THE RELATIONSHIP OF COGNITIVE STYLE AND CLASSROOM ENVIRONMENT TO ACADEMIC ACHIEVEMENT: AN EXPLORATORY STUDY

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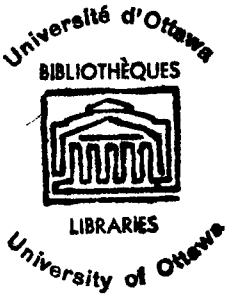

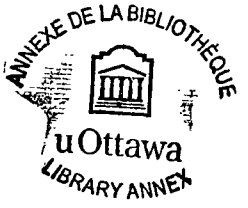

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CURRICULUM STUDIORUM

Rudolph Wagner was born on December 17, 1935 in Timmins, Ontario. He graduated from Toronto Teachers' College in 1956 and received the Bachelor of Arts degree in Psychology and Sociology from McMaster University at Hamilton, Ontario in 1967. In 1972, he received the Master of Education degree with specialization in Special Education from the Ontario Institute for Studies in Education of the University of Toronto.

TABLE OF CONTENTS

Chapter page

Appendix

LIST OF TABLES

INTRODUCTION

One of the current educational trends in Great Britain and North America is centred on innovation in school design and is termed, among other titles or labels, open plan education. Generally, these modifications in design have met with many positive claims being made regarding their efficiency and advantages for modern education. Empirical evidence substantiating or repudiating such claims, however, is sparse and inconclusive.

Resulting from a growing awareness of the importance of the physical environment in educational activities, schools have been built without internal walls to create space that can more readily accomodate many different activities. These schools make it easier to group and re-group students and provide a sense of openness.[1] Educators have come to believe that these facilities result in enhanced learning outcomes, not only in affective areas such as attitudes toward self, the teacher, and the school but also in cognitive skills such as reading, vocabulary, and numerical ability.

There appears, however, to be a great deal of

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1 Ross Traub, Joel Weiss, Charles Fisher, Donald Musella and Sar Kahn, Openness in Schools: An Evaluation Study, Research in Education, Series 5, Ontario Institute for Studies in Education, 1976, viii-69 p.

confusion in the literature regarding the terms associated with architecturally open schools. Much of the confusion seems to be centred on the difficulty of assessing what constitutes architecturally open classrooms. Some studies relate primarily to architecture[2] while, in others, the associated psychological dimensions or philosophy which relate to teaching style or methods are discussed.[3]

There was some concern that teachers in architecturally open classrooms would exhibit a different degree of psychological openness than teachers in traditional plan classrooms. It was felt that these differences, should they occur, might affect the academic achievement of the pupils. The results of several studies[4,5,6] examining the

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2 Open Space School Project Bulletin, School Planning Laboratory, School of Education, Stanford, March 1970,7p.

3 Ewald B. Nyquist and Gene R. Hawes, (eds.), Open Education, Bantam Books, Inc., New York, 1972, xi-399 p.

4 Nancy Murray, "The Opinions of Teachers Teaching in Open Space Elementary Schools in the Windsor Separate School Board", Unpublished M.Ed. Thesis, Wayne State University, 1971, xi-55 p.

5 D. Mister and L. McCann, "Survey of Teacher's Assessments of Open Area Schools", Ontario Teacher's Federation, Toronto, 1971, 30 p.

6 Marjorie O'Brien and James D. Feeney, "A Comparison of Open Space and Closed Space Schools on Some Aspects of Openness", Metropolitan Toronto Separate School Board, Toronto, 1973, 83 p.

differences between teachers in both types of facilities indicated that there were no appreciable differences in the psychological openness of teachers operating in each of the two types of classrooms. Therefore, for the purposes of this study, it was assumed that the degree of psychological openness of the teachers would be evenly distributed between the teachers in both types of classrooms.

Although educational institutions are concerned with the academic, psychological, and physical development of each pupil, the emphasis appears to remain on academic achievement. This is the criterion by which success or failure in the schools is usually measured. Consequently, a great deal of research has been conducted in an attempt to increase the predictability of academic performance.[7] Much of the research comparing architecturally open schools with traditional plan schools has been conducted in this area.

With respect to cognitive skills, the literature does not favour one type of facility over the other. In most of the studies using standardized tests of basic skills, insignificant differences in achievement were reported between architecturally open schools and traditional plan

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7 David E. Lavin, The Prediction of Academic Performance, Russell Sage Foundation, New York, 1965, 182 p.

schools.[8,9,10] Killough,[11] however, found that pupils in open space had significantly better achievement gains than their counterparts in self-contained classrooms. On the other hand, McRae[12] and Sackett[13] found that achievement scores were significantly lower for pupils in open space schools.

The results of a number of studies have emphasized disadvantages of architecturally open schools. The majority

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8 Brian Burnham, Reading and Mathematics Achievement of Grade 3 Pupils in Open Plan and Architecturally Conventional Schools, Studies of Open Education, No.10, York County Board of Education, Aurora, October 1973, 16 p.

9 Jack B. Warner, A Comparison of Students' and Teachers' Performance in Open Area Facility and in Self-Contained Classrooms , Unpublished Ed.D. Dissertation, University of Houston, 1970, xviii-107 p.

10 V.J. Kennedy and Michael W. Say, "A Comparison of the Effects of Open-Area Versus Closed-Area Schools on the Cognitive Gains of Students", Educators Report and Fact Sheet, No.4, 1971, 4 p.

11 Charles K. Killough, "An Analysis of the Longitudinal Effects That a Nongraded Elementary Program, Conducted in an Open-Space School, Had on the Cognitive Achievement of Pupils", Educators Report and Fact Sheet, Vol.9, No.2, 1971, 4 p.

12 B.C. McRae, The Effect of Open-Area Instruction on Reading Achievement, Department of Research and Special Services, Board of School Trustees, Vancouver, 1970, 4 p.

13 John W. Sackett, A Comparison of Self-Concept and Achievement of Sixth Grade Students in an Open Space School, Self-Contained School, and Departmentalized School, Unpublished Ph.D. Dissertation, Iowa University, 1971, vi-78 p.

of these disadvantages are related to distractibility due to noise and the numbers of individuals found in the open setting.[14,15] Myers[16] and Sugden[17] concluded that some pupils experience difficulty adjusting to the architecturally open environment with resultant lower academic performance. This study was conducted in an attempt to identify those pupils.

Pervin[18] stated that performance is a function of the interaction between characteristics of the individual and those of the environment and that both variables must be examined simultaneously. One of the major weaknesses in the research comparing cognitive achievement between pupils

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14 John E. Justus, "An Educator Views Open Space and the Planning Process", CEFP Journal, Vol.9, No.5, 1971, p. 12-14.

15 Robert E. Cheek, The Opinions of Teachers Teaching in Selected Open-Space Elementary Schools, Unpublished Ed.D. Dissertation, Wayne State University, 1970, x-198 p.

16 R.E. Myers, "A Comparison of the Perceptions of Elementary School Children in Open Area and Self-Contained Classrooms in British Columbia", Journal of Research and Development in Education, Vol.4, No.3, 1971, p. 100-106.

17 J.H. Sugden, Jr., "How Effective are Open Plan Elementary Schools?", American School University, Vol.45, 1973, p. 18-21.

18 Lawrence A. Pervin, "Performance and Satisfaction as a Function of Individual-Environment Fit", Psychological Bulletin, Vol.69, 1968, p. 56-68.

in open plan and traditional plan schools was the fact that pupil characteristics were not considered. Since the way an individual approaches and perceives his world appears crucial in his adjustment to the learning environment, it was decided to examine individual differences in terms of the pupil's cognitive style.

The theoretical rationale for the study is based upon the differentiation hypothesis developed by Witkin and his colleagues.[19] According to Witkin, individuals consistently exhibit a tendency to function at a more differentiated or less differentiated level along several dimensions. The more generalized dimension of individual differences is referred to as the analytic-global cognitive style.

Levels of differentiation may be measured by means of tasks that are primarily perceptual in nature. More differentiated individuals are field-independent while less differentiated individuals are primarily field-dependent in the perceptual and cognitive strategies they bring to problem-solving situations.

Because field-independent students appear better

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19 H.A. Witkin, R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation: Studies of Development, John Wiley & Sons, Inc., New York, 1962, xii-576 p.

able to autonomously structure situations, are generally more task oriented, and are less aroused by environmental stimuli, it would appear appropriate to assume that they would be better able to function in an architecturally open environment. Conversely, it can be predicted that field-dependent children would be academically handicapped in open plan classrooms. However, the smaller space and fewer environmental stimuli of traditional plan classrooms are expected to be more supportive for field-dependent pupils and thereby more effective in promoting their learning.

In this study the effects upon academic achievement of the interaction between psychological differentiation of the student and the physical nature of the classroom environment are assessed.

The two types of classroom environments utilized in this study are architecturally open classrooms and traditional, self-contained classrooms. Architecturally open classrooms refer to an architectural style of plant design in which large, open areas provide the physical learning environment for two or more teachers and classes of pupils. Traditional plan refers to a self-contained classroom housing one teacher and one class of pupils.

In a practical sense, the results have implications for the design of, and for the placement of pupils within educational facilities.

The research is reported in four chapters. Theory and related research are reviewed in Chapter I. A description of the research design is presented in Chapter II. The results of the statistical analysis are presented in Chapter III. In the fourth chapter, the results are discussed as well as implications for education and suggestions for further research.

CHAPTER I

REVIEW OF THE LITERATURE

The literature examined in this chapter is presented to establish a theoretical rationale for research on the effects of cognitive style and classroom environment upon academic achievement. In the first section is presented an analysis of the research pertaining to academic achievement in open plan and traditional plan classrooms. The concept of simultaneously examining the characteristics of the classroom environment and of the pupils within them is discussed in section two. This is followed by a statement of the problem and a discussion of individual characteristics in terms of Witkin's theory of psychological differentiation. The research hypotheses are presented in the final section.

1. Academic Achievement: Open Plan Vs Traditional Plan

During the late 1950's and early 1960's, open plan schools began to appear in the United States and Canada.[1] By 1970, over 50 per cent of all new schools in the United States had some form of open plan construction. As a result of a 1971 survey conducted in Ontario, it was disclosed that there were approximately 360 schools with

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1 Open Space Schools Project Bulletin, School Planning Laboratory, Stanford University, No.1, March 1970, 7 p.

partial or complete open area with over one-third of these schools located in Metropolitan Toronto.[2] Similar studies were conducted in other provinces of Canada.[3]

A major problem in trying to interpret the results of studies related to open plan and traditional plan classrooms is that architecture and programme openness have usually been confounded. A clear distinction has usually not been made between these factors. For this reason, only those studies relating specifically to open space and self-contained classrooms, that is, the architectural components, will be examined in reviewing the literature.

As stated in the introduction and, for the purposes of this study, an open plan classroom was operationally defined as an architectural style of plant design in which large, open areas provide the learning environment for two or more teachers and classes of pupils. Traditional plan classrooms refer to an architectural design in which classrooms are self-contained units providing the learning environment for one teacher and one class of pupils.

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2 Ontario Institute for Studies in Education, Department of Educational Administration, Directory: Open Plan Schools in Ontario, Toronto, Ontario, 1971, 46 p.

3 D. Ian Allen, Open Area Schools in British Columbia, Simon Fraser University, Burnaby, British Columbia, 1972, 151 p.

When open plan schools were first built, they were regarded by educators as a solution for educational problems; they were new and architecturally different from traditional plan schools. It was not uncommon for these architecturally innovative schools to be frequently associated with progress. Regardless of the variety of types of open plan schools, the absence of walls in a school are expected to result in at least four fundamental situations; 1) increased space because the classroom area is much larger than that found in the traditional classroom, 2) increased personal exposure and interaction because several teachers and classes of pupils are housed in the same open area, 3) increased pupil freedom and expectation of resposibility for much of their own learning, and 4) an increase in the number and intensity of environmental stimuli.

The overall enclosure of the open plan school provides square footage equal to, or greater than, an equivalent number of classrooms in a traditionally designed school.[4] The open area contains greater numbers of pupils and teachers which places staff members in constant physical proximity to each other and to the pupils.[5] Children in

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4 Robert F. Eberle, "The Open Space School", The Clearing House, Vol.44, September 1969, p. 23.

5 O.A. Oldridge, Overlander: A Study of Instructional Innovation Involving Teachers Attempting to Non-Grade an Open Area Elementary School, E.R.I.B.C., Vancouver, 1969, 42 p.

open plan classrooms are expected to learn and work more independently than are pupils in traditional plan classrooms.[6] They more freely talk and move about the large open room[7] and the walls are adorned with the results of their written, graphed, and painted works. Stimulated by their spontaneous interests or as inspired or persuaded by their teacher, the children, for most of their time, are engaged in activities individually or in small groups. Open space schools are equipped with a large number and variety of teaching aids which pupils are encouraged to use, examine, and manipulate.[8]

The variability in classroom architecture and teaching methods indicates that educators, regardless of classroom architectural design, are concerned with the academic, psychological, and physical development of each pupil. The emphasis, however, has been and continues to be centred on academic achievement. This is the criterion by

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6 R.B. Carson, F.T. Johnson and F.D. Oliva, "The Open Area School: Facilitator for or Obstacle to Instructional Objectives", Journal of Education, Vol.155, February 1973, p. 18-30.

