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The University of Oklahoma, Ed.D., 1969
Education, administration

University Microfilms, Inc., Ann Arbor, Michigan

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE APPLICATION OF FACTOR ANALYSIS IN IDENTIFYING RELATIONSHIPS AMONG SELECTED EDUCATIONAL DATA

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

BY

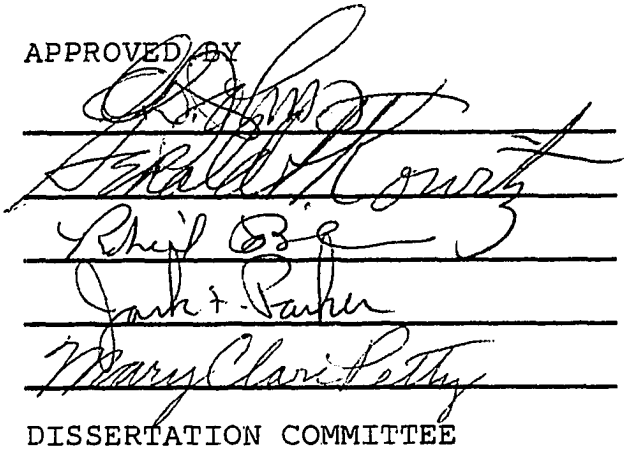
KENNETH EUGENE ELSNER

Norman, Oklahoma

1969

THE APPLICATION OF FACTOR ANALYSIS IN IDENTIFYING RELATIONSHIPS AMONG SELECTED EDUCATIONAL DATA

APPROVED BY



DISSERTATION COMMITTEE

ACKNOWLEDGEMENTS

The author is especially grateful to Dr. O. D. Johns, chairman of the doctoral committee and major professor, for his constructive criticism and encouragement throughout the graduate program and for his patience and guidance during the time in which this report was developed.

Acknowledgement of profound indebtedness is due Dr. Gerald T. Kowitz and Jerry Prather for their assistance, guidance, and time which they so generously gave in the development of the study and this report.

The author is also indebted to Dr. Jack F. Parker, Dr. Robert Bibens, and Dr. Mary Clare Petty, members of the doctoral committee, for their suggestions, encouragement, and assistance during the graduate program and for their comments on the manuscript.

An expression of gratitude is also due Bill Siler, Director of Research for the State Department of Education, for valuable assistance given in securing data used in this study and to the staff of the Merrick Computing Center of the University of Oklahoma for their assistance in the statistical analysis of the data.

An expression of gratitude to my wife, Bonnie, and to our children, Randy, Robin, and Russell, for their confidence and understanding.

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CHAPTER I

INTRODUCTION

Background, Need and Purpose of the Study

Background

There is general recognition that education plays a critical role in the achievement of local, state, and national objectives. It is becoming increasingly clear that a strong relationship exists between education and factors such as economic growth, poverty, civil rights, and foreign affairs. It is natural, therefore, for the demands for information about vital educational activity to be abundant and ever increasing. At the present time, educators do a less than adequate job of reporting to the public about schools; in addition, legislators, administrators, and researchers are hampered by a lack of related, reliable, and timely data.[1] It appears that duplication of effort, late and inaccurate reporting, and slow data processing too often characterize educational informational systems today.

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[1]Enoch Haga, ed., Automated Educational Systems (Elmhurst, Ill.: The Business Press, 1967), p. 66.

Informational systems are neither new nor unique; the structure and operation of an effective information system is both unusual and difficult.[1] The potential of an information system is obvious, but the demands for operating a system are formidable. The operation of a modern school assumes that complex decisions can be made quickly. The amount of data which may be relevant is often beyond the scope of the human mind. It is at this point that the information system can become a man-machine system. The functioning of the human mind can be supplemented by the computer. The machine can perform arduous tasks of extracting relevant information and presenting it in a lucid form at the proper time.

Need

The schools and the various educational agencies in every state are now routinely collecting great masses of information of many types and in many ways. However, the methods of data collection and of data processing now being employed, in view of modern technological advances, are in general antiquated, cumbersome, inefficient, and repetitious. Not only are the techniques outmoded, but there is serious lack of coordination among the many different data-collecting agencies; there is much overlap and duplication involved, and there is very frequent repetition of tasks required of

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[1]Robert W. Marker, Educational Data Processing (Boston: Houghton Mifflin Company, 1967), p. 45.

the person supplying the information.[1] Administrators in filling out report forms for different agencies and for different purposes, are supplying exactly the same detailed information over and over again from agency to agency and from year to year.

