DOCUMENT RESUME

ED 119 330 EA 007 966

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TITLE Relationships Among Leadership, Climate Teacher, and Student Variables in Curriculum Engineering.
PUB DATE 23 Apr 76
NOTE 24p.; Paper presented at the Annual Meeting of the American Educational Research Association (San Francisco, April 19-23, 1976)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage
DESCRIPTORS *Academic Achievement; Curriculum; *Curriculum Design; Curriculum Evaluation; Curriculum Planning; Educational Environment; Elementary Education; Family Background; Intelligence Quotient; *Leadership; Longitudinal Studies; Mathematical Models; *Organizational Climate; Principals; Statistical Analysis; Teacher Attendance; *Teacher Attitudes; Teacher Behavior

ABSTRACT

The study, a seventh in a series of longitudinal studies, was an investigation of causal and other relationships among leadership, climate, teacher, and student variables in curriculum engineering. Quantitative measures included principals' leadership, organizational climate, teachers' attitudes, teachers' performance, and students' achievement. Additional teacher and student variables were used as control variables. A causal model showing block-recursive and reciprocal relationships was used to demonstrate linkages among variables. The significance of regression coefficients and the proportion of variance accounted for in the effects supported the assumptions of causal relationships among the four classes of variables. (Author)

RELATIONSHIPS AMONG LEADERSHIP, CLIMATE TEACHER, AND STUDENT VARIABLES IN CURRICULUM ENGINEERING

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This is the seventh in a series of reports designed to investigate effects within a particular curriculum engineering system involving all professional personnel in a school district. Participants in the curriculum system perform the major curriculum functions: planning, implementing, evaluating, and replanning. Measured treatment effects were organizational climate, principal leadership, teacher attitudes, teacher performance levels, student intelligence, and student achievement. Previous reports in the series have tested causal relationships among the variables by use of a linear recursive model. The present study was the first in the series to additionally test the effects of home background variables and to use a block-recursive model.

The specific objectives of the study were: (1) to observe the effects of principal leadership and organizational climate upon each other and upon teacher attitudes, teacher attendance, and teacher performance in a curriculum engineering system, (2) to observe the effects of home background variables upon IQ and upon student achievement, (3) to observe the combined effects of principal leadership and teacher attitudes, attendance, and performance in a curriculum system upon student achievement, (4) to observe the combined effects of home background variables and IQ upon student achievement.

Definition of Terms

Certain terms need to be defined. Some of these are important for the theory content in this paper, and others are used to explain 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 processes necessary to make a curriculum system functional in schools: curriculum planning, implementation, evaluation, and replanning.

Curriculum system refers to the organization for both decision making and action with respect to curriculum functions.

Organizational climate refers to the dimensions of teacher and principal behaviors that effect a school environment ranging from open to closed. Dimensions of teacher behavior include: disengagement, hindrance, esprit, and intimacy. Dimensions of principal behavior include: aloofness, production emphasis, thrust, and consideration.[1]

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.[2]

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

Causal relation is an asymmetrical relation between two variables.

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 to refer to the mathematical system of equations

that represents an abstract and simplified picture of a realistic process.[4]

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

Certain symbols are used to designate relationships. The single directional arrow (⟶) indicates one-way causal ordering; the double-headed straight arrow (⟷) indicates reciprocal causation; and the double-headed curved arrow (⟷) indicates correlation.

Data Source

Details concerning the curriculum system operative in the school system have been given in previous reports in this series. It is sufficient for this report to indicate that the curriculum system that was installed at the beginning of the 1970-71 school year has been modified but remains operative. Base-line data were gathered in the spring of 1970, and similar data have been gathered each year since.

The present organizational structure provides for five principals in ten buildings to service approximately 4,000 students. Four of the principals service more than one of the nine buildings at the K-6 level. The fifth is principal of a junior high building. Principals, support service personnel, and approximately 140 classroom teachers work in the curriculum system.