7 Mary T. Gauvain, Susan S. Roper and Robert R. Nolan, Student's Perceptions of Behavior and Instructional Practices in Open-Space Schools, A paper presented at the Annual Meeting of the A.E.R.A., New York, April 1977, 11 p.

8 Eberle, Op. Cit., p. 24.

which success or failure in the schools is usually measured.[9]

The increase in the number of open plan schools was accompanied by an increase in the number of educational articles praising the new style of building. Enhanced learning outcomes were considered to hold true for all students in architecturally open schools throughout the complete spectrum of public education from elementary schools through university. Although the attitudes of the teachers and administrators involved have generally been favourable, very little valid research has been conducted in order to substantiate or repudiate such claims.[10] No studies have been conducted to examine the interaction of such environments with individual psychological differences among pupils.

Most studies have been descriptive and anecdotal.[11] Investigators have been interpreted as suggesting that students in open plan schools achieve as well as pupils in traditional plan schools, enjoy school more, have better

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9 Leona E. Tyler, The Psychology of Human Differences, Third Edition, Appleton-Century-Crofts, New York, 1965, viii-572 p.

10 Frank Brunetti, "Open Space: A Status Report", CEFP Journal, Vol.IX, No. 5, September-October 1971, p. 7-11.

11 Ibid., p. 9.

developed social patterns,[12] are more independent, lively, and self-reliant, are actively involved in decision making and, to varying degrees, pace and style their own learning.[13] However, in attempting to provide objective evidence regarding differences in academic achievement between students in both types of architectural facilities, researchers have found results to be contradictory and inconclusive.

In a series of studies conducted within the York County Board of Education,[14,15,16] it was found that the marginal differences in achievement, although favouring the open plan schools, were neither consistent nor significant. It was concluded that over the three school years beginning in September, 1970, no significant differences were found

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12 G.W. Fowler, An Evaluation of Open Area Schools in the Calgary Public School District, Calgary School Board, Calgary, Alberta, June 1970, 7 p.

13 Eberle, Op. Cit., p. 24.

14 Brian Burnham, Reading and Mathematics Achievement of Grade 1 Pupils in Open Plan and Architecturally Conventional Schools, Studies of Open Education, No.5, York County Board of Education, Aurora, 1971, 5 p.

15 --------, Reading, Spelling, and Mathematics Achievement of Grade 2 Pupils in Open Plan and Architecturally Conventional Schools, Studies of Open Education, No.6, York County Board of Education, Aurora, 1973, 9 p.

16 --------, Reading and Mathematics Achievement of Grade 3 Pupils in Open Plan and Architecturally Conventional Schools, Studies of Open Education, No.10, York County Board of Education, Aurora, October 1973, 16 p.

in the academic ability and scholastic achievement levels between the pupils in the two types of architectural settings.

Warner[17] also concluded that, although the open area was more flexible and space was being effectively used, one type of facility was not superior to the other in affecting academic performance.

Kennedy and Say[18] attempted to determine the effectiveness of an open-area school compared to a closed-area school on the cognitive gains of students possessing comparable socio-economic background. No conclusive evidence was found concerning the superiority of either environment for cognitive gains over a one year span. A major weakness in this study was the fact that the sample of subjects was limited to only two schools, one open-area and one traditional. It was recommended that a three year time span was necessary to produce maximum validity in data analysis and in drawing conclusions.

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17 Jack B. Warner, A Comparison of Students' and Teachers' Performance in an Open Area Facility and in Self-Contained Classrooms, Unpublished Ed.D. Dissertation, University of Houston, 1970, xviii-107 p.

18 V.J. Kennedy and Michael W. Say, "A Comparison of the Effects of Open-Area Versus Closed-Area Schools on the Cognitive Gains of Students", Educators Report and Fact Sheet, No.4, 1971, 4 p.

In a four year study conducted by Killough,[19] it was found that after at least two years, pupils in open space, nongraded programmes had significantly better achievement gains in most cognitive areas. The sample included 150 grade 1 to 5 students from a nongraded open plan elementary school and 150 grade 1 to 5 students randomly selected from four elementary schools with traditional plans. Although the populations of the schools were considered to be matched in population, geographic location, socio-economic structure, and ethnic distribution, it is not clear whether the differences were attributable to the nongraded programme, the type of facility, to the teacher, or a combination of all three factors.

Allen[20] found that the open plan environment was associated with better language development at grade five level. There were no apparent differences for grade three students.

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19 Charles K. Killough, "An Analysis of the Longitudinal Effects That a Nongraded Elementary Program, Conducted in an Open-Space School, Had on the Cognitive Achievement of Pupils", Educators Report and Fact Sheet, Vol.9, No.2, 1971, 4 p.

20D.I. Allen, "Student Performance, Attitude, and Self-Esteem in Open-Area and Self-Contained Classrooms", The Alberta Journal of Educational Research, Vol.20, No.1, March 1974, p. 1-7.

On the other hand, McRae[21] found that the open area students entering a secondary school scored lower on the Gates-MacGinitie Reading Test than students instructed in traditional classes. He found, however, that after one year of traditional instruction at the grade nine level, the pupils from the open area schools tended to "catch up" to the pupils from traditional classes.

Sackett,[22] in comparing self-concept and achievement of grade six pupils in three types of schools found that achievement scores, as measured by the Iowa Tests of Basic Skills, were significantly lower for pupils in the open space school. In addition, self-concept mean scores for students in the open space were significantly lower than self-concept mean scores of students in either self-contained or departmentalized schools.

The review of the literature pertaining to academic or cognitive achievement emphasizes the inconclusiveness of the findings and the ineffectiveness of conducting research where attempts are made to validate the superiority of one type of environment or facility over the other without

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21 B.C. McRae, The Effect of Open-Area Instruction on Reading Achievement, Department of Research and Special Services, Board of School Trustees, Vancouver, 1970, 4 p.

22 John W. Sackett, A Comparison of Self-Concept and Achievement of Sixth Grade Students in an Open Space School, Self-Contained School, and Departmentalized School, Unpublished Ph.D. Dissertation, Iowa University, 1971, vi-78 p.

taking into consideration the personality of the pupils. In the following section is discussed the rationale for examining the effects of the interaction between characteristics of the classroom environment and those of the pupils found within it.

2. Individual Characteristics and Type of Classroom Environment

A viable approach to educational instruction is, as Cronbach[23] suggested, to find for each individual the treatment to which he can most easily adapt. In an attempt to encourage this approach, he stated that a person who adapts well under one condition may not under another and that, "if for each environment there is a best organism, for every organism there is a best environment".[24] Researchers, according to Cronbach, should examine treatments and persons simultaneously.

This trend has been growing in research related to increasing the accuracy of predicting academic performance.[25] Early research focused primarily on ability and intellective

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23 Lee J. Cronbach, "The Two Disciplines of Scientific Psychology", American Psychologist, Vol.12, 1957, p. 671-684.

24 Ibid., p. 679.

25 David E. Lavin, The Prediction of Academic Performance, Russell Sage Foundation, New York, 1965, 182 p.

factors. Recently, there have been fundamental shifts in emphasis on the factors centering on this problem due to the recognition that some pupils achieve higher and some achieve lower than predicted by ability tests alone. These variations led to a search for the factors involved and consequently non-intellective variables such as personality traits and environmental conditions were considered. Even more recently, the search has led to the recognition that the interaction between aspects of the pupil's personality and his environment are important.

Pervin[26] also assumed that for each individual there are environments, both interpersonal and non-interpersonal, which more or less match the characteristics of his personality. He further stated that performance is a function of the interaction between characteristics of the individual and those of the environment and that, in psychology, both variables must be examined simultaneously.

Some of the research findings lend support to this type of approach in studying the effectiveness of open plan schools. The results of a number of studies have emphasized disadvantages of open plan schools. The majority of these disadvantages are related to distractibility due to

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26 Lawrence A. Pervin, "Performance and Satisfaction as a Function of Individual-Environment Fit", Psychological Bulletin, Vol.69, 1968, p. 56-68.

noise and the numbers of individuals found in the open setting.

Since only one school was used and it would be inappropriate to generalize to all open plan schools, it is nevertheless important to note that Justus[27] reported that many students and teachers found the level of noise a disturbing factor. Many of the students also stated that they had difficulty hearing the teacher due to the noise level and that the number of moving people was a distraction to them. Although the teachers felt that they were more distracted than the students, the students tended not to agree.

Cheek[28] also found that the noise level in open-space elementary schools was considered a problem and that desirable student behavior was not necessarily facilitated by such educational environments. It was concluded that both students and teachers need to adjust to human interactions and to learn to control the level of their voices.

The results of a similar study conducted within

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27 John E. Justus, "An Educator Views Open Space and the Planning Process", CEFP Journal, Vol.9, No.5, 1971, p. 12-14.

28 Robert E. Cheek, The Opinions of Teachers Teaching in Selected Open-Space Elementary Schools, Unpublished Ed.D. Dissertation, Wayne State University, 1970, x-198 p.

the Halton County Board of Education[29] indicated that, despite the appearance of fewer discipline problems in an open area school, the students admitted to wasting time and that open classrooms were sometimes noisy and distracting.

Indications are that not all pupils were disturbed to the same extent by visual distractions,[30] noise levels, or the number of people in the open area.[31] The results indicate that individual pupil differences may be contributing factors.

Burnham,[32] in an article relating to research in open plan education, suggested that some pupils in open plan schools appeared handicapped in their learning. Burnham further stated that a structured programme with external standards or limited mobility within an enclosed area may be desirable for some students. That is, some pupils appear to require a less active learning environment with

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29 Halton County Board of Education, West Education Centre, Evaluation Committee of the Innovation Council, Final Report, Oakville, 1969, 13 p.

30 T.E. Giles and G.D. Tedrick, "What Students Think About Open-Area Schools", Orbit 27, Vol.6, No.2, April 1975, p. 10-11.

31 Open-Area Schools, The Canadian Education Association, 1973, 40 p.

32 Brian Burnham, "Open Education: Some Research Answers to Basic Questions", Orbit 10, Vol.2, No.5, 1971, p. 22-24.

greater teacher control and direction.

Having attempted to test the hypotheses: 1) that people would behave differently in different environments, and 2) children would perceive their own and the teachers' roles differently, Myers[33] concluded that:

> Unquestionably, some pupils benefit more from being in an open area than do others. Our task is to determine which children benefit most and least from certain kinds of learning environments. That children are affected by their surroundings is borne out in general by these findings, but research must determine which children benefit most (and least) from their learning environments... .[34]

The results of a survey conducted by Sugden[35] also indicated that not all pupils, nor teachers, are able to adjust to the open area environment. It was found that some students, even excellent achievers, felt that the environment was not structured enough, and that some teachers resented working with others.

The comments made by the students and teachers in the study by Justus[36] further support the contention that

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33 R.E. Myers, "A Comparison of the Perceptions of Elementary School Children in Open Area and Self-Contained Classrooms in British Columbia", Journal of Research and Development in Education, Vol.4, No.3, 1971, p. 100-106.

34 Ibid., p. 106.

35 J.H. Sugden, Jr., "How Effective Are Open Plan Elementary Schools?", American School University, Vol.45, 1973, p. 18-21.

36 Justus, Op. Cit., p. 12-13.

individual differences must be taken into consideration when conducting research on academic achievement in open plan and traditional plan schools. It is precisely this theoretical premise that led to the formulation of the problem being explored in this study.

3. The Problem

The purpose of this research is to focus on the classroom environment and the pupil's cognitive style to determine how these factors relate to academic performance in the elementary school. Interrogatively, the research problem may be stated:

> "What is the relationship of cognitive style and classroom environment to academic achievement?"

The basic characteristics of open plan education and the rationale for examining the educational environment in relation to individual differences of the pupils within them have been examined in the first two sections. Witkin's concept of Psychological Differentiation will be discussed in the next section.

4. Individual Differences: Psychological Differentiation

Several areas of individual differences were explored in an attempt to identify those pupils who have difficulty adapting to, and achieving in, the architecturally

open classroom. Since the way an individual approaches or perceives his world appears crucial in his adjustment to the learning environment, it was decided to examine individual differences in terms of the pupil's cognitive style.

The theory which provided the foundation for Witkin's theoretical contribution was the developmental theory of Heinz Werner.[37] Conceiving development as a process of differentiation and hierarchical integration, he stated that:

> It is an orthogenetic principle which states that whenever development occurs it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchic integration.[38]

By orthogenetic principle, Werner meant that there is a gradual and systematic progression in growth or development from a global or less complex level to one that is more complex or differentiated. Thus, as the child grows, he expands his behavior repertoire and becomes increasingly better able to organize individual elements into complex patterns. Self-differentiation, according to

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37 Heinz Werner, Comparative Psychology of Mental Development, Revised Edition, International University Press, New York, 1957, xii-564 p.

38 Heinz Werner, "The Concept of Development from a Comparative and Organismic Point of View", In D. Harris, The Concept of Development: An Issue in the Study of Human Behavior, University of Minnesota Press, 1957, p. 126.

Werner, involves the body, interpersonal relations, and self-control.

