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ABSTRACT

This study, the fourth in a series of longitudinal studies, investigates causal and other relationships between leadership, teacher, and student variables in curriculum engineering. Measures were taken on leadership, teacher attitudes and performance, and student performance. A causal time-series model and path analysis were used to demonstrate linkages between variables. Significant growth in achievement was registered during the time span of the curriculum system when compared with growth during a similar but prior time span. The significance of the proportion of variance accounted for in the effects demonstrates that causal relationships exist between the three classes of variables. (Author)

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5.06

RELATIONSHIPS AMONG LEADERSHIP, TEACHER AND STUDENT VARIABLES IN CURRICULUM ENGINEERING

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I. PROBLEM

This is the fourth in a series of reports designed to investigate effects in a particular curriculum engineering system where all professional personnel in the school district were involved in the curriculum functions: planning, implementing, evaluating, and replanning. This is the first in the series of reports to investigate a priori assumptions concerning the relationships among leadership, teacher, and student variables in curriculum engineering. Measured treatment effects were teachers' attitudes, teachers' performance levels, and students' achievement. The specific objectives of the study were: (1) to observe the effects of principals' leadership upon teachers' attitudes and upon their performance in a curriculum engineering system, and (2) to observe the effects of principals' leadership and teachers' attitudes and performance in a curriculum engineering system upon students' achievement. Measures of principals' leadership and students' achievement are considered for the first time in this fourth report in the series.

Definition of Terms

Certain terms need to be defined. Some of these are important for the theory content presented in this paper, and other terms are used in explaining the model developed to illustrate demonstrated relationships among the variables.

A curriculum is a written product; it contains the plan for the total educational opportunities for students in the school where it is to be implemented.

Curriculum engineering refers to the curriculum system and its internal dynamics. It consists of all the processes necessary to make a curriculum system functional in schools: curriculum planning, implementation, evaluation, and revision.

Curriculum system refers to the organization for both decision making and action with respect to curriculum functions regarded as a part of the total operations of schooling.

Participation in curriculum planning is active membership in formally organized committees designed to plan a curriculum.

Principal leadership effectiveness refers to the extent to which the principal carries out successfully the leadership process in the areas of representation, demand reconciliation, tolerance of freedom, role assumption, consideration, production emphasis, predictive accuracy, integration, and superior orientation.[1]

Productivity refers to the outcomes associated with teacher behavior as measured by growth in student achievement.

Student achievement is the extent to which measurable growth in learning has taken place.

Causal relation is an assymetrical relation between two variables.

Effect coefficient, in exact use, refers to causal determinism; a weak causal order is assumed for purposes here, and the effect coefficient refers to the measure of expected difference between two groups which are different by one unit.[2]

Endogenous variables refer to those variables determined by forces operating within the scope of a particular model of reality while exogenous variables refer to those variables determined by forces operating outside.[3]

Exogenous variables are considered to be predetermined for the study of a particular system.

Model is used in this report to refer to the mathematical system of equations that represents an abstract and simplified picture of a realistic process.[4]

Parameters are exogenous variables outside the system that present a plausible rival hypothesis concerning relationships among variables in the system.

Path coefficients are standardized regression coefficients, or beta values.

Certain symbols are used to designate relationships. The single directional arrow (⟷) indicates causal ordering, and the double-headed curved (⟷) arrow is used to indicate correlation.

Background Information

Details concerning the curriculum system operative in School District 130, Cook County, Blue Island, Illinois have been given in previous reports in this series.[5] It is sufficient for this report to indicate that the curriculum system that was installed at the beginning of the 1970-71 school year remains operative. Base-line data was gathered in the spring of 1970, and data has been gathered each year since.

The organizational structure of the Blue Island school district has changed slightly since the curriculum system was installed.

Approximately four thousand pupils are housed in ten school buildings under the jurisdiction of five principals. Four of the principals service more than one building at the K-6 levels; the fifth is principal of the junior high school whose students are housed in one building.. The total staff of 132 teachers plus the central office professional personnel are involved in the curriculum system.

The two purposes the curriculum system serves are to maintain a self-renewing curriculum and to insure that the curriculum will be implemented in all schools and classrooms in the district. To achieve these purposes, the planning, implementing, and appraising functions, which comprise the curriculum system, are constant processes. Teachers are organized into three groups for the planning function. These include: (1) a curriculum council, (2) horizontal committees by grade level, and (3) vertical committees by subject area. The horizontal and vertical committees assure articulation among subjects across a grade level and within a subject across all grade levels. The curriculum council acts as the final reviewer of all curriculum changes proposed by the horizontal and vertical committees.

II. DESIGN AND PROCEDURES

The following is a description of the model hypothesized to represent relationships investigated, the nature and size of the samples, and the procedures used in analyzing the data.