It appears that the need for more information and for better methods of collecting and processing information is really of only secondary importance. It is impossible for the schools and educational agencies to be too well informed about the problems with which they must deal. It is quite possible, however, to collect and have at hand more detailed and non-related information than can be digested or assimilated, or can be interpreted and used with real effectiveness. It is possible to collect information without having thought out in advance just how it is to be used, or without developing adequate facilities for deriving from the detailed information the meanings that it contains--meanings which are frequently dependent upon complex interrelationships among the detailed items of information, rather than in the individual items themselves. The most important need of all, therefore, is for better methods of organizing, analyzing, integrating, reducing, and interpreting the information that is already being collected.[2]

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[1] E. F. Lindquist, Computer Concepts and Educational Administration, (University of Iowa Educational Information Center, 1966), p. 41.

[2] Ibid.

Within the past few years a national effort to deal with rapidly intensifying informational problems has developed. The U.S. Office of Education and the Council of Chief State School Officers, through the Committee on Educational Data Systems, are cooperating to initiate a nationwide coordinated system for collecting information on school professional staff, pupils, curricula, facilities, and finance.[1] Up to the present, this effort has produced a very small quantity of information in relation to what is needed, but it is a beginning.

In planning an educational data system, it is critically important that ample attention be given to the matter of selecting the basic items to be included in the system. It is not sufficient to gather data which our predecessors have gathered or to hypothesize new data. The purpose of education is twofold: the development of an individual to his highest potential and the cultivation of our society for the service of all mankind. What data then, we must ask, are of the greatest worth in achieving the purposes of education?

Paul R. Mort and his co-workers developed a so-called simplex of characteristics composed of a core element of "quality of schools" and four panels or families of data drawn together through correlational and factor analytical

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[1]Enoch Haga, ed., Automated Educational Systems (Elmhurst, Ill.: The Business Press, 1967), p. 67.

studies. The panels were termed "individual school," "school system policy," "educational climate," and "community." Lorne H. Woollott, in commenting on the work of Mort, made the following observations concerning educational data:

> From the studies of Mort and a recent discussion among members of the Committee of Educational Data Systems of the National Council of Chief State School Officers it seems reasonable to expect that something in the neighborhood of 72 data characteristics would be sufficient to describe the entire universe of education, at least through the secondary-school grades. Putting 72 such items into such a complex of computer programs based on six 12 X 12 matrices, one hugh 72 X 72 matrix with an assorted complex of statistical formulas from analysis of variance through factor analysis would give a remarkable starting point for decision making or at least for identifying the elements most closely related to decision making. Such an analysis could represent a pioneering venture into the measurement of attitudes, the quantification of processes, and the application of new mathematical treatments in the social sciences.[1]

The basic goal of the present study emerges from the proliferation of data from the modern school district operations. There appears to be a need to reduce the myriad of available indices to a few meaningful and essential ones without eliminating the meaning which the different indices may contribute.

Procedures and criteria for selecting items for the basic data system will vary according to the size, organization, and responsibilities of the educational agencies. It is clear, however, and exceedingly important, that a detailed

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[1]Don D. Bushnell and Dwight W. Allen, The Computer in American Education (New York: John Wiley and Sons, Inc., 1967), p. 193.

and intensive study be undertaken when an information system is contemplated.[1]

Purpose

This study was undertaken to ascertain if there is a high degree of correlation existing among the educational data which administrators are reporting to the Oklahoma State Department of Education. A more concise understanding of the correlation of the data being used by the local school districts in reporting to the State Department of Education might insure a more accurate assessment of the total educational program.

As the size and complexities of our public school systems continue to expand it appears that administrators will have an even greater need in the future for a more meaningful understanding of the complex interrelationships among the detailed items of educational data. At the present time, even with computer hardware facilities, it is extremely difficult for educational leaders to utilize the available educational data to the optimum degree because of their inability to grasp the relationships that exist among the available data. It is the purpose, therefore, of this study to identify relationships existing among selected items of information that each school district reports to the State Department of Education.