In summary, Werner stated that development proceeds from the undifferentiated, diffuse, unstable organization to the differentiated, articulated, and hierarchically organized system that is better adapted to the demands of a heterogeneous, variegated environment. Various different psychological processes appear at one time or another in the behavior of the child but the more mature ones gradually overtake the less mature and assume control of the child's functioning.

Prominent among those who have investigated individual differences have been Witkin and his colleagues.[39] They have summarized a considerable body of data supporting Werner's thesis that personality, which ultimately influences one's perception of the environment, generally evolves from a state that is global and diffuse to one that is differentiated and articulated; from one that is field-dependent to one that is field-independent.

Witkin expected to find individual consistency in degree of differentiation along several psychological

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39 H.A. Witkin, R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation: Studies of Development, John Wiley & Sons, Inc., New York, 1962, xii-576 p.

dimensions including ways of experiencing the world, the self, and the nature and structure of defenses and controls. This expectation of self-consistency is what Witkin called the differentiation hypothesis. Specifically, Witkin stated that:

> ...the differentiation hypothesis proposes an association among characteristics of greater or more limited differentiation, identified in the comparison of early and later functioning in each of several psychological areas: degree of articulation of experience of the world; degree of articulation of experience of the self, reflected particularly in nature of the body concept and extent of development of a sense of separate identity; and extent of development of specialized, structured controls and defenses. Implicit in this hypothesis is the view that greater inner differentiation is associated with greater articulation of experience of the world.[40]

Greater differentiated individuals, reporting impressions of their social and physical surroundings, tend to be relatively more discrete, structured, and assimilating than individuals with a more global style. Those individuals who are better able to articulate their experiences also experience a self that is more structured and reliant on internal frames of reference for viewing, interpreting, and reacting to the world. There is less need for guidance and support from others.

Limitedly differentiated individuals, however, are greatly limited in their ability to function independently

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40 Witkin, Op. Cit., p. 16.

of external forces and rely much more heavily on others for controls and direction. In addition, they tend to be more affected than highly differentiated individuals by variations in stimuli and lack of structure in their environments.

For Witkin, the term "style" refers to a consistent tendency to function at a more differentiated or less differentiated level in many situations. He stated that "cognitive style appears to be a manifestation, in the cognitive sphere, of a broader dimension that extends into the domain of personality functioning".[41] That is, individuals do not perceive and process information in the same manner. In this respect cognitive style can be considered an expression of the individual's personality. Witkin further suggested that a knowledge about the existence of cognitive styles and their specific nature might be useful in coping with some of the problems encountered in education especially those relating to teaching methods, evaluation, and placement.

The extent of differentiation may be measured by using tasks which are primarily perceptual in nature.

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41 Herman A. Witkin, "Some Implications of Research on Cognitive Style for Problems of Education", In M. Gottsegen and G. Gottsegen (eds.), Professional School Psychology, Vol. III, Grune and Stratton, New York, 1969, p. 218.

More differentiated individuals are field-independent while less differentiated individuals are primarily field-dependent in the perceptual and cognitive strategies they bring to problem-solving situations.

The term field-dependent was adopted by Witkin to identify the style of functioning which involves submission to the dominant organization of the field and the tendency to experience items as fused with their backgrounds while the term field-independent was used to describe the style of functioning that involves the ability to overcome an embedding context and to experience items as discrete from the field in which they are contained.

Because of their fundamental differences in style of functioning, field-dependent individuals tend to be more affected than are field-independent individuals by variations in stimuli and lack of structure in their environments.

Elliott[42] stated that field-dependent people tend to react with affective and intellectual disruption when their environment is marked by unusualness, incongruity, confusion, or lack of structure in general. Such

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42 Rogers Elliott, "Interrelationships Among Measures of Field-Dependence, Ability, and Personality Traits", Journal of Abnormal and Social Psychology, Vol.63, No.1, 1961, p. 27-36.

disruptions, he contended, last until some system or order is imposed upon the situation, either by the subject or by some external agency. A field-dependent individual is relatively unable to impose such structure autonomously; hence if order is introduced, he accepts it, but if order is not introduced, he remains disrupted.

It has been found that field-dependent subjects tend to be more susceptible to variations in arousal levels than field-independent subjects. Fitzgibbons and Goldberger[43] found that field-dependence was associated with a generally high level of arousal whether the experimental condition was structured or unstructured. They also found that the unstructured experimental condition intensified the already heightened autonomic activity of field-dependent subjects.

Cohen, Silverman, and Shmavonian[44] found that field-dependent subjects were more stressed by a brief environmental sensory deprivation experiment than were field-independent subjects as shown by both psychological

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43 David J. Fitzgibbons and Leo Goldberger, "Task and Social Orientation: A Study of Field Dependence, "Arousal", and Memory for Incidental Materials", Perceptual and Motor Skills, Vol.32, 1971, p. 167-174.

44 S.I. Cohen, A.V. Silverman, and B.M. Shmavonian, "Psychophysiological Studies in Altered Sensory Environments", Journal of Psychosomatic Research, Vol.6, 1962, p. 259-281.

and physiological measures of arousal. They found that field-dependent subjects exhibited a higher incidence of visual and auditory imagery, disorganization of thought, and greater discomfort with body sensations.

The results of a study by Zuckerman[45] indicated that being field-dependent was not associated specifically with responses to sensory deprivation but rather predicted stress responses to unfamiliar or novel situations of any kind. Embedded Figures Test scores were not specifically correlated with stress responses to sensory or social isolation but were correlated with responses to either type of isolation occuring on the subject's first day at the laboratory.

Haer[46] examined the relationship between field-dependence and indications of altered states of consciousness which were induced in subjects who experienced a condition of sensory overload during exposure to certain environmental stimuli. Apparently, field-dependent subjects tended to be unable to orient themselves in an environment overloaded with stimuli of an intense, alien, and

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45 Marvin Zuckerman, "Field-Dependency as a Predictor of Responses to Sensory Isolation", Perceptual and Motor Skills, Vol.27, 1968, p. 757-758.

46 John L. Haer, "Field-Dependency in Relation to Altered States of Consciousness Produced by Sensory overload", Perceptual and Motor Skills, Vol.33, 1971, p.192-194.

nonlogical nature, and the resultant impairment of functioning led to the production of altered states of consciousness.

Since they are most easily affected by alterations in environmental stimuli, field-dependent students would most likely demonstrate greater inability to cope with the increased space, noise levels, and the generally more stimuli-laden environment of architecturally open classrooms than would field-independent students. Conversely, field-independent students who are better able to autonomously structure situations, are generally more task oriented, and are less aroused by environmental stimuli, would be better able to function in an open plan environment.

The characteristics of field-dependent and field-independent children as outlined by Witkin[47] appear to add support to this contention. Field-dependent children are characterized by:

1) poorly developed self-concept,
2) poorly developed control structure; that is, easily distracted and/or overactive,
3) a lack of developed interests,
4) an inability to assume responsibility,
5) a lack of enterprise and initiative, and
6) a marked dependence on external sources of support and guidance.

Each of these characteristics would seem to impair or impede learning, especially in a non-structured learning

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47 Witkin, Psychological Differentiation, Op. Cit., p. 262-266.

environment in which the number and kind of extraneous stimuli are not closely controlled. The evidence appears to support the contention that field-dependent children would be academically handicapped in architecturally open classrooms. It would appear that the smaller space, fewer environmental stimuli, and relatively greater structure of the traditional plan classroom is better suited to the needs of field-dependent children. Field-dependent pupils appear to require a less active classroom environment with greater teacher direction and control in order to learn effectively.

In contrast, Witkin[48] stated that field-independent children are characterized by:

1) articulate awareness of both themselves and of their environment,
2) a relatively well-developed control structure,
3) relatively well-developed interests,
4) a clear sense of responsibility,
5) an ability to persist in the face of difficulties, and
6) an ability to set and maintain their own high standards of achievement.

Each of these characteristics indicate that field-independent children would be better able to cope with the increased space, increased personal exposure, increased environmental stimuli, and increased freedom and responsibility that is characteristic of the architecturally open classroom. Also, since they are better able to cope with

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48 Ibid., p. 262-266.

and adjust to their environment, field-independent pupils should not be adversely affected by either open plan or traditional plan classrooms.

In this section, individual differences in cognitive style have been discussed. In particular, it would appear from the available theory and cognitive style research that field-dependent individuals would have difficulty functioning effectively in the more complex open plan environment. Although it is possible for individuals to operate at different levels of differentiation at different times, a field-independent person is capable of functioning at a relatively more complex level if required and if motivated to do so in a particular situation. Thus, the literature examined in this section appears to indicate that cognitive style is an important factor in predicting the achievement of pupils in open plan and traditional plan classrooms.

Three additional variables that are seemingly related to both psychological differentiation and academic achievement are intelligence, sex, and age. Their relationships to psychological differentiation and school achievement will be examined in the next section.

5. The Relationship of Psychological Differentiation and Academic Achievement to Intelligence, Sex, and Age

An examination of three additional variables which are relevant to this study and which must be controlled is presented in this section. The three variables to be considered are intelligence, sex, and age.

Although there is some evidence to the contrary,[49] several researchers,[50,51,52] including Witkin[53] have found significant correlations between field-independence-dependence and intelligence. According to Witkin, the significant correlations are found to be primarily derived from the Wechsler Intelligence Scale for Children (WISC) subtests of Block Design, Picture Completion, and Object Assembly. It was suggested that the relation between

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49 John C. Busch and Lawrence M. DeRidder, "Note on Control for Intelligence in Studies of Field Dependence with Young Children", Perceptual and Motor Skills, Vol.32, 1971, p. 337-338.

50 Donald R. Goodenough and Stephen A. Karp, "Field-dependence and Intellectual Functioning", Journal of Abnormal and Social Psychology, Vol. 63, No. 2, 1961, p. 241-246.

51 Douglas M. Jackson, "Intellectual Ability and Mode of Perception", Journal of Consulting Psychology, Vol.21, No.6, 1957, p. 458.

52 E. Zigler, "A Measure in Search of a Theory?", Contemporary Psychology, Vol.8, 1963, p. 133-135.

53 Witkin, Psychological Differentiation, Op. Cit., p. 70.

extent of field-dependence and full-scale intelligence scores is accounted for by those tests which, like the perceptual tests, involve the capacity for analytical functioning. Witkin does not suggest differences in verbal mental ability between field-independent and field-dependent individuals.

Although there is no theoretical basis to indicate that verbal intelligence is related to psychological differentiation, there is substantial evidence to indicate that mental ability test scores are significantly correlated with academic success.[54] Intelligence, particularly in its verbal aspects, appears to account for the largest single portion of the variability in academic achievement among individual students.

Another variable of concern is the sex of the individual. Consistent with the findings by Witkin,[55] most researchers have found significant sex differences in mode of field approach.[56] These differences, males tending to be

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54 Leona E. Tyler, The Psychology of Human Differences, Third Edition, Appleton-Century-Crofts, New York, 1965, p. 61-123.

55 Witkin, Psychological Differentiation, Op. Cit., p. 214-221.

56 Patton B. Reighard and Dale T. Johnson,"Effects of Birth Order and Sex on Field Independence-Dependence", Perceptual and Motor Skills, Vol.37, 1973, p. 223-226.

more field-independent than females, are relatively small in comparison to the range of individual differences within each sex.

In addition to sex differences in extent of psychological differentiation, the results of studies examining sex differences in academic achievement have indicated that females generally tend to score higher than males.[57] Differences have been reported from a wide variety of investigations using various criteria of school success from teacher assigned grades to standardized achievement tests. Although males tend to score higher than females on some subtests such as mathematics and science, differences in composite achievement scores tend to favour the girls.

The third variable which must be considered is age. The way of perceiving the world is related to the extent of psychological differentiation that has evolved during the course of an individual's development. Individual differences in extent of differentiation are evident at an early age with a gradual progression from less complex to more complex.

Scores based on the Embedded Figures Test, a device used for measuring extent of differentiation in teenagers

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57 Tyler, Op. Cit., p. 239-272.

and adults, indicated a marked increase in extent of differentiation between the ages of 10 and 17 years.[58] The data, given in mean number of seconds to solution per figure, ranged from 137.0 (Males, N = 54) and 156.0 (Females, N = 54) at 10 years of age to 31.2(Males, N = 23) and 48.1 (Females, N = 25) at 17 years of age. High scores on the test indicate relatively field-dependent performance. Ten-year-old subjects were found to be markedly more field-dependent than 17 year-old subjects.

In addition to the gradual progression toward increased differentiation as they grow older, a great deal of variability in extent of differentiation between children exists at any age level. This suggests individual differences, not only in extent of differentiation but in pace of development as well.

A brief discussion of the variables intelligence, sex, and age was presented in this section. The evidence suggests the need to examine the possible effects of the relationship of these variables to psychological differentiation and academic achievement.

In the next section is presented a summary of the

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58 Herman A. Witkin, Donald R. Goodenough, and Stephen A. Karp, "Stability of Cognitive Style from Childhood to Young Adulthood", Journal of Personality and Social Psychology, Vol.7, No.3, 1967, p. 291-300.

theoretical rationale concluding with a statement of the hypotheses.

6. Summary and Hypotheses

The purpose of this study is to determine the effects of the pupil's cognitive style and the type of classroom environment on academic achievement. By examining the interaction between elements of the pupil's personality and his classroom environment, it is expected that a more accurate prediction may be made regarding his academic performance.