The Model

A causal model and path analysis were used to demonstrate the causal linkages among the variables: principal leadership, teacher motivation, teacher performance in a curriculum system, and student achievement. Steps in developing the causal model included a verbal statement of the theory explicating hypothesized relationships among variables and a statement of the causal sequence. The causal relationships assumed were as follows: student achievement at time t (SA_t) is determined by the student's IQ (SIQ), the students's sex (SSEX), the level of principal leadership (PL), the level of teacher performance (TPT and TPP), the initial achievement level at time t-1 (SA_{t-1}), and residual variables; teacher performance is determined by teacher ability (TAP), teacher motivation (TMC and TMT), principal leadership, and residual variables. The causal sequence was, therefore, assumed to be as follows: principal leadership has a causal relationship with student achievement. This effect is mediated through teacher motivation and teacher performance. The higher the ratings of principal leadership, teacher motivation, and teacher performance, the more positive is the influence on student achievement as this is controlled for differing students' ability level, for students' sex, and for initial achievement levels. The time-series model is shown below for purposes of identification.

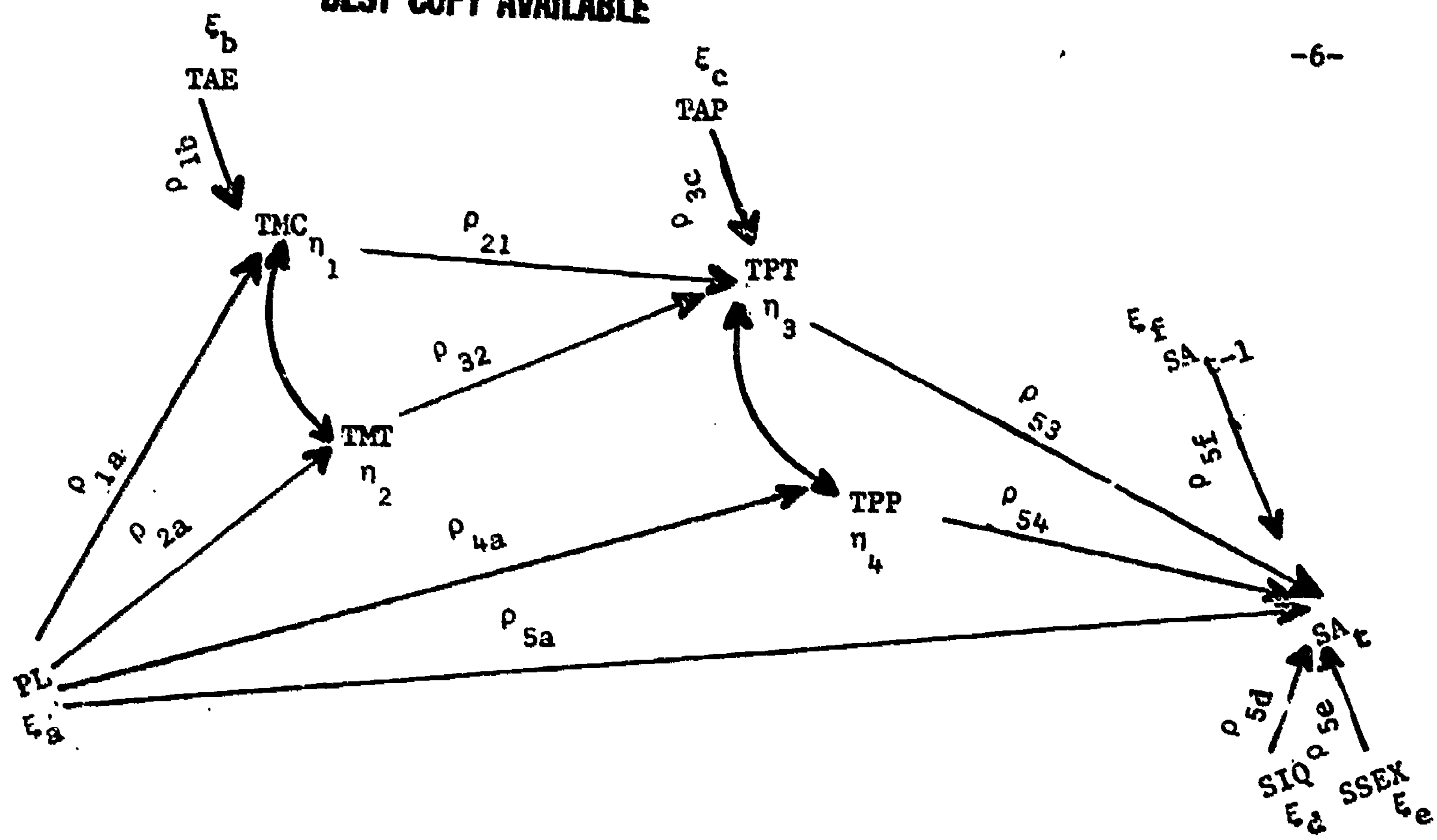

Figure 1. Time-Series Model.