DESIGN

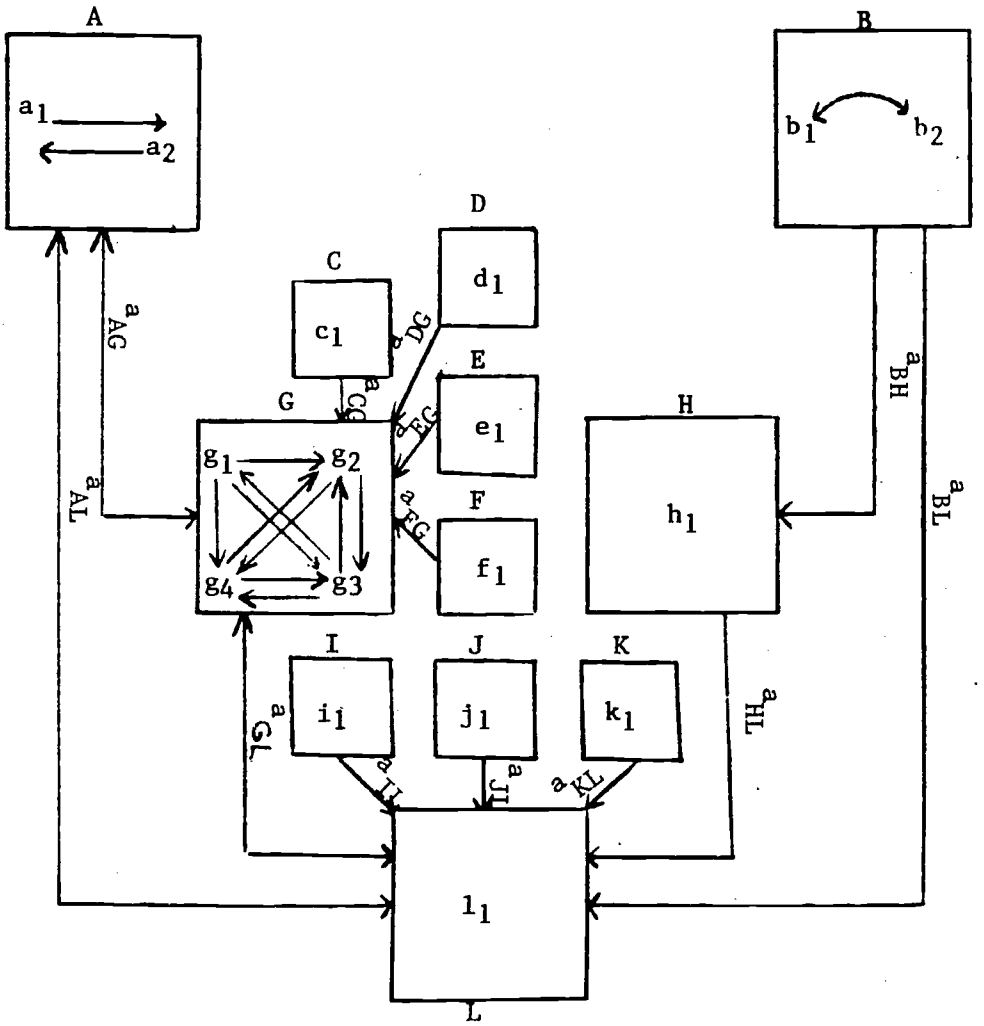
The design for this study was developed to present an alternative to the type of data analysis presented in previous reports in the series. The following is a description of the model hypothesized to represent relationships investigated, the nature and size of the samples, and the procedures used in analyzing the data.

The Model

A block-recursive model was used to test the causal linkages among the variables shown in the model in Figure 1. The block-recursive model allows the researcher to combine features of recursive systems with more complex reciprocal causation and/or feedback models. Simplifying assumptions were made concerning the hypothesized relationships among variables. These resulted in the following causal sequences. Student achievement (l_1) is determined by the parameters sex (i_1), attendance (j_1), and student age (k_1); by the exogenous variables father's occupation (b_1), race or ethnicity (b_2), principal leadership (a_1), and organizational climate (a_2); by the endogenous variables teacher attitudes toward curriculum (g_1), teacher attendance (g_2), teacher performance (g_3 and g_4), and IQ (h_1); and by residual variables. IQ is determined by father's occupation, race or ethnicity, and residual variables.

There is reciprocal causation among teacher variables, and these, in turn, are influenced by the parameters teacher sex (c_1), marital status (d_1), experience (e_1), and professional preparation (f_1); by the exogenous variables climate and leadership; and by residual variables. The causal sequence was, therefore, assumed to be as follows; principal leadership, organizational climate, father's occupation, and race or ethnicity have a causal relationship with student achievement. These effects were mediated through teacher variables and student IQ.

Block L contained the dependent variable of student achievement in all subject areas. Block A contained the organizational variables of leadership and climate. Block B contained the home background variables of occupation and race or ethnicity. Blocks C, D, E, F, and G contained the teacher variables of sex, marital status, experience, professional preparation, attitudes, attendance, and performance. Blocks H, I, J, and K contained the student variables of IQ, sex, attendance, and age. The purpose for separating the variables into blocks was to bring some order to the regressions analyses. That is,



In Block A: a_1 = Principal Leadership
a_2 = Organizational Climate
In Block B: b_1 = Father's Occupation
b_2 = Student Race or Ethnicity
In Block C: c_1 = Teacher Sex
In Block D: d_1 = Teacher Marital Status
In Block E: e_1 = Teacher Experience
In Block F: f_1 = Teacher Professional Preparation
In Block G: g_1 = Teacher Attitudes toward Curriculum
g_2 = Teacher Attendance
g_3 = Teacher Performance as Rated by Principals
g_4 = Teacher Performance as Self-perceived
In Block H: h_1 = Student IQ
In Block I: i_1 = Student Sex
In Block J: j_1 = Student Attendance
In Block K: k_1 = Student Age
In Block L: l_1 = Student Achievement

Figure 1. Causal model demonstrating block-recursive and reciprocal relationships.

variables similar in type were grouped, and this permitted a sequential order in the regression analyses. In testing effects on achievement, R^2 was used as the measure of explained variance. Block A variables were entered first. Block G variables were entered second. For the asymmetric analysis, R^2 was obtained by subtracting R^2 for the Block A variables from the combined R^2 for Block A and G variables. Block B variables were entered next. Finally, Block H was entered, and R^2 was considered the difference between the combined explained variance of Blocks B and H and Block B. See Tables I and II.