Schools differ in the physical aspects of their classroom environments. Large open areas housing several classes of pupils and teachers are termed open plan while the single classroom, single teacher style of classroom architecture is termed traditional plan. Since there are indications that some pupils experience difficulty in architecturally open classrooms, it seems important to identify these pupils.

The theoretical rationale for the hypotheses is based on Witkin's concept of psychological differentiation. He contended that the fundamental psychological characteristics of field-independent and field-dependent individuals pervade their perceptual, intellectual, emotional, motivational, defensive, and social operations. Cognitive

style was described as being one aspect of a pupil's personality which appeared to be an important variable in predicting academic performance in open plan and traditional plan classrooms. Sufficient data have been accumulated to indicate that field-independent and field-dependent individuals approach, and react to, their environments differently.

On the basis of Witkin's theory, it is predicted that field-dependent pupils will exhibit difficulty coping with, and adjusting to the larger, more active, and stimuli-laden environment of open plan classrooms. They are expected, however, to find the smaller space, greater structure, and less active environment of traditional plan classrooms better suited to their learning needs.

By contrast, field-independent pupils, because of their greater ability to adjust to variations in their environment, should not be adversely affected by either architecturally open or traditional plan classrooms. It is on the basis of these assumptions that an interaction effect between levels of cognitive style and type of classroom environment is predicted.

The second hypothesis is based on the evidence that field-independent individuals appear to posses more of the characteristics[59] that are essential for the attainment of

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59 Witkin, Psychological Differentiation, Op. Cit., p. 262-266.

academic success in our schools. Field-independent individuals are better able, than are field-dependent individuals, to persist in the face of difficulties and to set and maintain their own high standards of achievement. They tend to posses a greater variety of problem-solving strategies and skills which are necessary for attacking and solving problems and in persisting at tasks despite anxiety and frustration. These factors should enable field-independent pupils to attain higher scores on achievement tests than field-dependent pupils. As stated by Shumsky:

> It is the person who looks at life with confidence, who feels that it is within his power to aspire toward a goal and achieve it, who will tend also to be successful in his learning ability.[60]

The third hypothesis is derived from the expectation that field-dependent pupils will experience academic difficulty in architecturally open classrooms. Because field-dependent pupils are expected to obtain higher academic scores in traditional plan classrooms than in open plan classrooms and because field-independent pupils are expected to achieve equally well in both types of classroom environments, pupils in traditional plan classrooms will

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60 Abraham Shumsky, In Search of Teaching Style, Appleton-Century-Crofts, Meredith Corporation, New York, 1968, p. 238.

obtain higher academic achievement scores than pupils in architecturally open classrooms.

Therefore, the hypotheses of the study are as follows:

1. There will be an interaction between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement.
2. Field-independent subjects will have higher scores in academic achievement than field-dependent subjects.
3. Subjects in traditional plan classrooms will have higher scores in academic achievement than subjects in open plan classrooms.

CHAPTER II

EXPERIMENTAL DESIGN

A discussion of the procedures undertaken to experimentally test the hypotheses is presented in this chapter. It begins with a description of the three research instruments used in the project. In the second section is presented an outline of the research methods that were used in the experiment explaining the specific approaches that were taken in collecting the data. The research subjects are then described followed by an outline of the plan for the statistical analysis.

1. Research Instruments

In order to adequately test the research hypotheses, the following research instruments were selected: the Canadian Tests of Basic Skills,[1] the Children's Embedded Figures Test,[2] and the Canadian Lorge-Thorndike Intelligence Tests.[3]

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1 E.M. King, (ed.), Canadian Tests of Basic Skills, Thomas Nelson & Sons (Canada), Ltd., 1968, p. 1-99.

2 S.A. Karp and N. Konstadt, Children's Embedded Figures Test, Consulting Psychologists Press, Inc., Palo Alto, California, 1971, p. 21-26.

3 E.N. Wright, (ed.), Lorge-Thorndike Intelligence Tests, Canadian Multi-Level Edition, Thomas Nelson & Sons (Canada), Ltd., 1967, p. 1-83.

a) Canadian Tests of Basic Skills (CTBS):

To test the academic achievement of the students from the open plan and traditional plan classrooms, it was decided to use the Canadian Tests of Basic Skills. Due to the variability in curriculum among classrooms and schools, it was deemed desirable to test generalized academic skills and abilities rather than separate measures of achievement in content areas. The test battery was described as being designed to measure the pupil's ability to use his acquired skills.

Although developed from the extensive work in test construction carried out at the University of Iowa, the CTBS was standardized in Canada in 1966. Birch,[4] in his review, stated that the CTBS is simply a Canadian version of the well-known Iowa Tests of Basic Skills. However, many modifications were required in the Basic Skills Tests developed in Iowa to make them appropriate for use in Canadian schools. The authors stated that an attempt had been made throughout the development of the CTBS to build on the strengths of the Iowa Tests and yet to prepare a battery of tests that was suited to the unique

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4 L.B. Birch, "Canadian Tests of Basic Skills". In O.K. Buros, (ed.), The Seventh Mental Measurements Yearbook, Vol. 1, Gryphon Press, Highland Park, N.J., 1972, p. 15-16.

characteristics of the Canadian educational system.[5] Nationally representative norms were obtained by testing approximately 30,000 English speaking rural and urban pupils drawn from a stratified random sample from over 225 public and separate schools.

The Canadian Tests of Basic Skills consist of a total of eleven separate tests for grades three through eight with all tests contained in a single booklet. Each pupil takes only those items appropriate to his own grade level. The time limits and directions are the same for all grades.

Pupil progress is measured in vocabulary development, reading comprehension, the mechanics of written expression, application of special reading techniques to work-study materials, and mathematical understanding.[6] A composite raw score, the average of achievement in all five areas, is also tabulated.

Split-half reliability coefficients at the grade five level range from .72 in the Graphs Test to .93 in Reading. The raw score standard errors of measurement are quoted as ranging from 1.9 in the Graphs and Mathematics

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5 E.M. King, (ed.), Canadian Tests of Basic Skills, Manual for Administrators, Supervisors and Counsellors, Thomas Nelson & Sons (Canada), Ltd., 1968, p. 27.

6 Ibid., p. 3.

Problems Tests to 2.7 in the Reading Test. For composite scores, the split-half reliability coefficient was .98 with 1.6 being reported as the standard error of measurement. Reliabilities for composite grade-equivalent scores were computed from the standard errors of the appropriate part scores and the standard deviations of the total distributions. In computing the standard errors of measurement, the standard deviations of the total weighted norms sample were used.

Although expressing some criticism of specific tests such as Mathematics and Capitalization and Punctuation, Birch,[7] in his review of the CTBS, stated that it is probably as useful an instrument as exists and should prove valuable at least for the near future.

In view of the psychometric data available and the fact that these tests were standardized on a Canadian population, the Canadian Tests of Basic Skills was considered a valid and reliable instrument in the measurement of academic achievement.

b) Children's Embedded Figures Test (CEFT):

Each of the tests used to measure individual differences in psychological differentiation was described by Witkin as requiring the subject to separate an item

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7 Birch, Op. Cit., p. 16.

from the field or context of which it is a part.[8] These include the Rod-and-Frame Test (RFT), the Tilting-Room-Tilting-Chair Tests (TRTC), and the Embedded-Figures Test (EFT).

Although Witkin and his colleagues have utilized a composite index of the series of tests, the scores of each is considered "a quantitative indicator of the extent to which the subject's perception of an item has been influenced by the organized field surrounding it".[9]

In order to provide an index of cognitive style and to identify field-independent and field-dependent subjects, it was decided to administer the Children's Embedded Figures Test (CEFT), which was designed as a children's version of the Embedded-Figures Test. This was considered appropriate since it was determined that many children found the EFT too difficult. In addition, the authors suggested that the optimal age for shift from the use of the CEFT to the EFT is somewhere between the ages of 10 and 12 years.

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8 Witkin, Psychological Differentiation, Op. Cit., p. 36-40.

9 Herman A. Witkin, The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations, A paper presented at a symposium on "Cognitive Styles, Creativity and Higher Education", sponsored by the Graduate Record Examination Board, Montreal, Canada, November 8-10, 1972, p. 4.

The CEFT was developed to replace the EFT as a satisfactory measuring device for use with young children. As reported by the authors,[10] internal consistency reliability estimates at age 9-10 year level are .89 for males and .89 for females. Correlations between CEFT and EFT at that age level are reported as .70 for males and .73 for females (N = 20), At age 11, they are substantially higher for both males (.86) and females (.83).

In his review of the test, Weintraub[11] concluded that the Children's Embedded Figures Test serves as a "satisfactory downward extension of the EFT" and should prove to be a valuable research tool despite the need for additional validity and reliability data.

c) Lorge-Thorndike Intelligence Tests:

Because a positive relationship between mental ability and academic achievement was indicated by the literature, it was decided to administer the Lorge-Thorndike Intelligence Tests. If differences were found among groups, verbal mental ability scores would be utilized as a covariate in the statistical analysis of the data.

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10 Karp and Konstadt, Op. Cit., p. 25.

11 S.A. Weintraub, "Children's Embedded Figures Test", in O.K. Buros, (ed.), The Seventh Mental Measurements Yearbook, Vol. 1, Gryphon Press, Highland Park, N.J. 1972, p. 164-165.

Since field-independence was found to be significantly correlated with nonverbal measures of intelligence,[12] it was decided to use only the verbal scores as control for potential variations in intellectual abilities. This approach was adopted because it is important for the covariate to be highly correlated with the dependent variable[13] but not with the independent variable.

The Canadian Lorge-Thorndike Intelligence Tests, Multi-Level Edition, is a series of tests of abstract intelligence covering the range from grades three to nine. Although standardized in Canada, the Canadian version is essentially a slightly modified form of the Lorge-Thorndike tests widely used in the United States.

The verbal battery, consisting of five subtests, utilizes the verbal medium and is considered by the authors to be related to academic achievement. The nonverbal battery is entirely pictorial, diagrammatic, or numerical and is considered by the authors not as effective in predicting school performance as the verbal battery.

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12 Witkin, Psychological Differentiation, Op. Cit., p. 70.

13 Fred N. Kerlinger, Foundation of Behavioral Research, Holt, Rinehart and Winston, Inc., New York, 1964, p. 349.

Anastasi[14] reported that coefficients of validity of the Lorge-Thorndike Intelligence Tests obtained from correlations with standardized achievement tests and other forms of intelligence tests ranged from .60 to .80. Separate coefficients for the verbal and nonverbal batteries were not provided. Investigations of predictive validity over intervals of one to two years have yielded correlations between .50 and .70 with achievement tests. However, the correlations with the nonverbal battery are consistently lower than those with the verbal battery.

Odd-even reliability coefficients for the Canadian Lorge-Thorndike based on representative single-grade samples range from .83 to .94 in the verbal battery and from .89 to .93 in the nonverbal.[15] The standard errors of measurement for Level C cluster around 4.2.

Correlations between the verbal and nonverbal batteries range from .56 at grade eight to .68 at grade three. A correlation of .66 was reported for the grade 5 level. These results are generally lower than those which prompted Anastasi[16] to state that "the Lorge-Thorndike

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14 Anne Anastasi, Psychological Testing, Third Edition, The MacMillan Co., London, 1968, p. 221-224.

15 E.N. Wright, (ed.), Canadian Lorge-Thorndike Intelligence Tests, Technical Supplement, Thomas Nelson & Sons (Canada), Ltd., 1972, p. 8.

16 Anastasi, Op. Cit., p. 224.

verbal and nonverbal batteries thus appear to be more nearly comparable than is generally true of verbal and nonverbal tests".

In his review of the tests, Freeman[17] stated that the Lorge-Thorndike is among the best group tests of intelligence available with its sound psychological constructs and the use of Spearman's and Terman's theories as its theoretical base.

Tittle[18] concluded that "the Lorge-Thorndike IQ's correlate moderately to fairly highly with school achievement and with other IQ's derived from intelligence tests". Describing it as a widely-used and well-constructed series of tests, she encouraged its use in further studies.

Some evidence is available indicating the degree to which the Canadian Lorge-Thorndike Tests correlate with the Canadian Tests of Basic Skills. Three studies cited by the authors[19] indicate correlations of .76, .87, and .83 between composite scores of the CTBS and verbal scores

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17 F.S. Freeman, "Lorge-Thorndike Intelligence Tests, Multi-Level Edition", in O.K. Buros (ed.), The Fifth Mental Measurements Yearbook, Vol. 1, Gryphon Press, Highland Park, N.J. 1959, p. 478-481.

18 C.K. Tittle, "Lorge-Thorndike Intelligence Tests, Multi-Level Edition", in O.K. Buros, (ed.), The Seventh Mental Measurements Yearbook, Vol. 1, Gryphon Press, Highland Park, N.J., 1972, p. 684-686.

19 Wright, Technical Supplement, Op. Cit., p. 17.

of the Lorge-Thordike. Somewhat lower correlations (.58, .70, and .71) are reported for the nonverbal battery. The correlations are of sufficient magnitude to justify, if necessary, the use of verbal scores as a covariate in the statistical analysis of data.

