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ABSTRACT

The purpose of this study was to determine whether children with differing cognitive abilities can benefit from differing educational environments. The investigation was specifically concerned with two questions: (1) Are there differences in the mathematics achievement between children with an internal or external locus of control in both open and non-open classrooms? (2) Are there differences in the mathematics achievement between pupils with a low and high self-concept in both classroom types? The study was conducted in an independent suburban school district near a midwestern metropolitan area. Students in the non-open environments appear to exhibit higher mathematics achievement scores at the upper grade levels. Analysis of the data also reveals that internal locus of control and high self-concept are positively associated with an open classroom environment. It is suggested that the investigation needs to be replicated at lower grade levels, to examine the trends highlighted in this study. (MP)

THE EFFECTS OF SCHOOL ENVIRONMENT AND STUDENT COGNITIVE CHARACTERISTICS UPON SCHOOL ACHIEVEMENT IN MATHEMATICS

A report of a research study
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Introduction

Much educational controversy has dealt with the effects of alternative educational programs on student academic achievement. One large group of studies has sought to investigate the relationships of academic achievement and school environment. However, many of these studies were centered around an either/or view of education. There is presently a growing body of educators and their reported studies questioning such simplistic arguments. These educators believe that there is no one method of education that is consistently superior or inferior to alternative approaches. Rather, the individual differences of pupils should provide the guide for selecting the most appropriate setting for each child. Another large group of educational studies has sought to investigate the relationship of student's personality characteristics with academic achievement. Differences in cognitive style, locus of control, self-esteem, motivational factors, and other cognitive factors have been explored.

The concept of open education has often been embraced as a method of correcting the educational woes of present educational systems (Blackie, 1971; Kohl, 1969; Silberman, 1970). Review of the professional and popular literature on open education reveals several common themes. Nyguist and Hawes (1972) draw upon the thinking of Roland Barth and Charles Rathborne in characterizing open education.

"Open education is a way of thinking about children, about learning, and about knowledge. It is characterized by openness and trust; by spatial opennessof doors, and rooms; by openness of time to release and serve children, not to contain, prescribe and master them. The curriculum is open to significant choice by adults and children as a function of the needs and interests of each child at the moment."

From an analysis of the assumptions about open education, Traub et al. (1972) isolated several general outcomes as those of importance in open education: communication skills, number skills, problem solving skills, decision-making skills, knowledge of basic concepts, openness to new situations, self instructional skills, divergent thinking, cooperation in group problem-solving, resourcefulness, self-perception, personal and cognitive styles, and self-others frame of reference. It is thought that if children are to develop their intellectual potential they must be provided with an intellectually stimulating environment. The emotional and intellectual climate of a learning situation determines how well the pupil will obtain functional behavioral changes. It is assumed that the open atmosphere is less threatening than other educational structures, with the result being that the child will come to direct his own learning experiences and will learn more fully and with less trauma (Conklin, 1974). There is, however, an alarming lack of research to support the contention that open education will <u>best</u> serve all children.

Locus of control is a cognitive style variable that may affect

children differentially in open and non-open school settings. Locus of control is measured along an internal-external continuum. According to Ducette and Wolk (1973), locus of control was originally concieved as a mediating expectancy variable which primarily affects learning. An internal person has an expectancy that the environment is open to personal manipulation and that a relationship exists between his actions and his reinforcements. An external person, on the other hand, expects to be under the control of others and expects that effort does not necessarily result in reward. Thus an internal child, because he has come to expect that actions and outcomes are related, responds adaptively to reinforcements; an external child does not.

It seems a logical extension of the locus of control cognitive construct that internals would manifest more achievement-striving behavior then externals who feel they have little control over their environment. Any prolonged achievement effort will occur only among those individuals who believe they can through their own efforts accomplish desired goals. Achievement of these two groups of children, internal and external, should be differentially affected in contrasting learning environments.

Self-concept is also a cognitive variable that may differentially affect children in open and non-open school settings. Felkar (1974) sees self-concept as the sum total of the views which an individual has of himself. Self-concept is a unique set of perceptions, ideas, and attitudes about one's whole being. Accurate, realistic conceptions of self are learned. Since they are learned, they are teachable (Combs, 1962). For the most part, learning about self is a product of interaction with human beings. This has important meanings for education because many of the strongest social in-

fluences are brought to bear upon the child by way of his experiences in school. Since educational settings determine the number and degree of many of a child's positive and negative experiences achievement of high-self-concept and low-self-concept children should also be affected differentially in contrasting educational environments.