The variance in student achievement accounted for by Block A variable (R_A^2) was hypothesized to be explained through the direct path a_{AL} and the indirect path $a_{AG}a_{GL}$. The variance accounted for by the Block B (R_B^2) was hypothesized to be explained through the direct path a_{BL} and the indirect path $a_{BH}a_{BL}$. Next, the regression equation with Block A and Block G as independent variables (R_{AG}^2) shows the effect of the path (a_{AL}) from Block A plus the path (a_{GL}) from Block G. Similarly, the regression equation with Block B and Block H as independent variables (R_{BH}^2) shows the effect of the path (a_{BL}) from Block B plus the path (a_{HL}) from Block H. Finally, the regression equation with all variables effecting student achievement (R_{ABGH}^2) shows the total effect of all variables in Blocks A, B, G, and H; the parameters in Blocks C, D, E, and F effecting teacher variables; and parameters in Blocks I, J, and K.

It is appropriate to explain here the use of R^2 rather than standardized regression coefficients (beta values) as used in previous reports. Blocks are usually not single variables, but sets of variables. Each variable within a block will have a regression coefficient but these cannot be added meaningfully. There is a way to obtain a regression coefficient for a block of variables, but the tedious analysis did not seem warranted for this study. The full regression on achievement would just be carried out on separate block variables; then compound block variables would be created by using the regression coefficients as weights. A new regression analysis would then be carried out using the compound variables instead of the

TABLE I

ASYMMETRIC BLOCK VARIANCE

Block A	$var(a_{AL})$	R_A^2
	$var(a_{AG}a_{GL})$	
	$var(a_{AG}a_{GL})-var(a_{BH}a_{HL})$	
Block B	$var(a_{BL})$	R_B^2
	$var(a_{BH}a_{HL})$	
	$var(a_{BH}a_{HL})-var(a_{AG}a_{GL})$	
Block G	$var(a_{GL})-var(a_{AG}a_{GL})$	$R_{AG}^2-R_A^2$
	$var(a_{GL})-var(a_{AG}a_{GL})-var(a_{BL}a_{BH}a_{HL})$	
Block H	$var(a_{HL})-var(a_{BH}a_{HL})$	$R_{BH}^2-R_B^2$
	$var(a_{HL})-var(a_{BH}a_{HL})-var(a_{AL}a_{AG}a_{GL})$	

Note: The explained variance accounted for by Block G includes the influence of parameters in Blocks C, D, E, F. The total explained variance in student achievement includes the influence of parameters in Blocks I, J, K.

TABLE II

SYMMETRIC BLOCK VARIANCE

Block A	$var(a_{AL})$	R_A^2
	$var(a_{AG}a_{GL})$	
Block B	$var(a_{BL})$	R_B^2
	$var(a_{BH}a_{HL})$	
Block G	$var(a_{GL})$	R_G^2
Block H	$var(a_{HL})$	R_H^2

individual variables that made up the compounds.

The Sample

All teachers and all principals of sixth-grade students were considered the samples of teachers and principals, respectively. A random sample of thirty-five percent of students in the sixth grade constituted the student sample. For the regression analyses, n = 128.

Data and Instruments

Nine types of data were collected for the study: (1) cross-sectional data on student achievement for the 1974-75 school year, (2) ratings of principals by teachers on aspects of principal leadership, (3) ratings of organizational climate by teachers, (4) ratings of teachers by principals and self-ratings by teachers on their performance in a curriculum engineering system, (5) measures of teacher attitudes toward participation in a curriculum system, (6) student background data about father's occupation and race or ethnicity, (7) records of teacher and student attendance, and (8) personal data about teachers and students. Personal data about teachers included sex, marital status, the number of years of teaching experience, and the amount of professional preparation. Personal data about students included sex, age, and IQ.

Various aspects of principal leadership were measured by the Leader Behavior Description Questionnaire - Form XII.[5] Dimensions of organizational climate were measured by the Organizational Climate Description Questionnaire - Form IV.[6] Father's occupation was classified as one of the following: unemployed, non-skilled, semi-skilled, clerical, skilled, or management professional. Student race or ethnicity was specified as white, Latin American, or black. Teacher motivation to participate in curriculum functions was measured by the Curriculum Attitude Inventory.[7] Teacher attendance was measured by the number of days of absence during the school year. Teacher performance

in the curriculum system was assessed two ways: (1) by their principals' perceptions as measured by the Principals' Version of the Teacher Self-Analysis Inventory,[8] and (2) by their self-perceptions as measured by the Teacher Self-Analysis Inventory.[9] The Kuhlmann-Anderson Intelligence Tests, 7th Ed. provided student IQ scores. Student attendance was measured by the number of days of absence during the school year. Student achievement was measured by the Stanford Achievement Test.