Some simplifying assumptions, necessary in causal modeling, resulted in considering principal leadership (PL), teachers' and students' personal factors (TAE, TAP, SIQ, SSEX), and students' initial achievement level (SA_{t-1}) as exogenous or independent. That is, the named variables were considered to be predetermined by influences outside the system under investigation. Other variables were considered to be endogenous, determined by influences inside the system. The system of relationships postulated among exogenous and endogenous variables is described by the following equations for system effects:

I.1. $SA_t = \eta_5 \quad + \rho_{54}\eta_4 + \rho_{53}\eta_3 + \rho_{5a}\xi_a + \rho_{5d}\xi_d + \rho_{5e}\xi_e + \rho_{5f}\xi_f + R_y$

I.2. $TPP = \eta_4 \quad + \rho_{4a}\xi_a + R_x$

I.3. $TPT = \eta_3 \quad + \rho_{32}\eta_2 + \rho_{31}\eta_1 + \rho_{3c}\xi_c + R_w$

I.4. $TMT = \eta_2 \quad + \rho_{2a}\xi_a + R_v$

I.5. $TMC = \eta_1 \quad + \rho_{1a}\xi_a + \rho_{1b}\xi_b + R_u$

Procedures preliminary to setting up the regression model were: (1) univariate analysis of variance and t-tests to determine if there were differences among the means for each of the various measures rating principals, teachers, and students, and (2) correlation analyses to show the degree which the variables were related.

The Sample

All teachers in the school district were considered the sample of teachers. Similarly, all principals in the school district were considered the sample of principals. A random sample of one-fourth of the total number of students in each grade in each of the academic years, 1972-73 and 1969-70, was selected. Table I shows the number of cases for the two cross-sectional samples. Records for students above grade four were not available.

Table II shows the number of cases by grade for each year in the longitudinal study. Using the random sample of students in the 1972-73 academic year as a base, students for whom information was available in previous academic years were retained in the sample. Since students' cumulative folders are forwarded to the high schools when eighth graders graduate, no information for previous years was available for eighth graders who graduated in 1973. Second grade students were included in only two years of the six-year longitudinal study. First graders were not included in the longitudinal study.

Data and Instruments

Six types of data were collected for the study: (1) cross-sectional data on student achievement, (2) longitudinal data on student achievement for six years beginning in 1967-68 and ending in the school year of 1972-73, (3) ratings of principals by teachers on aspects of principal leadership, (4) ratings of teachers by principals and self-ratings by teachers on their performance in the curriculum system, (5) measures of teachers' attitudes toward teaching and toward participation in a curriculum system, and (6) personal data about teachers and students. Personal data about teachers included the amount of teaching experience and the amount of professional preparation. Personal data about students included sex and IQ.

Various aspects of principal leadership were measured by the Leader Behavior Description Questionnaire - Form XII (LBDQ).[6] Measures of teachers' performance by principals were the Classroom Visitation Scale (CVS)[7] and the Principal-Teacher Interview Scale (PTIS).[8] The measure of a teacher's self-perception of performance in a curriculum engineering system was the Teacher Self-Analysis Inventory (TSAI).[9] Measures of teachers' attitudes were the Curriculum Attitude Inventory (CAI)[10] and the Bowers Teacher Opinion Inventory.[11] Test reliability for the above measures was assured from the coefficients derived by Hoyt's analysis of variance technique. Measures of students' performance were various batteries of the Stanford Achievement Test (SAT).[12] Quantitative measures were obtained for all principals and teachers and for a stratified random sample of one-fourth of the student population.

Prior to the installation of the curriculum system in 1970, personal data and predispositional data were collected on teachers. In-process data for teachers' attitudes and performance as well as personal data for teachers have been collected each year since 1970. Data for principal leadership and student data were gathered in the 1973-74 school year. Longitudinal data regarding students' achievement and personal data about students' sex and IQ were gathered from students' cumulative file folders.

III. RESULTS AND DISCUSSION

Data for the above procedures for all subjects in all grade levels and for all years are quantitatively too large to be presented in this paper. The number of tables have been kept to a minimum for purposes of discussion here to illustrate the procedures.

Mean Differences

Means, standard deviations, and results of univariate analyses of variance of principals' leadership scores (LBDQ), teachers' performance scores (CVS-PTIS), and fifth grade students' achievement scores (SAT) by school are shown in Tables III - V. From the tables, it can be observed that differences were noted among principals in leadership effectiveness, among schools on measures of teachers' performance in the curriculum and instructional systems, and among students' achievement scores because of school assignment. Differences among means for remaining measures were not calculated since previous research in the school district, as reported by Beauchamp,[13] has shown that teachers' scores differ on all measures. Whereas students' achievement results for all grade levels are not presented here, Table VI shows at a glance the consistency of results when they are reduced to ranks. Schools where students' achievement was consistently ranked high had similarly high rankings for principal and teacher measures and vice versa.

Growth in Achievement

Means, standard deviations, and mean differences of students' achievement scores for ACOMP in grades 2, 3, and 4, for the school year 1972-73 over the school year 1969-70, are shown in Table VII. For this analysis, it was only possible to use the three grades because of changes in subtest batteries, and because data were not available for students who had left the school district during the interval between the two school years in question. From the table, significant growth may be noted for students in grade 4. However, other comparisons showed significant growth in various subtests at all grade levels. Only one decline was noted; this occurred in first grade arithmetic.