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[1]Enoch Haga, ed., Automated Educational Systems (Elmhurst, Ill.: The Business Press, 1967), p. 70.

The Problem

Statement of the Problem

The problem of this study was to determine by the application of factor analysis if significant relationships exist among selected items of information that each school district reports to the Oklahoma State Department of Education.

For research purposes the problem may be stated more succinctly in the following two questions:

1. How many factors exist in the selected data reported to the State Department of Education?

2. What are the characteristics of the underlying factors if in fact they do exist?

Delimitation

This study is limited to the public schools in Oklahoma that provided education for grades one through twelve and had an average daily attendance in grades one through twelve of more than 500 for the 1967-68 school year. There were 170 schools which met these criteria.

This study is limited to selected information contained in the following list of reports as recorded by the Oklahoma State Department of Education for the school year of 1967-68. The list is as follows:

1. Annual Personnel Report
2. Application for Accrediting
3. School District Transportation Reports

4. Estimate of Needs
5. School District Expenditures Report
6. Annual Statistical Report

Definition of Terms

Data: A general term used to denote any or all facts, numbers, or letters and symbols that refer to or describe an object, idea, condition, situation, or other factors.

Variable: An item which can assume any of a number of quantitative values. A condition which changes or may be changed as a result of processing additional data through the system.

Factor analysis: Is a method for determining the number and characteristics of the underlying variables among large numbers of measures.

Public school: An elementary or secondary school that is part of a system of schools maintained by public taxes and supervised by State authorities.

Factor: Is the underlying unity that exists among items of information that show a high relationship as reflected in the correlation coefficients.

Cluster: A number of variables or data items that are most highly interrelated as identified through the size of the correlation coefficients.

The Data

The data to be analyzed in this study will be the selected items of information recorded on the Annual Personnel Report, Application for Accrediting, Estimate of Needs, School District Expenditures Report, Annual Statistical Report and School District Transportation Reports, as filed with the Oklahoma State Department of Education for the 1967-68 school year.

Methodology

Procedure

The procedure of this study was structured to include all schools in Oklahoma that maintained an educational program through the secondary level and had an average daily attendance of more than 500 for the 1967-68 school year. The selected items of information to be studied were collected for each school district from the State Department of Education.

Treatment of Data

The statistical analysis of all data was accomplished by the use of a computer on the University of Oklahoma campus. Without the use of the computer this study would have been impossible.

The data collected were reduced to more manageable numbers by calculating the per average daily attendance ratio

or per one hundred average daily attendance ratio where it was appropriate. Those items of information which could not be reduced in a meaningful way were used in their original totals. The data in their final form were placed in the computer by means of key punched IBM cards.

Pearson product-moment correlations among the 48 variables were calculated and arranged into a correlation matrix.[1] The correlation matrix was factor analyzed by the principal factors method and the results of the factor analysis is presented in a rotated factor matrix.[2] The factor rotated matrix provided the final answer to the problem under study of how many and what are the characteristics of the relationships that exist among the selected items of information being analyzed.

Organization of the Study

This study is reported in five chapters and a reference section. The background of the problem, statement of the problem, data to be analyzed, and the methodology of the study have been discussed in Chapter I. A review of the literature and related research is presented in Chapter II. Chapter III includes an explanation of the design of the

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[1]Gilbert Sax, Empirical Foundations of Educational Research (Englewood Cliffs: Prentice-Hall, Inc., 1968), p. 193.

[2]Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1964), p. 661.

study. The analysis and interpretation of the data pertaining to the number and characteristics of underlying factors among the selected items of information as they are reported to the State Department of Education are presented in Chapter IV. Chapter V is a summary of the study with conclusions and recommendations, based upon this study.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Factor analysis has a rich and abundant literature. A review of the pertinent studies will contribute to a better understanding of the problem investigated in this study. Since the literature of factor analysis is extremely extensive, the studies reviewed here are, of necessity, selective. Brief reference is made to the work of some of the researchers who have made substantial contributions to the development and popularization of factor analysis, who have summarized and recapitulated the findings of others, or who have attempted to cross-identify the factors tentatively identified by others. More extensive reviews of selected investigations germane to this study are presented. The criteria for the inclusion of these specific studies in the present investigation are: (1) they involve studies that are concerned about school or community factors, (2) they contain elementary applications of factor analysis, (3) the studies were reported since 1950.