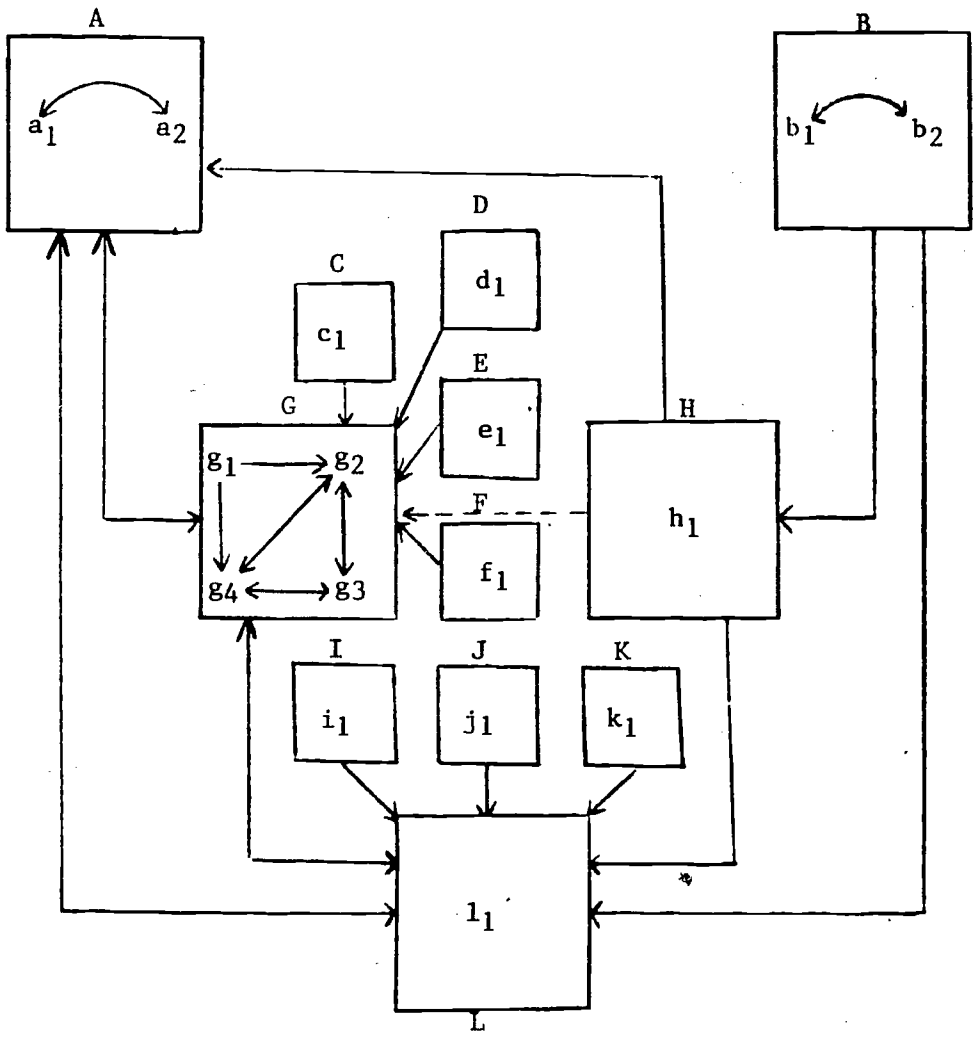
While data were collected for a thirty-five percent sample of all students in the district stratified by grade level, only data for grade six are included in this report. Similarly, while data were collected recurrently since 1970, only data for the 1974-75 school year are included here.

RESULTS

Results of procedures preliminary to setting up the regression model were presented in the sixth report in the series,[10] and they will not be repeated here. The model derived from the regression analyses for grade six is shown in Figure 2.

The results of the regression analyses for achievement in grade six are shown in Tables III and IV. Table III contains the magnitude of explained variance (R^2) in each subtest in achievement by individual variables. Table IV contains the magnitude of explained variance (R^2) in each subtest in achievement by Blocks A, B, AG, BH, IJK, and Total. In both Tables, the significance of the multiple R for each of the explained variances is indicated by asterisks. From Table III the importance of the various Blocks and the relative importance of individual variables within Blocks in explaining the variance in achievement can be noted.

The magnitude of the multiple regression coefficients was not significant when only Block A variables were included in the regression equations. The data fit the regression equations in all cases except one; principal leadership was excluded for one subtest, LAN.