Trend Differences

Means, standard deviations, and mean differences of students' growth in achievement scores in grade 6 between the years 1972-73 and 1967-68, are shown in Table VIII. For this analysis, it was only possible to compare five subtest areas because of changes in subtest batteries at different grade levels. From the table, it can be observed that significant growth occurred in three of the five subtest areas compared. Trend differences in growth in students' achievement over a six-year period were noted to assure that growth differences were not epochal. After the comparisons were made for the three years following the installation of the curriculum engineering system with the three years preceding the installation of the system, comparisons for each consecutive two-year period were made for all subtests in all grade levels. Overall trends for the six-year period showed that six of the eleven comparisons for students in grades 7 and 6 in 1972-73 showed significant differences in students' achievement growth for the three years following the installation of the curriculum engineering system as compared with the three years prior to the installation of the curriculum engineering system. Five of the six differences were in a positive direction.

The Model

The above comparisons were noted as procedures preliminary to setting up the regression model. A second preliminary procedure was to compute correlation coefficients for all possible variable pairs to show the degree to which the variables were related. Computations showed that, with one exception, all zero order correlations were non-zero.

Findings in the preliminary procedures justified the use of more complex procedures. For this paper, the procedures are limited to solving the structural equations shown in Section II; relationships are assumed to be linear and additive. Relationships among the variables in the static model, that which does not include an initial achievement level as input, are shown along with the time-series model so that changes in these relationships can be noted. The following solutions, therefore, show the results of fitting the data to the regression equations for fifth grade students in arithmetic computation. The effect coefficient for the residual equals $\sqrt{1-R^2}$. For the regressions, n = 10.

II. 1. Static Model:

$$SA = \eta_5 + 1.13\eta_4 - .90\eta_3 - .23\xi_a + 1.03\xi_d - .23\xi_e + .17R_y$$

1. Time-Series Model:

$$SA_t = \eta_5 + .20\eta_4 - .49\eta_3 + .08\xi_a + 1.07\xi_d - .22\xi_e - .14\xi_f + .20R'$$

II. 2. $TPP = \eta_4 + .18\xi_a + .98R_x$

$$\text{II. 3. TPT} = \eta_3 + .75\eta_1 + .07\eta_2 - .05\xi_c + .62R_w$$

$$\text{II. 4. TMT} = \eta_2 + .11\xi_a + .99R_v$$

$$\text{II. 5. TMC} = \eta_1 + .38\xi_a + .14\xi_b + .77R_u$$

The equations demonstrate how the effects of the exogenous and predetermined variables and parameters (right side of equations) are transmitted to the endogenous variables (left side of equations) via their components.

In the above equations, and in those for other grades, principals' influence (PL) on teachers' opinions toward teaching (TMT) and toward curriculum (TMC), and principals' influence on teachers' performance as rated by principals (TPP) were negligible as evidenced by low beta values for effect coefficients. Other data showed principals' leadership to have, alternatively, a strong negative or a strong positive influence on teachers' performance in various grades. These findings demonstrate that additional variables need to be sought to further explain teachers' motivation and ratings of teachers' performance by principals.

Fifth graders' achievement in arithmetic computation was shown to be positively influenced by teachers' performance as rated by principals; this influence was strong in the static model but negligible when initial achievement was considered in the time-series model. An approximately equal but opposite influence was attributable to teachers' self-perceptions of their performance in both models. Achievement was positively and strongly influenced by IQ in both models. Principals' leadership had, alternatively, a negative or positive influence, though this was negligible. Students' sex exerted a weak influence in a negative direction as did the initial achievement of students in arithmetic computation. Data for other grade levels and for other subtests showed that influences of these variables differed in both magnitude and direction.

The observed regression coefficients are assembled in Table IX. In addition to the measured direct effects, there were joint, or spurious effects due to the mutual correlations of TMC with TMT and TPT with TPP. Path diagrams for grade 5 for arithmetic computation are shown in Figures 2-3; these diagrams interpret the results in terms of a network of assumed relationships.