General Survey of Factorial Analysis

In a review of the literature to 1940, with emphasis on the period 1928-40, Wolfle in 1940 presented a bibliography which listed 530 references.[1] Solomon and Rosner in 1955 reviewed 164 articles and books published in the three year period of July 1952 to June 1955.[2] There have been other surveys which indicate the preparation and publication of a number of papers on factor analysis of the order of magnitude of 1,000 since the turn of the century.

Factor analysis was originally devised to discover the factors underlying individual differences in abilities or aptitudes as measured by test scores, but it has blossomed in many ways never envisaged by its initial protagonists. The first step towards a technique of factor analysis was made when Francis Galton, probably the greatest genius in the history of English psychology, introduced the function which is now known as the coefficient of correlation.[3] The measurement of correlation is basic to factor analysis because it provides the researcher with an arithmetical statement of the extent to which two sets of measurements agree.

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[1] Dael Wolfle, Factor Analysis to 1950, "Psychometric Monograph," No. 3, (Chicago: University of Chicago Press, 1940).

[2] Herbert Solomon, Mathematical Thinking in the Measurement of Behavior (Glencoe: The Free Press, 1954).

[3] C. J. Adcock, Factorial Analysis for Non-Mathematicians (London: Cambridge University Press, 1954), p. 10.

Probably the most common goal of investigations, both field and experimental, has been to demonstrate the importance of one factor in affecting one or more other factors. An advantage of factor analysis is that it provides a way of ascertaining relationships among a large assemblage of data with a minimum of prior conceptual and theoretical assumptions or commitments. Thurstone substantially summarizes the basic goal of factor analysis when he states:

> We proceed--with a set of measurements or indices that cover the domain, hoping to discover in the factorial analysis the nature of the underlying order--the underlying order in a domain can be discovered without first postulating it in the form of a hypothesis.[1]

Many early programs of research that dealt with relationships were eminently successful as judged by the findings of the investigators. To a large degree the researchers demonstrated to the satisfaction of nearly all concerned that a particular factor correlated with some other variable, but they almost invariably stopped at that point. The strength of the relation, the precise quantitative form, and even more fundamentally, the precise conceptualization of the "factors" involved, have often been lacking.[2]

An analysis of studies that were interested in showing a relationship might include the Stogdill "leadership climates" study which demonstrated the importance of the kind

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[1] L. L. Thurstone, Multiple-Factor Analysis (Chicago: University of Chicago Press, 1947), p. 56.

[2] Solomon, op. cit., p. 9.

of leadership--democratic, authoritarian, or laissez-faire--for group functioning.[1] Similarly, Muzafir Sherif's studies in 1935 of the establishment of a group norm showed the importance of other person's judgements for the judgements of each group member in an unclear situation.[2] Lewin in 1943 made a study comparing the efficacy of a lecture and a group discussion in changing housewives' opinions about food, demonstrated the importance of group discussions in abrogating old norms and thereby instituting change.[3] Hemphill in 1950 demonstrated the importance of certain factors, personality and otherwise, for leadership in a group.[4] The foregoing studies are included to illustrate the fact that until recently most investigators were content to prove that a particular factor correlated with some other variable.

In the social systems analyzed by the behavioral sciences, the possible number of variables is very large; and since the variables are overlaid or contaminated by interlocking effects, the determination of basic factors or essential elements presents many difficulties. Even though factor analysis has been in use for about sixty years, it has been

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[1]Edgar L. Morphet, Roe L. Johns, and Theodore L. Reller, Educational Administration (Englewood Cliffs: Prentice-Hall, Inc., 1959), p. 82.

[2]Solomon, op. cit., p. 9.

[3]Ibid., p. 9.

[4]Morphet, op. cit., p. 90.

employed only sparingly by sociologists.[1] Several obstacles have discouraged the application of factor analysis in identifying relationships that exist among the large number of variables that are used to describe a social system. One of the major problems is that gathering of many different kinds of quantitative data on even one social unit is very costly and laborious. The second practical limitation to the application of factor analysis involves the processing of a great amount of data beyond the original tabulation. Now, however, the availability of high-speed computers has eliminated the obstacle of computing the statistical analysis.