In Block A: a_1 = Principal Leadership
a_2 = Organizational Climate
In Block B: b_1 = Father's Occupation
b_2 = Student Race or Ethnicity
In Block C: c_1 = Teacher Sex
In Block D: d_1 = Teacher Marital Status
In Block E: e_1 = Teacher Experience
In Block F: f_1 = Teacher Professional Preparation
In Block G: g_1 = Teacher Attitudes toward Curriculum
g_2 = Teacher Attendance
g_3 = Teacher Performance as Rated by Principals
g_4 = Teacher Performance as Self-perceived
In Block H: h_1 = Student IQ
In Block I: i_1 = Student Sex
In Block J: j_1 = Student Attendance
In Block K: k_1 = Student Age
In Block L: l_1 = Student Achievement

Figure 2. Revised model demonstrating block-recursive and reciprocal relationships.

TABLE III

EXPLAINED VARIANCE IN STUDENT ACHIEVEMENT VARIABLES WITHIN A BLOCK AND COMBINED BLOCKS USING BLOCK-RECURSIVE MODEL

Variables	Achievement Subtests														
	SP	VOC	REC	WSS	LAN	MCONC	MCOMP	MAPP	SSC	SCI	LIC	TR	TM	TA	TB
Block A															
a_1	.01	-	-	-	-	.01	.02	-	-	-	-	-	.01	-	.04
a_2	.01	.01	.02	.01	.01	-	.01	-	.01	.01	.01	.01	-	.01	.01
Block B															
b_1	.03**	.02**	.05**	.03**	.04**	.02**	.06**	.02**	.02**	.01**	.02**	.05**	.04**	.02**	.04**
b_2	.21**	.32**	.30**	.28**	.28**	.33**	.25**	.26**	.31**	.29**	.26**	.32**	.30**	.33**	.32**
Block AG															
a_1	.04*	.01**	.02**	.01	-	.01	-	-	-	-	.01**	.01**	-	.02**	-
a_2	.01*	.01**	-	-	-	.01	-	-	-	-	.01**	.01**	-	.01**	-
g_1	-	.02**	.01**	.01*	.02**	-	.01*	-	.03**	.02**	.03**	.01*	.01**	.01**	-
g_2	-	.01**	.01**	.01*	.01*	.01	-	-	.01**	.01**	.07**	-	-	.02**	.02**
g_3	-	.01**	.01**	.01*	.02**	.01*	.01*	-	.02**	.01**	-	-	-	-	-
g_4	.02	-	-	.01*	.01**	.02	-	.01**	.02**	.02**	.01**	.01**	-	-	-
c_1	.01	.12**	.09**	.03*	.06**	.03*	.02*	.07**	.08**	.13**	-	.07**	.04*	.10**	.07**
d_1	.03*	.02**	.01**	.01*	.02**	.01	.03	.02**	.02**	.01**	.10**	.01**	.02**	.04**	.01**
e_1	-	.05**	.02**	.03*	.03**	.03*	.05**	.01**	.03**	.04**	-	.03**	.04**	.02**	.04**
f_1	.01*	.01**	.01**	-	.01**	-	.01**	.01**	.01**	-	-	.01**	.02**	.01**	.01**
Block BH															
b_1	-	-	.01**	-	.01**	-	.03**	-	-	-	-	.01**	-	-	-
b_2	.01**	.05**	.03**	.03**	.01**	.02**	.01**	.01**	.03**	.03**	.03**	.03**	.02**	.04**	.02**
h_1	.55**	.53**	.60**	.57**	.65**	.72**	.54**	.58**	.61**	.56**	.51**	.64**	.68**	.57**	.72**

TABLE III (continued)

Variables	Achievement Subtests														
	SP	VOC	REC	WSS	LAN	MCONC	MCOMP	MAPP	SSC	SCI	LIC	TR	TM	TA	TB
Block IJK															
i_1	.02*	-	-	.02*	.03	-	-	-	-	-	-	.01	-	-	-
j_1	.01*	.01	.01	.01*	.02*	.02*	.01	.01	-	.01*	.01*	.01	.01	.01*	.01*
k_1	.05*	.03	.03	.04*	.01	.05**	.02	.03	.03	.05*	.05*	.03*	.04*	.04*	.04*
Totals															
a_1	-	-	-	-	.01**	-	-	.02**	-	.01**	.01**	.01**	-	-	.01**
a_2	-	-	-	-	-	.01**	-	.01**	-	-	-	-	-	-	-
b_1	-	-	-	-	-	-	.03**	-	-	.01**	-	.01**	-	-	-
b_2	-	.06**	-	.04**	-	-	.01**	-	-	.04**	.04**	.04**	.03**	.05**	.03**
g_1	-	.01**	-	-	-	-	-	-	.02**	-	-	-	-	-	-
g_2	.01**	.01**	.01**	-	-	-	.01**	-	-	.02**	-	-	.01**	.01**	-
g_3	-	-	-	-	-	-	-	-	-	-	-	-	.01**	-	-
g_4	-	-	-	-	-	-	-	.01**	-	-	-	-	-	-	-
h_1	.55**	.53**	.60**	.57**	.65**	.72**	.55**	.58**	.61**	.56**	.51**	.64**	.68**	.58**	.72**
i_1	.02**	.01**	-	.02**	.02**	-	-	-	-	-	.01**	-	-	.01**	-
j_1	-	-	-	.01**	-	-	-	-	.01**	-	.01**	-	-	-	-
k_1	-	-	.01**	-	.02**	-	.01**	.01**	-	-	-	.01**	.01**	-	.01**