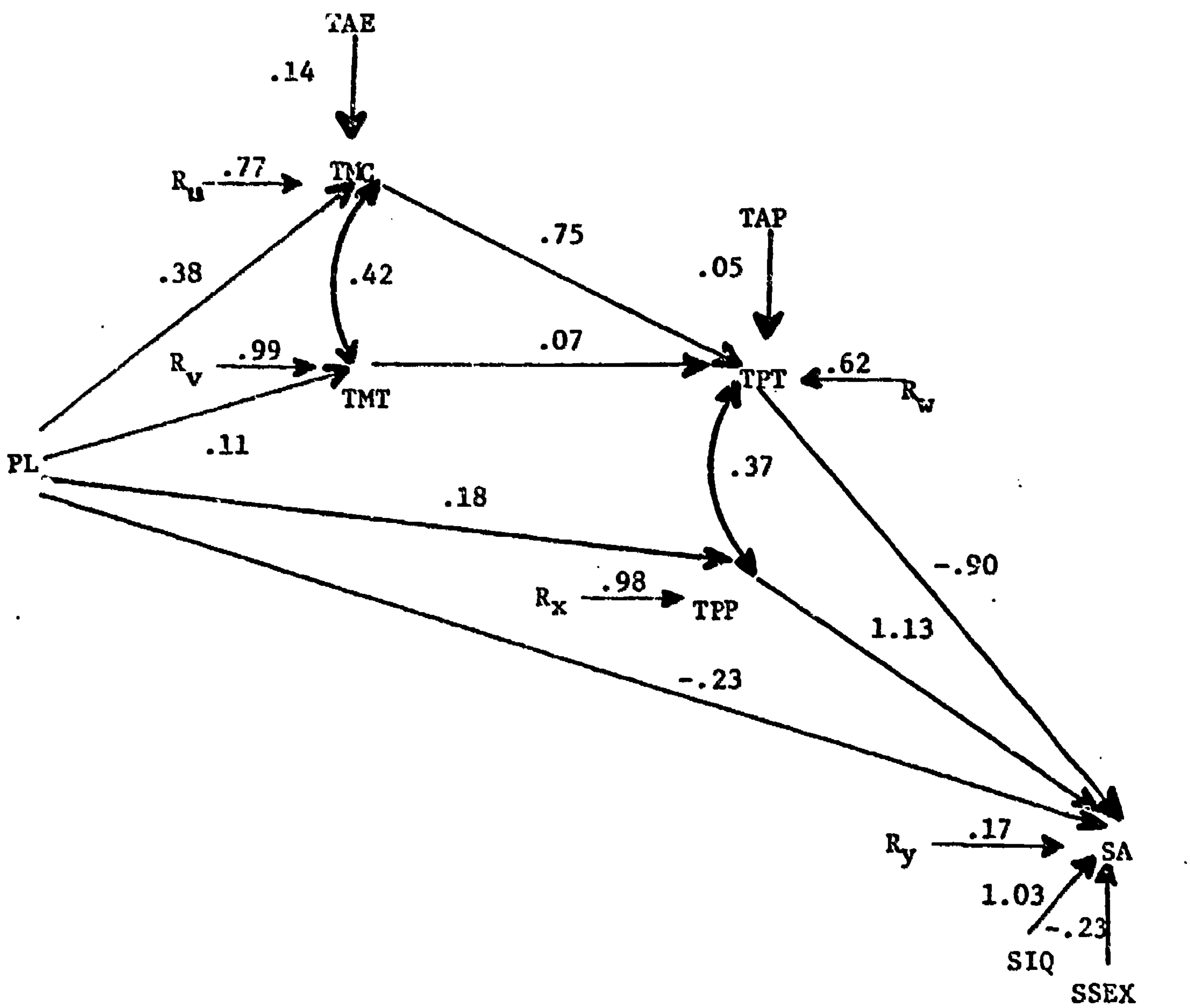

Figure 2. Path diagram for grade 5 in 1972-73 for Arithmetic Computation.

