor
Educational Administration

Dominic W. Massaro
Professor
Psychology

Donald M. McIsaac
Professor
Educational Administration

Wayne Otto
Professor
Curriculum and Instruction

Penelope L. Peterson
Assistant Professor
Educational Psychology

Robert G. Petzold
Professor
Music
Curriculum and Instruction

Thomas S. Popkewitz
Associate Professor
Curriculum and Instruction

Gary G. Price
Assistant Professor
Curriculum and Instruction

W. Charles Read
Associate Professor
English and Linguistics

Thomas A. Romberg
Professor
Curriculum and Instruction

Richard A. Rossmiller
Professor
Educational Administration

Peter A. Schreiber
Associate Professor
English and Linguistics

B. Robert Tabachnick
Professor
Curriculum and Instruction

J. Fred Weaver
Professor
Curriculum and Instruction

Gary G. Wehlage
Associate Professor
Curriculum and Instruction

Steven R. Yussen
Associate Professor
Educational Psychology

2/78