TABLE IV

EXPLAINED VARIANCE IN STUDENT ACHIEVEMENT
OBTAINED BY USING BLOCK-RECURSIVE MODEL

Blocks / Subtest	R^2	$\sqrt{1-R^2}$	R^2	$\sqrt{1-R^2}$	R^2	$\sqrt{1-R^2}$	R^2	$\sqrt{1-R^2}$	R^2	$\sqrt{1-R^2}$	R^2	$\sqrt{1-R^2}$
	A		B		AG		BH		IJK		TOTAL	
SA_{SP}	.02	.99	.24**	.87	.12	.94	.56**	.66	.08*	.96	.58**	.65
SA_{VOC}	.01	.99	.34**	.81	.26**	.86	.58**	.65	.04	.98	.62**	.62
SA_{REC}	.02	.99	.35**	.81	.18**	.91	.64**	.60	.04	.98	.62**	.62
SA_{WSS}	.01	.99	.31**	.83	.12	.94	.60**	.63	.07*	.96	.64**	.60
SA_{LAN}	.01	.99	.32**	.82	.18**	.91	.67**	.57	.06	.97	.70**	.55
SA_{MCONC}	.01	.99	.35**	.81	.13	.93	.74**	.51	.07*	.96	.73**	.52
SA_{MCOMP}	.03	.98	.31**	.83	.13	.93	.58**	.65	.03	.98	.61**	.62
SA_{MAPP}	-	-	.28**	.85	.12*	.94	.59**	.64	.04	.98	.63**	.61
SA_{SCC}	.01	.99	.33**	.82	.22**	.88	.64**	.60	.03	.98	.64**	.60
SA_{SCI}	.01	.99	.30**	.84	.24**	.87	.59**	.64	.06	.97	.64**	.60
SA_{LIC}	.01	.99	.28**	.85	.23**	.88	.54**	.68	.06	.97	.58**	.65
SA_{TR}	.01	.99	.37**	.79	.16*	.92	.68**	.57	.05	.97	.71**	.54
SA_{TM}	.01	.99	.34**	.81	.13	.93	.70**	.55	.05	.97	.74**	.51
SA_{TA}	.01	.99	.35**	.81	.25**	.87	.61**	.62	.05	.97	.65**	.59
SA_{TB}	.01	.99	.36**	.80	.17*	.91	.74**	.51	.05	.97	.77**	.48

* Multiple R $p < .05$
** Multiple R $p < .01$

The magnitude of the multiple regression coefficients for Block B variables was significant at the .01 level for all subtests and total scores. Ethnicity accounted for approximately 90% of the combined effects of the Block B variables. Data fit the regression equations in all cases.

The magnitude of the multiple regression coefficients for the combined Block A and Block G variables varied in significance. The multiple R's for TA, VOC, REC, LAN, SCI, SSC, and LIC were significant at the .01 level. Teacher sex and marital status accounted for more than 50% of the variance in TA explained by Block AG variables. Teacher sex, teacher experience, and curriculum attitudes accounted for more than 50% of the variance in SSC explained by Block AG variables. Teacher status and teacher attendance accounted for more than 50% of the variance in LIC explained by Block AG variables. The multiple R's for TR, TB, and MAPP were significant at the .05 level. Teacher sex and teacher experience accounted for more than 50% of the variance in TR and TB explained by Block AG variables. Teacher sex accounted for more than 50% of the variance in MAPP explained by Block AG variables. The multiple R's for TM, SP, WSS, MCONC, and MCOMP were not significant. The data fit the regression equations for Block AG variables in all cases except one; teacher performance as self perceived was excluded for one subtest, MCOMP.

The magnitude of the multiple regression coefficients for Block B and Block H variables was significant at the .01 level for all subtests and total scores. IQ accounted for more than 90% of the combined effects of Block B and Block H variables. The data fit the regression equations in all cases except one; occupation was excluded for one subtest, MAPP.

The magnitude of the multiple regression coefficients for the combined Block I, Block J, and Block K parameters varied in significance. The multiple R's for SP, WSS, and MCONC were significant at the .05 level. Student age accounted for more than 50% of the variance explained by Block IJK parameters. The multiple R's for all other subtests and total scores were not significant. The data fit the

regression equations in all cases except one; student sex was excluded for one subtest, SSC.

Finally, magnitude of the multiple regression coefficients for the combined variables and parameters in all blocks was significant at the .01 level for all subtests and all total scores. IQ consistently accounted for approximately 90% of the combined effects of all variables and parameters. The data fit the regression equations in all cases.