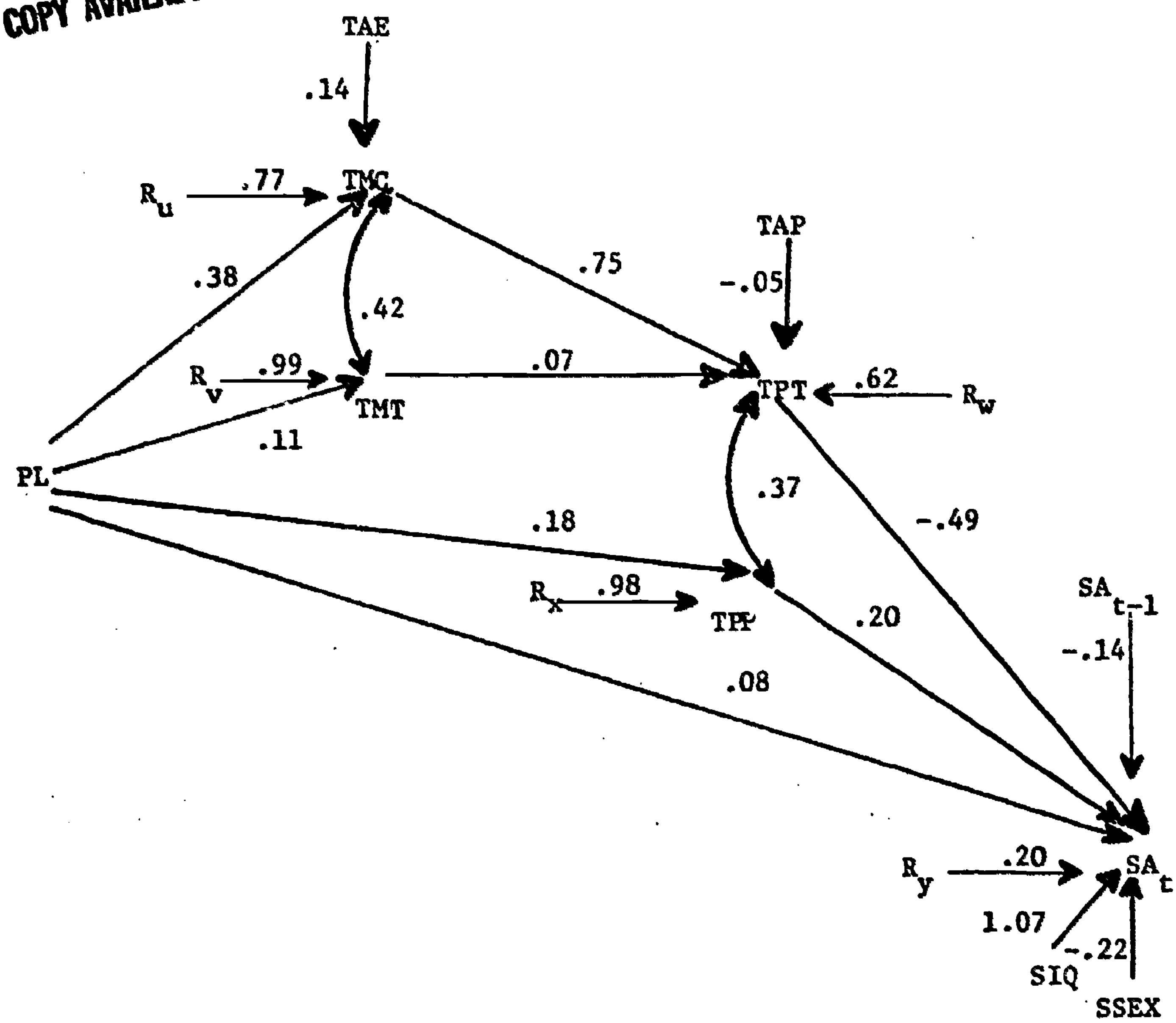

Figure 3. Time-series path diagram for grade 5 in 1972-73 for Arithmetic Computation.

Despite fluctuations in the magnitude and direction of influence of variables for various subtests at differing grade levels, certain patterns were established. For example, teachers' self-perceptions of their performance and principals' ratings of teachers' performance were nearly always of equal magnitude and opposite in direction indicating counter-productive forces. Principals' leadership was usually positive and of high magnitude. IQ influence varied from moderate to strong. Among the variables hypothesized to influence teachers' self-perceptions of their performance in a curriculum system (TPT), only their attitudes toward curriculum exerted a strong influence. This was positive in all grade levels and beta values were large in all grades but one. IQ became a significant factor in accounting for the variance in students' achievement when a time-series model was used, that is, when initial achievement was considered as a variable. The influence of sex was generally of low magnitude; the direction of influence, as might be expected, varied according to subject matter. Data fit the regression equations in nearly all cases and the proportion of variance accounted for in student achievement with few exceptions was statistically significant for the various achievement subtests at all grade levels. The findings led to the conclusion that causal relationships exist among the variables: principal leadership, teacher attitudes, teacher performance in the curriculum system, and student achievement. There was support to conclude that principal leadership influences teacher attitudes and teacher performance with respect to curriculum engineering. The results further supported the conclusion that principal leadership, teacher attitudes, and teacher performance in a curriculum system influence student achievement.

To the knowledge of the researchers, this is the first study to attempt mathematical modeling of the relationships among variables in a curriculum system. The study is analytical of real-world relationships and is supported by a theoretical framework; as such, it contributes toward bridging the theory-research gap. The mathematical formulations of verbal theories forced the researchers to focus only on the relationships of the variables under scrutiny and therefore contribute toward more precise thought in educational theorizing, and more particularly, in curriculum theorizing. Further, the kind of theoretical framework used in the study permitted greater complexity to be introduced than would have been possible with merely a verbal theory. Continued testing of the model to obtain a better knowledge of the nature of these and other relationships and the degree to which schooling variables are related can serve as a guide in formulating educational practice and policy.

FOOTNOTES

[1]Ralph M. Stogdill, "Manual for the Leader Behavior Description Questionnaire - Form XII: An Experimental Revision," (Columbus, Ohio: Bureau of Business Research, College of Commerce and Administration, The Ohio State University, 1963), p. 3.

[2]The distinction is made by Jae-On Kim and Frank J. Kahout in an unpublished paper, "Special Topics in General Linear Models" (University of Iowa, 1974), pp. 33-34.

[3]Michael J. Brennan, Preface to Econometrics (3d ed.; Cincinnati: South-Western Publishing Co., 1973), p. 212.

[4]Lawrence R. Klein, An Introduction to Econometrics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1962), p. 11.

[5]George A. Beauchamp, "Longitudinal Study in Curriculum Engineering" (an unpublished paper presented at the Annual Meeting of the American Educational Research Association, Chicago, April, 1974); "A Study of the Effects of the Installation of a Curriculum Engineering System" (an unpublished paper presented at the Annual Convention of the American Educational Research Association, New Orleans, La., February, 1973); and "A Study of the Effects of the Installation of a Curriculum Engineering System" (an unpublished paper presented at the Annual Convention of the American Educational Research Association, Chicago, Illinois, April, 1972).

[6]Bureau of Business Research, The Ohio State University, 1962.

[7]George A. Beauchamp, Classroom Visitation Scale, Northwestern University, 1972.

[8]George A. Beauchamp, Principal-Teacher Interview Scale, Northwestern University, 1972.

[9]George A. Beauchamp, The Teacher Self-Analysis Inventory, Northwestern University, 1970.