2. Research Methods

The design of the study required the collection of data from students attending two types of schools; open plan schools and traditional plan schools. This section includes a discussion of the procedures by which the schools and subjects were selected and a brief description of the method used to gather the data.

a) Selection Procedures:

It was anticipated that data would be gathered during the fall term of the 1973-74 school year. Of the five boards of education who were asked to take part, three agreed to participate in the study during the specified research period. The original research plan was to randomly select eight open plan and eight traditional plan schools from the total number of elementary schools from the boards of education that agreed to take part in the study.

An open plan school was operationally defined as a school containing two or more classes of pupils housed with

two or more teachers in a large open area facility. A traditional plan school was defined as a school containing single classrooms of pupils each assigned to one teacher and housed in a self-contained classroom area. The emphasis rested on the structural or architectural characteristics rather than on the psychological dimensions of the classroom environment.

Because of heavy demands from other research projects, the boards of education could not commit all schools to the study. Therefore, a limited sample of schools with principals willing to participate in the study was obtained and assigned to the researcher. As a result, a total of 15 elementary schools (7 open plan and 8 traditional plan) from three boards of education from the Metropolitan Toronto area were used in the research project.

Strict randomness of selection was not possible since not all of the schools from the various boards of education were made available to the study. However, despite the fact that both open plan and traditional plan schools were obtained from various locations within Metropolitan Toronto, both types of schools were grouped within the same geographical areas.

Because children become more differentiated as they grow older,[20] a single age category was selected in order

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20 Witkin, Psychological Differentiation, Op. Cit., p. 22.

to avoid differences in cognitive style levels due to the age factor. In order to ensure that 10 year-old subjects were used in the study, only those pupils having a birth date between March 1, 1963 and February 28, 1964 were selected. That is, the pupils ranged in age from 9 years-6 months to 10 years-6 months as of September 1, 1973. Any pupils not born within the designated time interval were eliminated from the sample.

Since both male and female pupils used in the study were to be ten years of age during the 1973-74 school year, grade five classes were selected from which to draw the sample. From the grade five classes available in each school, one teacher was randomly selected and the pupils listed on that teacher's class register were used as the experimental subjects. Consequently, fifteen "classes" of pupils were selected. A total of 198 pupils were registered in the seven open plan classrooms while 264 pupils were registered in the eight traditional plan classrooms selected for the study.

As a means of ensuring that possible differences could indeed be associated with the differences in the environments in which they were situated, the students who had not been in the open plan or traditional plan classroom for at least one full year prior to testing were also excluded from the study. This approach is consistent with most studies.

Every effort was made to gather complete data on subjects who were absent during a portion of the testing. In some instances, however, this was impossible. Therefore, the pupils who had not completed all stages of the testing programme due to illness, transfer, or other forms of attrition were also eliminated from the project.

These conditions had the effect of reducing the available population and, because the entire population was not used, no doubt had the effect of introducing some bias in the sample. However, although 26 pupils (13.1 per cent) were excluded from the open plan classrooms and 36 (13.6 per cent) were eliminated from the traditional plan classrooms, a total of 400 male and female subjects who met all the criteria remained. As summarized in Table I, these included 172 subjects from open plan classrooms and 228 subjects from traditional plan classrooms.

b) Treatment:

During the late fall and early winter terms of the 1973-74 school year, data were gathered for each subject by means of the following tests: 1) Canadian Tests of Basic Skills, Form 1, Grade 5 Level, 2) Lorge-Thorndike Intelligence Tests, Level C, Verbal Battery, and 3) Children's Embedded Figures Test. When permission to test the pupils was obtained from the classroom teacher, the results of all three tests were gathered within a one

Table I.-

Classification of Research Subjects by Classroom Type, Sex, and Cognitive Style.

Classroom Type	Total	Sex	Total	Cognitive Style*	Total
Open Plan	172	Male	80	F.I.	31
				MID	31
				F.D.	18
		Female	92	F.I.	25
				MID	40
				F.D.	27
Traditional Plan	228	Male	117	F.I.	39
				MID	34
				F.D.	44
		Female	111	F.I.	35
				MID	42
				F.D.	34
Total:	400		400		400

* F.I. means field-independent (scores of 17 or higher) on the CEFT.
F.D. means field-dependent (scores of 9 or lower) on the CEFT.
MID refers to those pupils who scored between 10 and 16, inclusive, on the CEFT.

week period. This was accomplished by the researcher and one assistant although the scoring and compilation of data were done by the principal researcher.

In order to minimize measurement error, testing procedures and scoring were carried out as described in the test manuals with strict adherence to standardized wording and directions. Each score sheet was carefully examined for double answers and other technical errors before the results were tabulated.

Some variations of scores may be expected because of the resultant five month testing period. Because permission to test depended on the schedule imposed by the teachers involved and because the tests required a great deal of time to complete, the testing period was much longer than desired. However, neither type of classroom received undue advantage during the testing programme because pupils in both types of schools were tested at approximately the same time (See Appendix 1).

3. Research Subjects

Complete data were obtained for a total of 400, ten-year-old, male and female subjects. From this total research sample, it was necessary to differentiate between those subjects who were considered to be field-independent

and those considered to be field-dependent. This was accomplished by utilizing the results of the Children's Embedded Figures Test.

On the basis of total test scores, two criterion groups were formed. Those subjects who scored between 17 and 25 on the CEFT were termed field-independent ($M = 19.77$, $SD = 2.11$) and those subjects scoring between 0 and 9 were termed field-dependent ($M = 5.75$, $SD = 1.82$). This range was arbitrarily selected in order to ensure maximum differences between the two groups while maintaining an adequate number of subjects for the study. As a result, there were 253 research subjects (See Table 1); 101 subjects were located in the open plan classrooms while 152 were located in the traditional plan classrooms. The increased number of subjects in the traditional plan classrooms is primarily a result of the larger number of traditional plan classrooms used in the study, variations in class sizes, and variations in the number of pupils eliminated from the study because they did not satisfy all the criteria.

It is readily apparent (Table I) that a larger number of field-independent males ($N = 31$) than field-dependent males ($N = 18$) were found in the open plan classrooms. Parents of field-dependent males may transfer their children from open plan classrooms to traditional plan

classrooms when they encounter academic difficulties. This may be especially true with males because they, more than females, tend to exhibit more aggressive and acting-out behavior patterns when frustrated by academic difficulties.

It is also possible that open plan classrooms provide an atmosphere that fosters field-independency in its male pupils. Witkin[21] suggested that environmental conditions influence the child's development toward greater differentiation.

4. Plan for the Statistical Analysis

Included in this section is a description of the independent and dependent variables, a brief discussion of the experimental unit, and the statistical procedure used to test the hypotheses.

The independent variables used in this study were type of classroom environment, sex, and cognitive style.

The dependent variable, academic achievement, was measured by the Canadian Tests of Basic Skills. The criterion measure was the composite raw score of the five areas. The data analyzed were means for the respective groups of pupils within each class. Glass and Stanley[22]

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21 Witkin, Psychological Differentiation, Op. Cit., p. 270-273.

22 Gene V. Glass and Julian C. Stanley, Statistical Methods in Education and Psychology, Prentice-Hall, Englewood Cliffs, N.J., 1970, p. 506-507.

have suggested using the class or group as the experimental unit rather than individual pupils. They have suggested this procedure to allow for personal interactions within the classroom and to provide greater stability for scores used either as criterion measures or covariate.

It was proposed to first examine verbal intelligence to determine its appropriateness as a covariate. Should significant differences be found, mean verbal intelligence scores were to be used as covariate in the statistical analysis of data. If no significant differences were found, a 2 x 2 x 2 analysis of variance design would be selected as the appropriate procedure to analyze the data. The level of significance was set at five per cent.

5. Summary

In this chapter were discussed the procedures involved in order to test the hypotheses outlined in Chapter I. The chapter began with a summary of the information relative to the instruments used in the study. An outline of the research methods used in the experiment were discussed in the second section. A description of the research subjects was provided in the third section. The chapter concluded with a brief outline of the plan for the statistical analyses, including a discussion of the unit of analysis.

CHAPTER III

ANALYSIS OF DATA

The results of the analysis of data are reported in this chapter. In the first section, descriptive statistics are presented and the appropriateness of using verbal intelligence scores as a covariate is discussed. The results of testing the three hypotheses are given in the second section. A summary of the findings of the study is presented in the final section.

1. Preliminary Analysis

In this section, the results of the preliminary analysis of data (See Appendix 2) are reported. Means and standard deviations for verbal mental ability scores for all research subjects are presented in Table II. Differences in mean verbal intelligence scores between classroom types ($F = 3.53$, $p < 0.06$) and sex ($F = 0.17$, $p < 0.68$) were found to be nonsignificant. However, contrary to expectation,[1] significant differences in scores were found between extremes in cognitive style ($F = 54.74$, $p < 0.0001$).

In view of the significant relationship between cognitive style and verbal intelligence and, therefore, in

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1 H.A. Witkin, R.B. Dyk, H.F. Paterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation: Studies of Development, John Wiley & Sons, Inc., New York, 1962, p. 70.

Table II.-

Means and Standard Deviations for Verbal Intelligence Scores for all Subjects Selected by Classroom Type, Sex, and Cognitive Style.

Classroom Type	Sex	Cognitive Style*	Mean	S.D.
Open Plan	Male	F.I.	102.81	7.44
		F.D.	84.45	6.79
	Female	F.I.	101.02	6.23
		F.D.	85.80	2.23
Traditional Plan	Male	F.I.	101.26	10.73
		F.D.	90.83	4.38
	Female	F.I.	102.02	5.58
		F.D.	93.19	7.25

Classroom Type: Open Plan M = 93.52, Traditional Plan M = 96.83
Sex: Males M = 94.92, Females M = 95.65
Cognitive Style: Field-independent M = 101.80, Field-dependent M = 88.80

* F.I. means field-independent
F.D. means field-dependent

order to avoid the risk of losing some of the variance attributable to cognitive style, it was decided not to use verbal intelligence scores as a covariate in the statistical analysis of data. This decision was considered appropriate because the difference between verbal intelligence and type of classroom environment and between verbal intelligence and sex were found to be nonsignificant. However, the possibility remains that the correlation between cognitive style and verbal intelligence may have had a contaminating effect on the results. This point will be discussed in detail in Chapter IV.

Means and standard deviations for composite scores of the Canadian Tests of Basic Skills by type of classroom, sex, and cognitive style are presented in Table III. As expected, field-independent males achieved as well academically in traditional plan classrooms as in open plan classrooms. However, field-independent females appeared to score higher in traditional plan classrooms than in open plan classrooms. In addition, field-dependent males and females appeared to score higher in academic achievement in traditional plan classrooms than in open plan classrooms. However, field-dependent pupils tended to score lower than field-independent pupils in traditional plan classrooms. Regardless of the type of classroom environment,

Table III.-

Means and Standard Deviations for Composite Scores of the Canadian Tests of Basic Skills by Classroom Type, Sex, and Cognitive Style.

Classroom Type	Sex	Cognitive Style*	Mean	S.D.
Open Plan	Male	F.I.	245.60	41.02
		F.D.	177.70	19.28
	Female	F.I.	229.77	45.42
		F.D.	188.70	17.03
Traditional Plan	Male	F.I.	245.85	23.26
		F.D.	217.77	16.02
	Female	F.I.	257.17	25.77
		F.D.	221.99	30.07

Classroom Type: Open Plan M = 210.4, Traditional Plan M = 235.7
Sex: Males M = 222.4, Females M = 225.4
Cognitive Style: Field-independent M = 245.1, Field-dependent M = 202.8

* F.I. means field-independent
F.D. means field-dependent

field-independent pupils scored substantially higher in academic achievement than field-dependent pupils.

One of the assumptions underlying the use of analysis of variance is the existance of homogeneity of variance. Consequently, the F_{max} test for homogeneity of variance was conducted resulting in an F-ratio of 8.04 which, with 8 and 7 degrees of freedom, was nonsignificant ($_{.95}F_{(8,7)} = 12.70$).

2. Results of Testing the Hypotheses

The three research hypotheses were tested in the null form using a 2 x 2 x 2 analysis of variance. The three factors were type of classroom, cognitive style, and sex. Results are presented in Table IV.

It was predicted in the first hypothesis that there would be a significant interaction between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement. The analysis of data did not reveal a significant interaction between levels of cognitive style and type of classroom environment. As shown in Table V, both field-independent and field-dependent subjects scored higher in traditional plan classrooms.

The test of the second hypothesis was found to be significant: field-independent subjects scored significantly

Table IV.-

Summary of Analysis of Variance for Canadian Tests of Basic Skills Composite Scores by Type of Classroom, Cognitive Style, and Sex.

Source	SS	d.f.	MS	F
E (Type of Classroom)	9521.74	1	9521.74	11.52*
P (Cognitive Style)	26834.29	1	26834.29	32.46*
S (Sex)	136.14	1	136.14	0.16
E x P	1950.45	1	1950.45	2.36
E x S	387.68	1	387.68	0.47
P x S	286.02	1	286.02	0.35
E x P x S	1074.92	1	1074.92	1.30
R : E x P x S	42992.14	52	826.77	

$.95F_{(1,52)} = 4.04$

Table V.-

Means for Composite Scores of the Canadian Tests of Basic Skills by Classroom Type and Cognitive Style.