Method:

The purpose of this study was to determine whether children with differing cognitive attributes can benefit from differing educational environments. Specifically, this study was concerned with the following questions: (1) Are there differences in the mathematics achievement between children with an internal or external locus of control in both open and non-open classrooms? and (2) Are there differences in the mathematics achievement between children with a low-self concept and a high-self concept in both open and non-open classrooms?

The study was conducted in an independent suburban school district near a midwestern metropolitan area. The classrooms selected for use in the study were determined by use of the Dimensions in Schooling (DISC VI) Questionnaire. The Dimensions of Schooling (DISC VI) Questionnaire was developed by Traub, Weiss, Fisher and Musella (1972) for the Ontario Institute for Studies in Education (OISE). The DISC VI was developed for assessing the extent to which a school's program embodies the characteristics of open education. These same researchers have reported reliability and validity scores for the instrument. All available upper elementary classroom teachers were asked to respond to the questionnaire and from this population the three most open and the three most non-

open environments were selected for use in the study. All students (n=125) in the selected classrooms were administered the Coopersmith Self-Esteem Inventory (SEI) and the children's Nowicki-Strickland Internal-External Control Scale (SNC-IE). Mathematics achievement scores on the Iowa Tests of Basic Skills Form 5, obtained from the subjects' schools records, were the criterion measured.

The Coopersmith Self-Esteem Inventory (SEI) was devised by Stanley Coopersmith (1967) to assess a person's subjective judgement or evaluation of his personal worthiness that is expressed in the attitudes toward himself in various situations. The inventory consists of 58 statements, each of which asks the individual to answer whether or not the statement describes his usual feeling in a given situation. The possible responses are "Like Me" and "Unlike Me." An individual's score on the inventory places him/her along a continuum with positive global self-esteem and negative self-esteem at the extremes.

The children's Nowicki-Strickland Internal-External Scale (CNI-IE) was developed by Norwicki and Strickland (1973) and assesses children's locus of control along an internal-external continuum. It has reported test-retest reliability of 0.71 and construct validity. It is an excellent general global measure of locus of control for elementary school children.

The data obtained were analyzed utilizing two-way analysis of covariance procedures. Mathematics achievement scores were the dependent variable. Student IQ scores were the covariate. Classroom climate and locus of control were the independent variables for the first analysis. Classroom climate and self-concept were the independent variables for the second analysis. A factoral design

with unique cell frequencies and using the classical experimental design approach for assigning proportions of SS was utilized (Kim, and Kohout, 1975).

Results:

Means and standard deviations for all the concomitant, dependent and independent variables are reported in Table 1.

Table 1 about here

Pearson product moment correlations were also computed between the independent variables, the dependent variable and IQ, the concomitant variable. These results are reported in Table 2. As can be seen from the table, the variable IQ was highly correlated with mathematics achievement and the independent variables locus of control and self-concept. It was not significantly correlated with classroom climate.

Table 2 about here

Two separate two-way analysis of covariances were carrried out to answer the proposed questions. Mathematics achievement scores on the ITBS were the dependent variable and IQ scores were the covariate in each analysis. In the first analysis, the independent variables were classroom climate and locus of control. The statistics pertinent to investigating the effects of these independent variables upon mathematics achievement are reported in Table 3.

Table 3 about here

From the data in Table 3 it can be seen that the F value for interaction of .265 did not reach significance. The main effects F value of 3.386 was significant at the .037 level. However, neither of the main effects F value of 3.633 for classroom climate nor the F value of 3.218 for locus of control were significant at the .05 level. This resulted because the cell frequencies of each factor are not proportional to the marginal frequencies of the factors. Thus there is some association between classroom climate and locus of control causing the additive effect as a whole to be significant for the criterion measure of mathematics achievement while neither of the individual main effects is significant. This occurs because classroom climate and locus of control receive credit only for the incremental sum of squares that each adds to the effects of the other factors.

In the second analysis the independent variables were classroom climate and self-concept. The statistics pertinent to investigating the effects of these independent variables upon mathematics achievement are reported in table 4.