A review of the literature would not be complete without a reference to the contributions of Paul R. Mort to the application of factor analysis in identifying relationships that exist among the practices of schools as they contribute to an atmosphere that makes schools adaptable to change. When Mort was making financial surveys in a number of states in the 1920's and 30's, he found people raising questions quite unrelated to the empirical data or the logic of proposed plans.[2] Puzzled by these seemingly extraneous questions, he set out to find what points of reference correlated with the questions. This investigation led Mort into a

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[1]Christen T. Jonassen and Sherwood H. Peres, Interrelationships of Dimensions of Community Systems (Columbus: Ohio State University Press, 1960), p. 2.

[2]Donald H. Ross (ed.), Administration for Adaptability (New York: Metropolitan School Study Council, 1958), p. 19.

extensive research which has produced a variety of instruments to measure the adaptability of school systems and has inspired many other studies in the area of qualitative education.

Mort and Cornell, with support from the Council for Research in the Social Sciences of Columbia University, facilitated the development of an instrument, the publication of a monograph on a theory of approach to research in adaptability, and the application of these tools to a study of Pennsylvania schools in 1937.[1] The instrument developed for this study is often referred to as "The Lag Book" or the "Mort-Cornell Guide." The instrument was first published in 1937 and was extensively used in the Pennsylvania Study. The interest in these studies prompted the development of parallel lines of inquiry and the publication of a series of research reports associated with several communities in and around New York City, organized as the Metropolitan School Study Council.

Factor analysis has been slowly adopted by the educational researcher in areas that deal with large numbers of variables. The literature appears to indicate that by the late 1940's the factorial analysis technique of investigation was progressing past the stage of merely identifying relationships and that many researchers were seeking to discover

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[1]Paul R. Mort and Francis G. Cornell, A Guide for Self-Appraisal of School Systems (New York: Bureau of Publications, Teachers College, Columbia University, 1937).

the underlying unities which operate to produce the observed characteristics. The Metropolitan School Study Council appears to have been the major supporting organization of these early studies and Paul R. Mort was the guiding force that directed most of the early research as it applied to a more analytical analysis of public school systems.

Survey of Selected Recent Investigations

The seventeen selected references on factor analysis reported here were more specifically considered representative of investigations of this nature completed since 1950. Each one included the use of factor analysis, and they dealt with public school problems that included several variables.

In 1950 Eastmond made an analysis of the elementary-school staff characteristics related to the quality of education.[1] His investigation was a continuation of the work started by Buley and later extended by Woollatt. In 1947 Buley had made an extensive study of the identification of staff characteristics related to adaptability.[2] Buley did not compute coefficients of correlation, but he used a difference-of-means technique to screen out the measures. In 1948, Lorne Woollatt, then a research associate with the

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[1] Jefferson N. Eastmond, "An Analysis of Elementary-School Staff Characteristics Related to the Quality of Education" (unpublished Doctor's dissertation, Teachers College, Columbia University, 1954).

[2] Hilton C. Buley, "Personnel Characteristics and Staff Patterns Associated with the Quality of Education" (unpublished Doctor's dissertation, Teachers College, Columbia University, 1947).

Metropolitan School Study Council, subjected Buley's data to more rigorous statistical methods.[1] He computed correlation coefficients with adaptability for all the staff characteristics that had been singled out by Buley.

Eastmond sought to discover what the factors were that give rise to the statistically significant measures obtained for a series of school staffs. In essence Eastmond set out to use the tool of statistical factor analysis to see what this rather curious collection of probably reflective measures added up to. Using the same data Buley had analyzed, he statistically checked hypothetical clusters of characteristics of elementary school staffs in Metropolitan School Study Council systems.

Eastmond identified three significant factors or clusters of characteristics that seem to have a high relationship. The number one factor identified contributed more than all the other factors toward the total variance accounted for. The closest item to the center of this factor was average salary. The factor contained fourteen characteristics. The measurements in the number one factor seem to indicate that the underlying factor is one of broad interests, rich backgrounds, sophistication, curiosity, action, and maturity. The second factor contained eleven characteristics. Training seemed highly reflective of the core of this factor. The

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[1]Ross, op. cit., p. 464.

clustering of the measurement around the characteristic of staff having had more than two years training, logically leads one to regard this functional unity as some kind of professional factor. Factor three had only four measures that had considerable weightings. Some aspect of stability and security appears to be the core of this factor.