Classroom Type	Cognitive Style	
	Field-independent	Field-dependent
Open Plan	237.7	183.2
Traditional Plan	251.5	219.9

higher in academic achievement (Mean = 245.1) than field-dependent subjects (Mean = 202.8)

The test of the third hypothesis was also found to be significant: subjects in traditional plan classrooms scored significantly higher in academic achievement (Mean = 235.7) than subjects in open plan classrooms (Mean = 210.4).

The F-ratios for sex and other interactions were nonsignificant.

3. Summary

A description and analysis of data were presented in this chapter. Differences in mean verbal intelligence scores between classroom types and sex were found to be nonsignificant but significant score variations existed between extremes in cognitive style. The reasons for not using verbal intelligence scores as a covariate in the analysis of data were discussed.

The results of testing the three hypotheses were as follows:

1. Contrary to prediction, a significant interaction was not found between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement.

2. Field-independent pupils scored significantly higher in academic achievement than field-dependent pupils.

3. Pupils in traditional plan classrooms scored significantly higher in academic achievement than pupils in open plan classrooms.

CHAPTER IV

DISCUSSION OF RESULTS

A discussion and interpretation of the results of the study are presented in this chapter. The results of testing the three hypotheses are examined in the first three sections. Some implications of the study are presented in the fourth section.

1. Interaction between Levels of Cognitive Style and Type of Classroom Environment

It was predicted that there would be an interaction between levels of cognitive style and type of classroom environment. On the basis of Witkin's theory,[1] it was predicted that field-dependent pupils would exhibit difficulty coping with, and adjusting to the larger, more active, and stimuli-laden environment of open plan classrooms. They were expected, however, to find the smaller space, greater structure, and less active environment of the traditional plan classrooms better suited to their learning needs. The prediction was based on the assumption that field-dependent pupils would score significantly higher in academic achievement in traditional plan

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1 H.A. Witkin, R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation: Studies of Development, John Wiley & Sons, Inc., New York, 1962, xii-576 p.

classrooms than in open plan classrooms. Although the trend is in the predicted direction, the results of the statistical analysis did not support the prediction. A significant interaction was not found between levels of cognitive style and type of classroom environment.

As discussed in Chapter I, there are clear age-related changes in psychological differentiation over the life span of an individual.[2] Developmental curves for the EFT, RFT, and BAT, covering the 8 to 24-year period, indicated a marked, continuous increase in field-independence between the ages of 8 and 17 years. Ten-year-old individuals were found to be relatively more field-dependent (Mean EFT = 146.5) than 17 year-old individuals (Mean EFT = 31.2).

It is reasonable to assume that the failure to obtain a significant cognitive style x classroom type interaction may be attributed to the fact that ten-year-old children are relatively field-dependent and, therefore, require the structure provided by traditional plan classrooms.

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2 Herman A. Witkin, Donald R. Goodenough, and Stephen A. Karp, "Stability of Cognitive Style from Childhood to Young Adulthood", Journal of Personality and Social Psychology, Vol. 7, No. 3, 1967, p. 291-300.

Similar results were reported by Hunt.[3] He described models, at the secondary and college levels, which were an attempt to coordinate student characteristics with their educational environments. For example, in the Conceptual Systems Matching Model, individuals were dimensionalized in conceptual level from very low to high. Conceptual Level was based on a theory of conceptual development which hypothesized that, under ideal training conditions, a person develops from a low level of conceptual development in which he is more dependent on others and not capable of generating his own concepts, to a higher conceptual level in which he is less dependent and more capable of generating his own concepts.

The characteristics of persons at various conceptual levels parallel very closely those of limitedly and highly differentiated individuals described by Witkin. The person at a higher stage of conceptual development has "more alternatives available, is better able to tolerate stress, and is more likely to be able to cope with situations in which he makes honest mistakes".[4] Hunt reported that low conceptual level pupils profited from structured educational

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3 David E. Hunt, Matching Models in Education, Monograph Series No.10, Ontario Institute for Studies in Education, Toronto, Ontario, 1971, v-87 p.

4 Ibid., p. 24.

approaches (lecture method) while high conceptual level pupils profited from relatively unstructured or flexible approaches (discovery method). Apparently Hunt had difficulty obtaining sufficient pupils, in the twelve- to eighteen-years age range, who scored at the higher extreme in conceptual level.

In view of the results reported by Hunt, it appears reasonable to assume that, when compared with older pupils, ten-year-old field-independent children are relatively field-dependent and the differences between them are not as great as implied by their scores on the Children's Embedded Figures Test.

The results of the statistical analysis relative to the first hypothesis were examined in this section. A major factor which may have affected the results and contributed to the failure to achieve a significant interaction between levels of cognitive style and classroom environment was discussed.

2. Differences in Academic Achievement between Field-independent and Field-dependent Pupils.

It was predicted that field-independent pupils, because they tend to posses a greater variety of problem-solving strategies and skills, would score higher in academic achievement than field-dependent pupils. The

results of the statistical analysis supported the prediction; field-independent pupils scored significantly higher in academic achievement (Mean = 245.1) than field-dependent pupils (Mean = 202.8).

In an effort to maintain all of the variance attributable to cognitive style, verbal intelligence scores were not used as a covariate in the statistical analysis of data. Because cognitive style was found to be significantly related to verbal intellectual abilities, a Pearson product-moment correlation was obtained between the two variables in order to determine the magnitude of the relationship. The positive relationship between cognitive style and verbal intelligence, although low ($r = .39$, $N = 253$), undoubtedly accounted for a portion of the variance in academic achievement.

Because it could not be determined with certainty what portion of academic achievement was attributable to cognitive style and what portion was attributable to verbal intelligence, a post hoc analysis of data was conducted. Data were re-analyzed using mean verbal intelligence scores as covariate (See Appendix 4). The resultant univariate F-ratio ($F = 0.03$, $p < 0.87$) indicated no significant differences between field-independent and field-dependent pupils when the criterion variable was academic achievement. It may be concluded that the significant differences in

academic achievement between field-independent and field-dependent pupils were largely accounted for by variations in verbal intellectual ability.

The finding of a significant and positive correlation between cognitive style and verbal intelligence scores lends support to the critics[5,6,7] of Witkin when they suggest that cognitive style may be nothing more than an extension of intelligence. However, in this study, the variance common to both factors was approximately 15 per cent. This indicates that, although cognitive style may be related to verbal intelligence, it is not synonymous with it. Additional research in this area is required.

An interpretation of the results of testing the second hypothesis was presented in this section. The findings indicated that field-independent pupils scored significantly higher in academic achievement than field-dependent pupils. Because there existed a significant and positive correlation between measures of cognitive style

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5 E. Ziggler, "A Measure in Search of a Theory?", Contemporary Psychology, Vol. 8, 1963, p. 133-135.

6 D.N. Jackson, "Intellectual Ability and Mode of Perception", Journal of Consulting Psychology, Vol. 21, No. 6, 1957, p. 458.

7 Thomas E. Dubois and Walter Cohen, "Relationship Between Measures of Psychological Differentiation and Intellectual Ability", Perceptual and Motor Skills, Vol.31, 1970, p. 411-416.

and verbal mental ability and because verbal intelligence scores were not used as a covariate in the statistical analysis of data, a post hoc analysis of data was conducted. The results indicated that the variance in academic achievement between field-independent and field-dependent pupils was largely accounted for by variations in verbal mental ability.

3. Differences in Academic Achievement between Pupils in Traditional Plan and Open Plan Classrooms.

On the basis of Witkin's theory, field-dependent pupils were expected to score higher in academic achievement in traditional plan classrooms than in open plan classrooms. Field-independent pupils, however, were expected to score equally well in both types of classroom environments. Therefore, it was predicted that pupils in traditional plan classrooms would score higher in academic achievement than pupils in open plan classrooms.

The results of the statistical analysis support the prediction; pupils in traditional plan classrooms scored significantly higher in academic achievement ($M = 235.7$) than pupils in open plan classrooms ($M = 210.4$). Field-independent females, field-dependent females, and field-dependent males scored substantially higher in academic achievement in traditional plan classrooms than in open

plan classrooms. Field-independent males, however, scored as well in open plan classrooms as in traditional plan classrooms.

The results of this study do not provide support for the proponents of architecturally open classrooms. In terms of academic achievement, the results favour traditional plan classrooms. Perhaps, as suggested by Katz,[8] traditional plan classrooms tend to stress a traditional-formal academically oriented education while open plan environments tend to stress self-determination, freedom of choice, and aesthetic appreciation.

Anderson,[9] a critic of open plan classrooms, stated that too much pupil freedom in which "too often children are told to do their own thing, while the teacher does his own thing" results in a deterioration of academic standards. The results of this study appear to indicate that the confines of a smaller classroom space may be necessary, at least with ten-year-old pupils, in order to achieve maximum academic Performance.

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8 Lilian G. Katz, Research on Open Education: Problems and Issues, College of Education Curriculum Laboratory, University of Illinois, Urbana, 1972, p. 1.

9 D. Carl Anderson, "Open Plan Schools: Time for a Peek at Lady Godiva", Education Canada, The Canadian Education Association, Vol.10, No.2, June 1970, p. 6.

The possibility exists that these results are applicable only to ten-year-old subjects and cannot be generalized to all age levels in the elementary and secondary schools. This study should be replicated at various elementary and secondary grade levels to determine whether the results are stable with older and younger pupils. One may speculate that, since younger children tend to be more field-dependent, a traditional plan classroom might be more appropriate while for older children, who tend to be more field-independent, an architecturally open classroom might be more conducive to their learning styles.

The results of the statistical analysis relative to the third hypothesis were examined in this section. The evidence indicated that traditional plan classrooms were significantly more effective in enhancing academic achievement, at least with ten-year-old pupils, than architecturally open classrooms. Some implications of the study for education will be presented in the next section.

4. Implications of the Study for Education

In this concluding section, the results of the statistical analysis are examined in relation to the broader question of implications for education. Some suggestions for possible future research are also offered.

As discussed in the first chapter of this study, the results of research examining the differences in student academic achievement between architecturally open and self-contained classrooms proved to be contradictory and inconclusive. In an effort to be more precise in the prediction of academic achievement, it was suggested that there existed a need to examine the interaction effects of the pupil's personality and type of classroom environment. Cognitive style was considered to be an important personality variable.

Contrary to expectation, a significant cognitive style by classroom type interaction did not result. However, the results indicated that traditional plan classrooms were more effective than architecturally open classrooms when the criterion variable was academic achievement. This finding has several implications for education. Undoubtedly, the results of this study must be supported by future research but it appears that ten-year-old pupils at the elementary school level profit from the smaller space of traditional plan classrooms. Boards of Education must be cognizant of these findings when designing and building future educational facilities, especially at the elementary school level.

It should be recognized, however, that the failure to effectively control for the teacher variable must be

considered a limitation of the study. The learning which occurs in classrooms is attributable not only to the physical environment but also to the interactions of people and programmes within it. Teacher style usually determines the the type of programme used in the classroom although architectural features may facilitate one style or programme over another. Despite the inherent difficulties, there is a need to explicitly define architectural features and type of instructional programme. Both variables must be kept conceptually independent. Future studies should attempt to control for various teaching styles or strategies used in both types of architectural environments.

The possibility of matching pupils and teachers on the basis of cognitive style and then examining the effect upon academic achievement in both types of classrooms warrants serious consideration. Attempts should be made to examine such problems as the effect upon academic achievement of field-independent teachers working with field-independent pupils in architecturally open classrooms.

Because only one age level was examined in this study, this experiment should be replicated at other age levels. One may speculate that, since younger children tend to be more field-dependent, a traditional plan classroom might be more appropriate while for older children,

who tend to be more field-independent, an architecturally open classroom might be more conducive to their learning.

Because programmes and teaching strategies tend to change over time as teachers and pupils adjust to the learning environment, longitudinal studies may be more productive. The cummulative effects of architectural design and teaching strategies over several years may result in observable differences in academic performance at various grade levels.

Studies should be conducted in an effort to assess which programme features work best in each of the two types of architectural design. Neither architecturally open nor self-contained classrooms should be considered as ideal types. Each contain architectural factors which facilitate some, but not necessarily all, programme features.

The research method used in this study may be useful in examining affective areas of pupil development. One may postulate that field-independent pupils may enjoy or "like" architecturally open classrooms to a greater extent than traditional plan and that field-dependent pupils react more favourably to traditional plan than to open plan classrooms.

In this chapter were presented a discussion and interpretation of the results of the study. The results of testing the three hypotheses were presented in the first

three sections. A significant interaction was not found between levels of cognitive style and type of classroom environment when the criterion variable was academic achievement. A post hoc analysis of data revealed that the significant difference in academic achievement between field-independent and field-dependent pupils was largely accounted for by variations in verbal mental ability. However, ten-year-old pupils in traditional plan classrooms scored significantly higher in academic achievement than ten-year-old pupils in architecturally open classrooms. Some implications for education and suggestions for further research were presented in the fourth section.