Table 4 about here

The results of the second analysis revealed no significant main effects when school environment and self-esteem were the independent variables. Interaction effects were not significant in either of the two analysis. Non-significant trends indicated children in the non-open school environment scored higher on the criterion measured.

While the results of the study did not reveal a significant

relationship among locus of control, self-concept and school environment with regards to mathematics achievement, a number of interesting observations may be made from the data. Firstly, as reported by other researchers, it appears that students in the non-open environments will exhibit higher mathematics achievement scores at the upper grades level. Secondly, other analysis of the data utilizing the Pearson r Correlation Coefficient reveals that internal locus of control and high self-concept are positively associated with mathematics achievement. These variables also show a trend to be positively associated with an open environment in the classroom. Thus it might be that students will develop a higher self-concept and a more internal locus of control in an open environment and this will eventually affect their mathematics achievement. This study consequently needs to be replicated at lower grade levels. If the trends prove to be significant then it might be advisable to introduce the children to an open environment at the lower grades and a non-open environment at the upper grades. In this way children may exhibit higher scores on affective and academic measures.

Table 1

Means and Standard Deviations of Measured Variables

Instrument	Classroom Climate			
	Open[a]		Non-Open[b]	
	Mean	S.D.	Mean	S.D.
ITBS/Math	45.29	25.34	54.87	28.14
SEI	64.03	15.03	61.44	16.44
CNC-IE	14.77	5.11	14.20	4.94
IQ measure	108.41	13.29	110.81	14.51

[a]N = 66

[b]N = 59

Table 2

Correlation Coefficients
between All Variables

	IQ	School	LOC	SC	Math
IQ	--	-.09	-.16*	.18*	.73*
School		--	.06	.08	-.18*
Locus of Control			--	-.48*	-.17*
Self-Concept				--	.21*
Mathematics					--

*Significant at the .05 level

Table 3

Analysis of Covariance Summary Table for Mathematics Achievement by Open and Non-Open Classroom Climate and Internal-External Locus of Control

Source	df	SS	MS	F	P
Main Effects	2	2282.305	1141.152	3.386	.037
School	1	1224.408	1224.408	3.633	.059
LOC	1	1084.456	1084.456	3.218	.075
Interactions	1	89.145	89.145	.265	.608
Residual	120	40441.490	337.012		

Table 4

Analysis of Covariance Summary Table for Mathematics Achievement by Open and Non-Open Classroom Climate and Self-Concept

Source	df	SS	MS	F	P
Main Effects	2	1198.108	599.054	1.728	.182
School	1	1198.092	1198.092	3.456	.065
Self-Concept	1	.260	.260	.001	.978
Interactions	1	11.362	11.362	.033	.857
Residuals	120	41603.468	346.696		

Bibliography

Blackie, J. Inside the Primary School. New York: Schocken, 1971.

Combs, A.W., (ed.) Perceiving, Behaving, Becoming. Washington, D.C.: Association for Supervision and Curriculum Development, 1962.

Conklin, K.R. "Developmental Psychology vs. the Open Classroom," The Education Forum, 39(1), 1974, 43-47.

Coopersmith, S. The Antecedents of Self-Esteem. San Francisco: W.H. Freeman and Company, 1967.

Du Cette, J. and S. Wolk. "Cognitive and Motivational Correlates of Generalized Expectancies for Control," Journal of Personality and Social Psychology, 26 (3), 1973, 420-426.

Felker, D.W. Building Positive Self-Concepts. Minneapolis: Burgess Publishing Company, 1974.

Kim, Jae-On, and F.J. Kohout. "Analysis of Variance and Covariance: Subprograms ANOVA and ONEWAY" in Norman H. Nie, et al., (eds.) Statistical Package for the Social Sciences, 2nd Ed. New York: McGraw-Hill Book Company, 1975.

Kohl, H. The Open Classroom. New York: Random House, 1969.

Nowicki, S. Jr., and B.R. Strickland. "A Locus of Control Scale for Children," Journal of Consulting and Clinical Psychology, 40, (1), 1973, 148-154.

Nyquist, E.B., and G.R. Hawes, eds. Open Education. New York: Bantam Books, Inc., 1972.

Silberman, C.E. Crisis in the Classroom. New York: Random House, 1970.

Traub, R.E., J. Weiss, C.W. Fisher, and D. Musella. "Closure on Openness: Describing and Quantifying Open Education," Interchange, 3 (2,3), (1972), 69-84.