[10]Michael Langenbach, "The Development of an Instrument to Measure Teachers' Attitudes Toward Curriculum Use and Planning" (unpublished doctoral dissertation, Northwestern University, 1969).

[11]Norman D. Bowers, The Bowers Teacher Opinion Inventory, Northwestern University, 1955.

[12]Truman L. Kelley, Richard Madden, Eric F. Gardner, and Herbert C. Rudman, Stanford Achievement Test (N.Y.: Harcourt, Brace & World, Inc., 1964).

[13]Beauchamp, op. cit., 1974.

TABLE I

NUMBER OF CASES BY GRADE FOR EACH
CROSS-SECTIONAL SAMPLE

	Grade							
Academic Year	8	7	6	5	4	3	2	1
1972-73	111	125	125	117	128	122	118	130
1969-70	-	-	-	-	149	166	167	163

TABLE II

NUMBER OF CASES BY GRADE FOR EACH
YEAR OF THE SIX-YEAR
LONGITUDINAL SAMPLE

	Grade						
Academic Year	7	6	5	4	3	2	1
1972-73	125	125	117	128	122	118	-
1971-72		116	109	111	122	114	106
1970-71			101	97	92	101	90
1969-70				86	90	82	100
1968-69					80	89	76
1967-68						72	81

TABLE III

MEANS, STANDARD DEVIATIONS, AND RESULTS OF UNIVARIATE ANOVA OF PRINCIPALS' SCORES ON THE LEADER BEHAVIOR DESCRIPTION QUESTIONNAIRE BY SCHOOL

School	N		PL(LBDQ)
1	29	M	329.897
		SD	63.549
2	6	M	282.333
		SD	43.302
3	17	M	353.353
		SD	40.830
4	23	M	392.217
		SD	46.230
5	14	M	374.857
		SD	28.587
6	39	M	343.385
		SD	44.320
7	9	M	358.778
		SD	36.434

For univariate analysis of variance:

LBDQ – $F(6,130) = 6.76^{**}$

$^{**}p < 0.01$

TABLE IV

MEANS, STANDARD DEVIATIONS, AND RESULTS OF UNIVARIATE ANOVA OF TEACHERS' SCORES ON THE COMBINED CLASSROOM VISITATION AND PRINCIPAL - TEACHER INTERVIEW SCALES BY SCHOOL

School	N		TPP (CVS-PTIS TOTAL)
1	32	M	4901.312
		SD	472.226
2	10	M	4052.500
		SD	654.307
3	23	M	4759.348
		SD	314.983
4	23	M	4612.565
		SD	625.931
5	14	M	4778.571
		SD	328.583
6	18	M	4045.556
		SD	511.040
7	12	M	4905.333
		SD	376.724

For univariate analysis of variance:

CVS-PTIS - $F(6,125) = 9.67^{**}$

$^{**}p < 0.01$

TABLE V

MEANS, STANDARD DEVIATIONS, AND RESULTS OF UNIVARIATE ANOVAS OF STUDENTS' ACHIEVEMENT SCORES BY SCHOOL FOR GRADE 5 IN 1972-73

School	N		WM	PM	SP	L	ACOMP	ACONC	APP	SST	SCI
2	12	M	4.5	4.8	5.1	4.5	4.7	5.2	4.9	4.7	4.0
		SD	1.8	1.7	1.6	1.7	1.2	1.1	1.6	1.0	1.1
4	33	M	6.4	5.7	6.0	6.4	5.6	5.4	5.6	5.9	5.8
		SD	1.4	1.6	2.0	1.5	0.8	1.3	1.7	1.0	1.6
5	11	M	4.3	4.2	4.0	3.6	4.1	4.4	3.9	4.0	4.0
		SD	0.9	0.9	1.5	1.2	1.0	0.8	0.9	0.8	0.8
6	52	M	5.0	5.2	5.4	5.2	5.4	5.2	4.9	5.0	4.7
		SD	1.1	1.4	1.7	1.8	1.0	1.1	1.6	1.3	1.3
7	9	M	4.8	4.7	5.4	4.8	5.3	5.1	4.4	4.3	4.5
		SD	1.1	1.3	1.0	1.7	1.0	0.8	1.4	0.7	1.0

For univariate analyses of variance:

WM - $F(4,112) = 9.91^{**}$
PM - $F(4,112) = 2.85^{*}$
SP - $F(4,112) = 3.06^{*}$
L - $F(4,112) = 7.72^{**}$
ACOMP - $F(4,112) = 5.76^{**}$
ACONC - $F(4,112) = 1.58$
AAPP - $F(4,112) = 2.86^{*}$
SST - $F(4,112) = 8.13^{**}$
SCI - $F(4,112) = 7.20^{**}$

$^{*}p < 0.05$ $^{**}p < 0.01$

TABLE VI

RANKS FOR PRINCIPAL, TEACHER, AND STUDENT MEASURES BY SCHOOL IN 1972-73

GRADES 1 - 8

SCHOOL	PL	TMC	TMT	TPT	TPP
1	6	4	7	6	2
2	7	2	2	5	6
3	4	6	5	4	4
4	1	3	6	3	5
5	2	1	1	1	3
6	5	7	4	7	7
7	3	5	3	2	1

GRADE 6

SCHOOL	IQ	WM	PM	SP	L	ACOMP	ACONC	AAPP	SST	SCI
2	5	5	5	5	5	5	5	5	5	5
4	1	1	1	1	1	1	1	1	1	1
5	3	2	3	2	2	4	4	4	3	4
6	2	4	4	3	4	3	3	3	4	3
7	4	3	2	4	3	2	2	2	2	2