SUMMARY AND CONCLUSIONS

This study was conducted in order to examine the interaction effects of cognitive style and classroom architectural environment on academic achievement. Early attempts made at predicting academic achievement were based primarily on intellective factors. As it became evident that intellective factors alone were not adequate for prediction, personality and environmental variables were considered. It has recently become apparent that both personality and environmental variables must be investigated in combination.

The architectural types of classroom environments, open plan and traditional plan, were used as secured. No attempt was made to alter programmes. When compared with traditional plan, architecturally open classrooms evinced greater physical space and a general increase in the number and intensity of environmental stimuli. Because of the fundamental architectural differences between the two types of classrooms, it was assumed that each would differentially affect the pupils within them.

The rationale for the study was based on the theoretical framework developed by Witkin and his colleagues. They have summarized a considerable body of data supporting Werner's thesis that development proceeds from the

undifferentiated organization to the differentiated, hierarchically organized system that is better adapted to the demands of a heterogeneous, variegated, environment.

Witkin and his colleagues expected to find individual consistency in degree of differentiation along several psychological dimensions including ways of experiencing the world, the self, and the nature and structure of defenses and controls.

The individual's unique pattern of perceiving the world and handling stress is related to the personality adjustment that has evolved in the course of his development. This "cognitive style" is defined as a stable, individual preference in mode of perceiving and conceptualizing the environment. The perceptual component of the more general cognitive style, which Witkin termed field-independence-field-dependence, involves the ability to overcome an embedding context.

Based on theory and empirical evidence, it was postulated that field-dependent and field-independent subjects would be differentially affected by the two types of educational facilities examined in this study. Since field-dependent individuals appeared to be less adaptable to their environments than field-independent persons, it was assumed that field-dependent pupils would be most

impaired in their academic learning by open plan classrooms and most supported by traditional plan classrooms. Thus, the three hypotheses of the research were as follows:

1. There will be an interaction between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement.
2. Field-independent subjects will have greater academic achievement than field-dependent subjects.
3. Subjects in traditional plan classrooms will have greater academic achievement than subjects in open plan classrooms.

Data were obtained from a total of fifteen grade five classes secured from eight traditional plan and seven open plan schools situated in three Boards of Education in Metropolitan Toronto. From a total of 462 ten-year-old subjects, 400 satisfied all the criteria for inclusion in the study. Of these, the composite achievement scores of 253 extreme field-independent and field-dependent, males and females, were subjected to statistical analysis.

The independent variables used in the study were type of classroom environment, sex, and cognitive style. The dependent variable, academic achievement, was measured by the Canadian Tests of Basic Skills. The criterion measure was the composite raw score.

An examination of the literature indicated that the variables sex and age could affect cognitive style scores and the variables sex and verbal intelligence could

affect academic achievement. Substantial variations in verbal intelligence scores were found between field-independent and field-dependent subjects but the differences between classroom types and sex were nonsignificant. A decision was made not to use verbal intelligence scores as a covariate in the statistical analysis of data. The sex factor was retained as a control variable but it accounted for only a small portion of the variance.

The statistical treatment was analysis of variance using classroom means for field-independent males, field-independent females, field-dependent males and field-dependent females as the unit of analysis.

The results of the study were as follows:

1. A significant interaction was not found between levels of cognitive style and type of classroom environment when the criterion variable was academic achievement.

2. Field-independent pupils scored significantly higher in academic achievement than field-dependent pupils.

3. Pupils in traditional plan classrooms scored significantly higher in academic achievement than pupils in open plan classrooms.

Contrary to expectation, the cognitive style by classroom plan interaction was not significant. Although the trend was in the predicted direction, the combination of measures of a pupil's cognitive style and type of elementary classroom design did not significantly increase

the predictability of academic achievement. It was found that field-independent pupils scored significantly higher in academic achievement than field-dependent pupils. A post hoc analysis of data revealed that the significant differences were primarily accounted for by variations in verbal intellectual ability. The results of the research provide some support for the critics of architecturally open classrooms. Pupils in self-contained classrooms obtained significantly higher scores in academic achievement than pupils in architecturally open classrooms regardless of cognitive style or sex.

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Bieri, James, Wendy M. Bradburn, and M. David Galinsky, "Sex Differences in Perceptual Behavior", Journal of Personality, Vol. 26, 1958, p. 1-12.

In this study the authors found sex differences in cognitive style scores as measured by the EFT. As expected, males obtained significantly lower scores than females. In addition, women had greater variability of scores than men.

Burnham, Brian, "Open Education: Some Research Answers to Basic Questions", Orbit 10, Vol. 2, No. 5, 1971, p. 22-24.

Following an extensive review of the literature pertaining to open education, in addition to conducting research in the area, Burnham suggested that on some occasions, and for some youngsters, a structured programme within an enclosed area may be desirable.

Cronbach, Lee J., "The Two Disciplines of Scientific Psychology", American Psychologist, Vol. 12, 1957, p. 671-684.

The author stated that it is the task of applied psychology to find for each individual the treatment to which he can most easily adapt. He further declared that the organism and treatment are an inseparable pair and that no researcher can dismiss one or the other as error variance.

Dubois, Thomas E., and Walter Cohen, "Relationship Between Measures of Psychological Differentiation and Intellectual Ability", Perceptual and Motor Skills, Vol.31, 1970, p. 411-416.

The authors found significant relationships between measures of field-independence and purely verbal, informational, and other measures of achievement. They suggested the possibility that measures of field-independence obtain much of their reported generality as a function of their relationship to general intelligence.

Eberle, Robert F., "The Open Space School", The Clearing House, Vol. 44, September, 1969, p. 23-28.

In this article the author discussed some of the basic differences between open plan and traditional plan schools while stressing many of the possible advantages of the former. The implication was made that the open plan school provides more flexibility and better learning outcomes for all its pupils.

Jackson, Douglas M., "Intellectual Ability and Mode of Perception", Journal of Consulting Psychology, Vol. 21, No. 6, 1957, p. 458.

Jackson found a significant correlation between scores of Witkin's embedded-figures test and intelligence. He cautioned against attempts to interpret relationships between individual differences in perception and personality without adequate controls for intellectual differences.

Justus, John E., "An Educator Views Open Space and the Planning Process", CEFP Journal, Vol. 9, No. 5, 1971, p. 12-14.

The author suggested that, while there were many favourable attitudes toward open space schools, some discontent was mounting in several areas, including the assessment of environmental influences of open space upon students.

Killough, Charles K., "An Analysis of the Longitudinal Effects That a Nongraded Elementary Program, Conducted in an Open-Space School, Had on the Cognitive Achievement of Pupils", Educators Report and Fact Sheet, Vol. 9, No. 2, 1971, 4 p.

In this three-year longitudinal study, Killough found that after at least two years in a nongraded school programme conducted in an open-space elementary school, the pupils had significantly better achievement gains in most cognitive areas than did pupils from traditionally designed facilities.

Myers, R.E., "A Comparison of the Perceptions of Elementary School Children in Open Area and Self-Contained Classrooms in British Columbia", Journal of Research and Development in Education, Vol. 4, No, 3, 1971, p. 100-106.

In concluding this study, the author stated that children are unquestionably affected by their learning environments. He further suggested that some pupils benefit more from being in an Open Area classroom than do others and that the researcher's task is to determine which children benefit most and least from various kinds of learning environments.

Sackett, John W., A Comparison of Self-Concept and Achievement of Sixth Grade Students in an Open Space School, Self-Contained School, and Departmentalized School, Unpublished Ph.D. Dissertation, Iowa University, 1971, vi-78 p.

Sackett found that sixth grade students in an open space school generally held a lower self-concept than did the sixth grade students in a traditional plan school. In addition, the pupils from the open plan facility achieved more poorly in academic achievement as measured by the Iowa Tests of Basic Skills.

Sugden, J.H., Jr., "How effective are open plan elementary schools?", American School and University, Vol. 45, 1973, p. 18-21.

Although concluding that open space schools meet the needs of their pupils and that the strengths outweigh the weaknesses, Sugden admitted that not all pupils and teachers adjust to the open environment.

Tyler, Leona E., The Psychology of Human Differences, Third Edition, Appleton-Century-Crofts, New York, 1965, viii-572 p.

In this work, Tyler discusses much of the research and many of the major dimensions of individual differences.

Witkin, H.A., R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Karp, Psychological Differentiation: Studies of Development, John Wiley & Sons, Inc., New York, 1962, xii-418 p.

This book, covering twenty years of research, is a second major report (the first being: Personality Through Perception, 1954). The volume continues the earlier work on field-independence, field-dependence within the elaborated construct of the "differentiation hypothesis" which proposes an interrelationship among several areas of psychological functioning. Numerous studies are reviewed examining the relationships among perceptual, cognitive, and personality functions which characterize more or less differentiated individuals. The results of research dealing with stability of differentiation, sex differences, and etiology are well documented.

--------, The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations, A paper presented at a symposium on "Cognitive Styles, Creativity and Higher Education", sponsored by the Graduate Record Examination Board, Montreal, Canada, November 8-10, 1972, 58 p.

In this paper, the author reviews a great deal of the literature pertaining to cognitive styles and the implications of his work to education. Witkin, however, does not discuss the effect of the physical educational environment upon field-independent and field-dependent individuals.

--------, Donald R. Goodenough, and Stephen A. Karp, "Stability of Cognitive Style from Childhood to Young Adulthood", Journal of Personality and Social Psychology, Vol. 7, No. 3, 1967, p. 291-300.

The authors found, for both males and females, a developmental trend toward increasing field-independence to age seventeen. Further, it was found that, despite a marked general increase in differentiation in perceptual functioning with age, each individual tended to maintain his relative position among his peers regardless of age level.

Young, Harl H., "A Test of Witkin's Field-Dependence Hypothesis", Journal of Abnormal and Social Psychology, Vol. 59, 1959, p. 188-192.

This study represented a test of Witkin's differentiation hypothesis. While the results were not as striking as those found by Witkin, considerable support was provided indicating appreciable validity of the hypothesis. In addition, the patterns of correlations for the sexes show many similarities to the Witkin data.

APPENDIX I

SCHEDULE OF TESTING BY TYPE OF SCHOOL, MONTH, AND NUMBER OF CLASSROOMS TESTED

APPENDIX I

SCHEDULE OF TESTING BY TYPE OF SCHOOL, MONTH, AND NUMBER OF CLASSROOMS TESTED

Date		Traditional Plan	Open Plan
November	1973	1	1
December	1973	2	1
January	1974	0	0
February	1974	3	2
March	1974	2	3
	Total:	8	7

APPENDIX 2

TEST RESULTS FOR ALL SUBJECTS IN ACADEMIC ACHIEVEMENT, COGNITIVE STYLE, AND VERBAL MENTAL ABILITY

APPENDIX 2

TEST RESULTS FOR ALL SUBJECTS IN ACADEMIC ACHIEVEMENT, COGNITIVE STYLE, AND VERBAL MENTAL ABILITY

Open Plan School Number 01

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
1	M	176	16	90
2	F	204	15	98
3	M	161	4	80
4	F	222	16	79
5	F	261	17	103
6	M	150	16	79
7	F	165	4	87
8	F	298	17	133
9	F	160	9	87
10	M	186	14	88
11	M	192	12	95
12	F	228	5	93
13	F	140	12	81
14	M	295	17	113
15	F	195	14	99
16	F	197	5	93
17	F	200	13	89
18	F	162	7	75
19	F	198	10	94
20	F	134	3	77
21	F	130	14	84
22	F	160	21	81

Open Plan School Number 02

1	M	166	16	82
2	F	215	13	83
3	M	174	17	87
4	M	191	16	92
5	M	125	6	80
6	M	179	14	88
7	F	130	7	78
8	F	220	18	99
9	F	153	7	84
10	F	260	5	92
11	M	136	16	78

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
12	M	214	10	88
13	M	184	7	84
14	M	210	20	99
15	F	174	12	86
16	F	252	20	110
17	M	151	3	85
18	M	269	18	115
19	F	119	11	67
20	M	182	19	82
21	F	223	16	98
22	M	162	12	83
23	F	292	24	112
24	F	278	18	110
25	F	233	14	91
26	M	241	18	98
27	M	168	16	90
28	M	197	16	84
29	M	293	24	109
30	M	189	12	88
31	M	230	20	109
32	F	216	24	88
Open Plan School Number 03				
1	F	282	23	106
2	F	169	6	84
3	F	206	11	94
4	F	145	5	71
5	F	234	9	100
6	M	180	7	100
7	F	200	5	92
8	M	242	14	115
9	M	221	17	95
10	F	214	16	102
11	M	255	10	107
12	F	151	20	82
13	F	252	15	108
14	M	192	16	88
15	M	243	20	105
16	F	192	6	89
17	M	204	18	93
18	F	228	14	89
19	F	190	20	89
20	M	242	7	95
21	F	228	19	105
22	M	164	10	77