In addition to finding interest in the magnitude of regression coefficients and R^2 values, the positive or negative direction of influence is also a concern. For example, when all variables effecting achievement in all areas were considered, the influence of leadership behavior was negative. Organization climate was found to adversely effect achievement in six of the eleven subtest areas (VOC, WSS, LIC, LAN, SCI, and MCONC) and in Total Auditory. The finding that strength in organization variables (leadership and climate) so uniformly have a negative effect upon student achievement is puzzling. Future analyses will be directed to looking at the quality of these influences, in terms of the dimensions measured by each of the instruments. Race or ethnicity had a negative influence; that is, Latin American students achieved at a lower level than white students, and black students achieved at the lowest level. Occupational status was found to have a negative coefficient in only one area, Science. Teacher variables were found to have scattered negative influences: (1) teacher attitudes had a negative influence on student achievement in three of the eleven subtest areas (VOC, SSC, and SCI) and in Total Auditory, (2) teacher performance as self-perceived had a negative influence on student achievement in six of the eleven subtest areas (VOC, WSS, LIC, LAN, SP, and SCI) and in Total Auditory, and (3) teacher performance as rated by principals had a negative influence on five of the eleven subtest areas (WSS, REC, LAN, MAPP, and SP), and in Total Reading and Total Battery. Student sex had a negative influence in five of the eleven subtest areas (VOC, LIC, SSC, MAPP, and SCI) and in Total Auditory and Total Math; that is, male students achieved at a higher level than female students in the

named areas. Student age had a strong negative influence in explaining the variance in achievement in all areas. Surprisingly, teacher attendance, measured in terms of absence, had a negative influence in only four of the eleven subtest areas (WSS, MCOMP, MAPP, and SP) and in Total Reading, Total Math, and Total Battery. That is, teacher absence did not adversely effect achievement in the subtest areas not named. All other variables had a postive influence on achievement in all areas when all variables were considered. These findings are generally consistent with those using the path analytic method of analyzing data, number six in this series of reports.[11]

From Table IV, the range of variance in achievement explained by the various blocks and the effect of combined blocks of variables can be noted. There was a substantial increment added to the explained variance when IQ (Block H) was compounded with home background variables (Block B). For example, for Block B, the range of explained variance in achievement for the various subtests was from .24 to .37. When IQ was added (BH), this range jumped from .54 to .74, and increase of 100% for most subtests. There was little, if any, unique variance accounted for when direct effects of schooling (organizational (A) and teacher variables (G)) were added to the compound of home background and IQ variables. The range of explained variance in achievement for the various subtests when all model variables were entered in the regression equations was from .58 to .77.

When only schooling variables (AG) were used in regression, the range of explained variance in achievement for the various subtests was from .12 to .26. The multiple R's for two thirds of the subtests were significant at either the .05 or .01 levels. Since the explained variance for direct organizational effects (Block A) (organizational climate and principal leadership) ranged from .01 to .03, the explained variance for (AG) was primarily effected by teacher variables. It is interesting to note that the explained variance in three of the four total scores (Total Battery, Total Reading, and Total Auditory) had a multiple R significant at either

the .05 or .01 levels. Only Total Math had a multiple R that was not significant.

Another interesting comparison utilizes the data in Table V. The table shows the R^2 values from the path analytic study[12] and from the present study for all variables hypothesized to effect student achievement. The range of values for explained variance in achievement when home background variables were not considered was from .44 to .81 in contrast to the range from .58 to .77 for the block-recursive analysis which included home background variables. All multiple R's in both methods of analysis were significant at the .01 level. The similarity of the amount of variance accounted for utilizing the two methods is striking. This probably is explained more by the large common influence of the measure of IQ than by the choice of method.

The results from analyzing recursive relationships above and the reciprocal causal relationships to follow warranted a change in the hypothesized relationships as shown in Figure 1. When assumed reciprocal causal relationships were tested, the blocks of variables previously used as independent variables became the dependent variables. The assumed reciprocal causal relationships were analyzed by regression equations, and the warranted changes are shown in Figure 2.

A summary of the variance in organizational variables explained by teacher and student variables, and a summary of the variance in teacher variables explained by student variables is contained in Table VI. The variance in LBDQ scores (a_1) explained by the variables effecting student achievement averaged .90. That in OCDQ scores (a_2) averaged .70. Data fit the regression equations for both LBDQ and OCDQ with the exception of Block B variables; in Figure 2, therefore, father's occupation and race or ethnicity are not shown as effecting Block A variables. Similarly, although procedures preliminary to regression analyses showed that Block A variables were correlated neither the variance in leadership accounted for by climate nor the variance in climate accounted for by leadership

TABLE V

COMPARISON OF VALUES OF EXPLAINED VARIANCE IN STUDENT ACHIEVEMENT OBTAINED USING PATH ANALYSIS AND BLOCK RECURSIVE MODELING

	R^2 Path Analysis All variance	R^2 Block-Recursive All variance
SA_{SP}	.77**	.58**
SA_{VOC}	.66**	.62**
SA_{REC}	.59**	.62**
SA_{WSS}	.66**	.64**
SA_{LAN}	.73**	.70**
SA_{MCONC}	.81**	.73**
SA_{MCOMP}	.67**	.61**
SA_{MAPP}	.52**	.63**
SA_{SSC}	.62**	.64**
SA_{SCI}	.44**	.64**
SA_{CIC}	.45**	.58**
SA_{TR}	.69**	.71**
SA_{TM}	.69**	.74**
SA_{TA}	.60**	.65**
SA_{TB}	.73**	.77**