GRADE 5

SCHOOL	IQ	WM	PM	SP	L	ACOMP	ACONC	AAPP	SST	SCI
2	4	4	3	4	4	4	3	3	3	4
4	1	1	1	1	1	1	1	1	1	1
5	5	5	5	5	5	5	5	5	5	5
6	2	2	2	2	2	2	2	2	2	2
7	3	3	4	3	3	3	4	4	4	3

GRADE 4

SCHOOL	IQ	WM	PM	SP	L	ACOMP	ACONC	AAPP	SST	SCI
2	4	5	5	5	5	5	5	5	5	5
4	1	1	1	1	1	1	1	1	1	1
5	5	3	3	3	4	3	5	4	4	4
6	2	2	2	2	2	2	2	2	2	2
7	3	4	4	4	3	4	3	3	3	3

GRADE 3

SCHOOL	IQ	WM	PM	SP	WSSK	L	ACOMP	ACONC	SSTSCI
2	5	5	5	5	5	5	5	5	5
3	2	1	1	1	1	1	3	2	4
4	1	2	2	3	3	2	2	1	1
5	4	4	3	4	2	4	4	4	3
7	3	3	4	2	4	3	1	3	2

GRADE 2

SCHOOL	IQ	WM	PM	SP	WSSK	L	ACOMP	ACONC	SSTSCI
2	5	5	5	5	5	2	5	4	4
3	2	2	2	2	2	3	2	2	2
4	1	1	1	1	1	1	1	1	1
5	4	3	3	4	4	4	4	3	3
7	3	4	4	3	3	5	3	5	5

GRADE 1

SCHOOL	IQ	WR	PM	VOC	SP	WSSK	ARITH
2	5	5	5	5	5	5	5
3	3	3	2	1	2	2	1
4	1	2	1	2	1	1	2
5	2	1	3	4	4	4	4
7	4	4	4	3	3	3	3

TABLE VII

MEANS, STANDARD DEVIATIONS, AND MEAN DIFFERENCES OF STUDENTS' ACHIEVEMENT SCORES BY SCHOOL YEAR FOR ARITHMETIC COMPUTATION GRADES 2,3,4 - 1969-70 and 1972-73

School Year	Grade 4				Grade 3				Grade 2			
	N	M	SD	M_2-M_1	N	M	SD	M_2-M_1	N	M	SD	M_2-M_1
1969-70	149	4.1	0.8		166	3.6	0.8		157	2.6	0.6	
				0.3*				0.1				0.2
1972-73	128	4.4	1.0		122	3.7	0.9		118	2.8	0.6	

*$p < 0.05$

TABLE VIII

MEANS, STANDARD DEVIATIONS, AND MEAN DIFFERENCES OF STUDENTS' ACHIEVEMENT GROWTH SCORES FROM GRADES 4 TO 6 AND FROM GRADES 1 TO 3 FOR GRADE 6 STUDENTS IN 1972-73

School Year	N	WM M	WM SD	WM M_2-M_1	PM M	PM SD	PM M_2-M_1	SP M	SP SD	SP M_2-M_1	WSSK M	WSSK SD	WSSK M_2-M_1	ACOMP M	ACOMP SD	ACOMP M_2-M_1
From Grade 4 to Grade 6	71	1.9	1.1	1.1**	1.8	1.2	0.9**	2.2	1.1	1.2**	1.8	1.1	0.5	1.2	1.2	0.2
From Grade 1 to Grade 3	71	0.8	2.4		0.9	2.3		1.0	2.5		1.3	2.7		1.0	0.7	

**$p < 0.01$

TABLE IX

REGRESSION COEFFICIENTS FOR PATHS TO TEACHER EFFECTS AND STUDENT ACHIEVEMENT (ACOMP) GRADE 5

Effect	Variable	Standard Partial Regression Coefficients (Beta)	Coefficients of Multiple Determination (R^2)	Multiple R
η_1	PL	.38	.14	.38
	TAE	.14	.16	.40
η_2	PL	.11	.01	.11
η_3	TMC	.75	.60	.77**
	TMT	.07	.61	.78**
	TAP	-.05	.61	.78**
η_4	PL	.18	.03	.18
η_5	Static Model:			
	PL	-.23	.07	.26
	TPP	1.13	.15	.39
	TPT	-.90	.18	.43
	SIQ	1.03	.93	.97**
	SSEX	-.23	.97	.98**
η_5	Time-series Model			
	SA_{t-1}	-.14	.46	.68*
	PL	.08	.47	.68
	TPP	.20	.48	.69
	TPT	-.49	.50	.71
	SIQ	1.07	.94	.97*
	SSEX	-.22	.96	.98*

*$p < 0.05$
**$p < 0.01$