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
Open Plan School Number 04				
1	F	233	18	97
2	F	156	15	77
3	F	173	5	81
4	M	270	22	97
5	M	278	14	106
6	F	292	20	113
7	F	316	16	108
8	F	216	9	78
9	F	265	13	95
10	M	266	23	96
11	M	179	2	77
12	M	300	20	115
13	F	297	16	113
14	F	280	20	103
15	F	213	16	105
16	F	272	12	97
17	M	354	20	142
18	F	281	11	107
19	F	169	14	86
20	M	207	16	96
21	F	257	21	98
22	M	185	16	80
23	M	253	18	113
24	F	228	4	89
25	M	304	19	124
26	M	181	5	89
27	M	181	21	89
28	F	195	5	90
29	M	281	18	98
30	F	305	19	111
31	M	242	15	95
32	F	203	19	89
33	M	148	3	77
Open Plan School Number 05				
1	F	251	10	90
2	F	171	12	83
3	M	193	3	85
4	F	194	17	89
5	M	321	17	118
6	M	286	22	114
7	F	153	10	77
8	M	169	6	84

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
9	M	247	13	106
10	M	256	17	95
11	F	206	11	91
12	F	223	8	90
13	M	279	16	99
14	F	294	15	116
15	M	229	12	80
16	M	113	11	74
17	M	193	23	98
18	F	275	11	94
19	F	235	6	96
20	M	205	8	91
21	F	168	6	85
22	F	174	21	95
23	F	249	18	97
24	M	332	14	123
25	M	216	10	86
Open Plan School Number 06				
1	F	129	6	75
2	F	155	16	86
3	M	155	13	88
4	M	157	17	88
5	F	334	23	119
6	F	150	9	77
7	M	170	8	84
8	F	171	15	89
9	F	229	13	92
10	F	183	5	90
11	F	241	21	99
12	F	164	12	79
13	F	177	12	88
14	F	289	24	114
15	M	188	18	94
16	F	193	11	89
17	M	230	12	94
18	M	213	11	104
19	M	201	7	81
20	M	205	9	92
21	F	196	10	83
22	F	176	15	89
23	M	127	7	89
24	F	170	5	91
25	F	173	6	89

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
Open Plan School Number 07				
1	M	223	22	103
2	F	149	17	96
3	F	243	7	95
4	M	223	19	95
5	M	197	8	79
6	M	289	23	112
7	M	274	17	112
8	M	163	13	96
9	M	172	5	74
10	M	235	17	87
11	M	319	18	107
12	F	196	10	90
13	F	161	4	74
Traditional Plan School Number 01				
1	M	233	16	93
2	F	333	22	122
3	M	197	14	82
4	M	212	6	91
5	F	176	12	80
6	M	303	20	109
7	F	312	19	111
8	F	169	19	91
9	M	235	16	88
10	F	276	18	111
11	M	301	21	122
12	F	218	5	88
13	F	166	11	78
14	F	232	13	89
15	M	261	9	99
16	M	248	17	99
17	F	304	24	123
18	F	166	17	88
19	F	228	19	95
20	M	189	7	82
21	F	194	15	90
22	M	243	20	94
23	F	198	21	75
Traditional Plan School Number 02				
1	M	258	11	91

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
2	M	207	13	80
3	M	193	20	79
4	M	308	19	108
5	M	187	8	86
6	M	210	14	87
7	F	243	6	97
8	M	239	5	94
9	M	178	2	75
10	M	204	4	84
11	F	295	19	114
12	M	227	7	91
13	F	263	24	111
14	F	260	13	109
15	M	217	8	86
16	M	229	20	94
17	F	280	14	109
18	F	303	7	119
19	M	186	19	78
20	M	177	4	80
21	F	198	18	86
22	M	248	4	105
23	F	171	10	78
24	M	245	23	100
25	F	253	8	94
26	F	234	10	85
27	M	169	5	77
28	F	237	3	88
29	F	159	11	83
30	M	226	6	90
31	F	210	3	96
Traditional Plan School Number 03				
1	F	192	4	85
2	F	166	12	85
3	M	259	17	100
4	M	253	22	99
5	F	294	17	112
6	F	180	12	85
7	F	217	4	87
8	M	217	15	90
9	M	241	21	111
10	F	240	18	91
11	F	245	21	102
12	F	237	4	106
13	M	279	24	105

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
14	F	241	21	101
15	M	237	13	101
16	M	283	7	102
17	F	208	5	100
18	M	197	2	83
19	F	224	6	102
20	M	240	20	94
21	M	208	19	78
22	F	262	8	100
23	F	244	15	89
24	M	226	11	89
25	M	300	23	106
26	F	255	7	101
27	M	199	2	88
Traditional Plan School Number 04				
1	M	181	5	87
2	F	240	12	91
3	M	210	18	84
4	F	214	5	98
5	M	146	16	93
6	M	213	7	96
7	F	230	21	85
8	F	141	5	92
9	M	202	4	93
10	F	194	4	73
11	M	223	11	95
12	M	233	3	105
13	M	260	7	99
14	F	289	18	116
15	M	245	18	115
16	F	201	14	104
17	M	188	11	92
18	F	239	12	97
19	M	173	1	75
20	F	212	11	97
21	M	281	18	118
22	F	154	7	77
23	F	213	10	82
24	F	236	17	103
25	M	195	12	87
26	F	147	5	79
27	F	224	15	94

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
Traditional Plan School Number 05				
1	M	157	5	78
2	F	284	20	99
3	F	317	22	123
4	F	202	13	95
5	F	177	6	88
6	M	194	11	88
7	M	224	19	93
8	M	211	18	81
9	M	262	20	95
10	M	253	8	106
11	F	295	16	107
12	F	314	21	117
13	M	187	15	83
14	M	236	8	89
15	F	185	8	85
16	F	233	10	96
17	M	216	22	87
18	M	171	20	89
19	M	195	12	87
20	F	225	10	79
21	F	300	8	113
22	M	272	24	114
23	M	210	7	93
24	F	296	12	118
25	M	224	5	90
26	M	257	14	95
27	F	198	6	86
28	M	312	16	112
29	F	195	7	86
30	M	238	22	95
31	M	170	22	84
32	M	265	10	99
33	M	212	8	81
Traditional Plan School Number 06				
1	M	208	16	88
2	M	192	13	88
3	F	253	18	105
4	M	225	6	98
5	F	220	17	84
6	F	190	22	88
7	M	258	6	99
8	F	191	6	89

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
9	M	293	13	121
10	F	308	19	116
11	M	243	11	99
12	M	182	12	90
13	F	187	15	86
14	F	252	6	94
15	M	193	3	87
16	M	271	23	123
17	F	236	13	92
18	M	171	4	76
19	F	263	13	106
20	F	200	16	92
21	F	218	6	84
22	M	215	3	94
Traditional Plan School Number 07				
1	F	179	5	93
2	M	175	15	83
3	M	198	17	83
4	M	223	6	86
5	M	203	18	92
6	F	334	17	120
7	M	155	13	68
8	M	279	11	95
9	F	199	21	82
10	F	219	10	96
11	M	234	17	90
12	F	221	14	91
13	F	226	12	90
14	M	205	19	97
15	F	208	15	78
16	M	194	13	99
17	F	208	6	82
18	F	186	10	90
19	M	187	8	95
20	F	228	5	100
21	F	202	14	91
22	F	173	12	80
23	F	183	16	78
24	F	327	25	108
25	M	209	8	97
26	M	197	4	85
27	M	162	11	83
28	F	237	12	94
29	M	233	15	98

Student Number	Sex	CTBS Composite	Cognitive Style	Verbal I.Q.
30	M	176	8	73
31	F	208	13	93
32	F	215	9	87
33	F	270	22	103
43	F	273	16	98
Traditional Plan School Number 08				
1	F	231	19	94
2	F	231	11	105
3	F	206	5	86
4	M	237	8	99
5	M	296	21	105
6	F	187	19	102
7	M	238	6	95
8	M	203	20	92
9	M	172	20	85
10	M	236	6	101
11	F	269	10	109
12	F	232	13	104
13	F	268	3	111
14	M	215	16	84
15	F	215	11	105
16	F	218	19	92
17	M	270	21	110
18	M	207	4	91
19	F	223	18	92
20	M	326	15	107
21	F	257	22	94
22	M	232	11	91
23	M	260	12	82
24	M	339	19	112
25	F	335	9	121
26	F	205	19	85
27	F	279	6	108
28	M	220	21	91
29	M	274	8	103
30	M	318	18	118
31	M	317	5	111

APPENDIX 3

SOURCE TABLE OF MEANS AND STANDARD DEVIATIONS FOR COMPOSITE SCORES OF CANADIAN TESTS OF BASIC SKILLS AND VERBAL INTELLIGENCE BY TYPE OF CLASSROOM, SEX, AND COGNITIVE STYLE

SOURCE TABLE OF MEANS AND STANDARD DEVIATIONS FOR COMPOSITE SCORES OF CANADIAN TESTS OF BASIC SKILLS AND VERBAL INTELLIGENCE BY TYPE OF CLASSROOM, SEX, AND COGNITIVE STYLE

	Male				Female			
	Field-independent		Field-dependent		Field-independent		Field-dependent	
	X	Y	X	Y	X	Y	X	Y
	113.00	295.00	80.00	161.00	105.67	239.67	85.00	177.20
	99.86	228.43	83.00	153.33	103.80	251.60	84.67	181.00
Open	97.67	222.67	97.50	211.00	95.50	212.75	87.20	188.00
	109.25	276.13	81.00	169.33	101.83	261.67	84.50	203.00
Plan	106.25	264.00	86.67	189.00	93.67	205.67	90.33	208.67
	91.00	172.50	86.50	175.75	110.67	288.00	84.40	161.00
	102.67	260.50	76.50	184.50	96.00	149.00	84.50	202.00
Mean	102.81	245.60	84.45	177.70	101.02	229.77	85.80	188.70
S.D.	7.44	41.02	6.79	19.28	6.23	45.42	2.23	17.03
	106.00	273.75	90.67	220.67	102.00	248.25	88.00	218.00
	91.80	232.20	86.80	207.20	103.67	252.00	98.80	249.20
Trad.	99.00	254.29	91.00	226.33	101.50	255.00	97.29	227.86
	105.67	245.33	92.50	210.33	101.33	251.67	83.80	170.00
Plan	92.25	220.50	89.50	215.33	113.00	305.00	91.60	211.00
	123.00	271.00	90.80	212.40	98.25	242.75	89.00	220.33
	90.50	210.00	85.40	198.40	103.40	282.50	90.50	207.50
	101.86	259.71	100.00	251.50	93.17	220.17	106.50	272.00
Mean	101.26	245.85	90.83	217.77	102.02	257.17	93.19	221.99
S.D.	10.73	23.26	4.38	16.02	5.58	25.77	7.25	30.07

APPENDIX 4

SUMMARY OF ANALYSIS OF COVARIANCE FOR CANADIAN TESTS OF BASIC SKILLS COMPOSITE SCORES BY TYPE OF CLASSROOM, COGNITIVE STYLE, AND SEX

APPENDIX 4

SUMMARY OF ANALYSIS OF COVARIANCE FOR CANADIAN TESTS OF BASIC SKILLS COMPOSITE SCORES BY TYPE OF CLASSROOM, COGNITIVE STYLE, AND SEX

Source	SS	d.f.	MS	F
E (Type of Classroom)	2821.51	1	2821.51	8.89*
P (Cognitive Style)	8.45	1	8.45	0.03
S (Sex)	5.15	1	5.15	0.02
E x P	4.08	1	4.08	0.01
E x S	66.67	1	66.67	0.21
P x S	3.70	1	3.70	0.01
E x P x S	770.88	1	770.88	2.43
R : E x P x S	16188.93	51	317.43	

$.95F_{(1,51)} = 4.04$

APPENDIX 5

ABSTRACT OF

The Relationship of Cognitive Style and Classroom Environment to Academic Achievement: An Exploratory Study

APPENDIX 5

ABSTRACT OF

The Relationship of Cognitive Style and Classroom Environment to Academic Achievement: An Exploratory Study[1]

The study investigated the effects upon academic achievement of an individual's cognitive style and the type of classroom environment in which he is situated. The concepts of Herman Witkin formed the theoretical base.

The hypotheses of the research were as follows:

1. There will be an interaction between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement.
2. Field-independent subjects will have higher scores in academic achievement than field-dependent subjects.
3. Subjects in traditional plan classrooms will have higher scores in academic achievement than subjects in open plan classrooms.

Data were obtained from a total of 400 ten-year-old pupils from seven open plan and eight traditional plan schools located in three Boards of Education in Metropolitan Toronto. Of these, the composite achievement raw scores of 253 extreme field-independent and field-dependent, males and females, were subjected to statistical analysis.

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1 Rudolph Wagner, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ontario, 1977, xiv-101 p.

The conclusions were as follows:

1. A significant interaction was not found between levels of cognitive style and type of classroom environment when the criterion variable is academic achievement.

2. Field-independent pupils scored significantly higher in academic achievement than field-dependent pupils.

3. Pupils in traditional plan classrooms scored significantly higher in academic achievement than pupils in open plan classrooms.

Although a trend was in the predicted direction, no significant interaction was found between levels of cognitive style and type of classroom environment for the ten-year-old pupils used in the study. It was found that field-independent pupils achieved significantly higher in academic achievement than field-dependent pupils. The results of a post hoc analysis of data revealed that the variance in academic achievement between field-independent and field-dependent pupils was largely accounted for by variations in verbal mental ability. The results of the study provide support for the critics of open plan classrooms. In terms of academic achievement, the results favour traditional plan classrooms regardless of cognitive style or sex. Some implications of the study for education and suggestions for further research were also provided.