** Multiple R $p < .01$.

TABLE VI

AVERAGE EXPLAINED VARIANCE IN ORGANIZATIONAL AND TEACHER VARIABLES USING RECIPROCAL CAUSATION ASSUMPTIONS

Variables	R^2
Block A	
LBDQ (a_1)	.90
OCDQ (a_2)	.70
Block G	
CAI (g_1)	.64
TAT (g_2)	.75
PTSAI (g_3)	.80
TSAI (g_4)	.94

was significant at the .05 level. Therefore, Block A variables were shown as correlated in Figure 2. TSAI (g_4) alone accounted for more than 50% of the explained variance in LBDQ and OCDQ. The variance in CAI scores (g_1) explained by the variables effecting student achievement averaged .64. The data fit the regression equations in all cases. TSAI accounted for more than 60% of the explained variance in CAI, and TSAI and TEXP (e_1) combined accounted for more than 80% in all cases. The variance in TSAI explained by the variables effecting student achievement averaged .94. The data fit the regression equations in all cases. CAI accounted for approximately 40% of the explained variance in TSAI, and CAI and PROP (f_1) combined accounted for approximately 60% in all cases. The variance in PTSAI scores (g_3) explained by the variables effecting student achievement averaged .80. The data fit the regression equations with one exception; variables were excluded from the equation for Total Math. Teacher marital status and sex accounted for more than 50% of the explained variance in PTSAI in all cases. The variance in TAT scores (g_2) explained by the variables effecting student achievement averaged .75. The data fit the regression equations with one exception: variables were excluded from the equation for Math Applications. Teacher sex accounted for 40% of the explained variance in TAT.

DISCUSSION

Overall findings warranted the conclusion that causal and other relationships exist among the four classes of variables: organizational, home background, teacher, and student. There was support to conclude the following: (1) there is a correlation between principal leadership and organizational climate, and between father's occupation and race or ethnicity; (2) there is support for the assumption of reciprocal causation among organizational, teacher, and student variables; and (3) home background variables influence IQ and student achievement. The negative impact of leadership and

climate cannot be explained, but future efforts are warranted to determine if the quality of leadership and climate would have a decidedly positive or negative influence on student achievement. It is known that achievement in all subtests in all grades analyzed (one, three, and six) was lower than the previous year. Obviously, something is adversely effecting achievement, and further investigation is warranted. A commonality analysis revealed that there was little unique variance added to the combined effects of home background variables and IQ when schooling variables were considered. The controversial nature of the literature on IQ, however, makes it debatable whether or not IQ itself is an effect of schooling. Perhaps research in this area will be more revealing in the future.

To the knowledge of the researchers, this is the first study to attempt mathematical modeling of the relationships among variables in a curriculum system testing block-recursive and reciprocal causation assumptions. Since the study is analytical of real-world relationships and is supported by a theoretical framework, it contributes toward bridging the theory-research gap. Precise thought in education and curriculum theorizing is fostered by using mathematical formulations of verbal theories to focus on a particular variable or blocks of variables. The extension of models in previous studies to the block-recursive and reciprocal causation assumptions made in this study permitted greater complexity to be introduced. It is noteworthy, however, that results differed little between the two types of analyses. Continued testing of the model and comparison of results using regression procedures and a multivariate analysis of variance procedure will, hopefully, render a better knowledge of the nature of these and other relationships and the degree to which schooling variables are related. This added knowledge showing that school does make a difference, can serve as a guide in planning effective educational policy and practice.

FOOTNOTES

[1]Andrew W. Halpin, Theory and Research in Administration (New York: The MacMillan Company, 1966), pp. 150-152.

[2]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.

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

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

[5]Leader Behavior Description Questionnaire - Form XII Columbus: Bureau of Business Research, College of Commerce and Administration, The Ohio State University, 1962).

[6]Prepared by Andrew W. Halpin and Don B. Croft. Reprinted with permission of MacMillan Publishing Co., Inc. from Theory and Research in Administration by Andrew W. Ahlpin, op. cit.

[7]Michael Langenbach, "The Development of an Instrument to Measure Teachers' Attitudes Toward Curriculum Use and Planning" (Unpublished Doctoral Dissertation, Northwestern University, Evanston, 1969).

[8]George A. Beauchamp, Principals' Version of the Teacher Self-Analysis Inventory, Northwestern University, Evanston, 1974.

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

[10]George A. Beauchamp and Patricia C.Conran, "Longitudinal Study in Curriculum Engineering - VI." Mimeographed, a paper presented at the annual meeting of the American Educational Research Association in San Francisco, California, April, 1976.

[11]Ibid.

[12]Ibid., p. 6.