Eastmond did further research in the area of staff characteristics. Boyer and Ross have extended the research into areas of identifying trends in staff characteristics and the development of a guide for self-analysis of personnel relationships of school systems.

Frederic L. Ayer, in a doctorial study completed in 1952, made an analysis of certain community characteristics related to the quality of education.[1] He used data that had been gathered by the Metropolitan School Study Council in 1944-46. By centroid factor analysis Ayer sought a grouping of items into factors. Ayer sought the essence of meaning behind what he assumed to be, to a great extent, merely reflected measures of environmental forces that influence school quality.

Five factors accounting for 63 per cent of the total variance were extracted from the data which consisted of 22 characteristics. It was assumed that all major factors

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[1]Frederic L. Ayer, "An Analysis of Certain Community Characteristics Related to the Quality of Education" (microfilmed Doctor's dissertation, Teachers College, Columbia University, 1952).

contained in this group of variables had been extracted. In order to simplify the process of interpretation, all "factor loadings" of .20 or below were omitted from the listing of measures by factors.

Factor number one was identified by rotating the matrix to provide maximum loading of wealth on this factor. Only two clear population characteristics measures seem related to that factor of the total community setting of schools that is most directly measured by "wealth per pupil." These two characteristics were identified as per cent of population 50 and over and per cent of home ownership.

Factor number two was identified by rotating the matrix to provide maximum loading of per cent of business and professional workers. This factor contained most of the clearly identified population characteristics. Characteristics with the highest loadings were per cent eighth grade graduates, per cent business and professional workers, per cent college graduates, and per cent home ownership.

Factor number three was identified by rotating the matrix to reduce the loading for per cent of college graduates while making a good fit for the axes on the density and enrollment. The eight characteristics that clustered together on this factor seem to describe a condition of "urbanness." The three populations characteristics identified were per cent unskilled workers, per cent home ownership, and per cent eighth grade graduates.

Factor number four was identified by a rotation to minimize the "Time Scale" loadings. The "Time Scale" is a list of twenty-two educational provisions for which a school system being gauged is asked to indicate the date of introduction into its schools. By reference to a table, each of the twenty-two dates entered is given a weighted value. The three items that appeared to show some relationship to this factor were per cent foreign born, per cent college graduates, and per cent population 50 and over.

Factor number five was identified by a rotation that gave maximum loading to size of population. Only two population characteristics were identified in this factor; they were per cent home ownership and per cent foreign born. Ayer interpreted this factor to indicate that sparseness of population in a school district within a metropolitan area is a good thing for the adaptability of the local system.

Mort, Cornell, and Pierce have made additional contributions to the understanding of how community characteristics are related to the quality of education. Ross in his review of research from 1950 to 1958 states that very little additional research has been undertaken to extend the efforts of Mort, Cornell, and Ayer.[1] The literature seems to indicate that in the last ten years there has been a renewed awareness of how important the community is in its influence on the

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[1]Ross, op. cit., p. 248.

quality of education that is being provided in the public schools. It appears that as interest in the slum and ghetto schools continues to increase, further studies such as Ayer conducted will be forthcoming.

Mort in 1954, with assistance of Brickell and others, developed a conceptualization of causal flow from the environmental factors identified to practices measured in the classroom by "The Growing Edge."[1] This conceptualization was published in the Teachers College Record of January 1954, under the title "School and Community Relationships to School Quality." This organization of "panels" of influencing factors has become known as "The Simplex" and has provided a theoretical construction for further analysis. The Simplex was developed to study the fundamental interrelationships of the large constellation of factors that was presently representing the staff and the community. Mort was exploring the usefulness of the fact that forces acting on the school do not always act directly on the children. He thought that it was possible to group the factors identified as being related to school quality according to the remoteness of their effect upon the school. Some of these factors, such as the character of the school staff, one would have every right to expect to affect the operation of the school directly. If one thinks of the whole mass of factors affecting the school as

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[1] Ibid., p. 119.

making up a sphere in which forces flow from the outside toward the center--that center being school quality--and the sphere being made up of the central core surrounded by four concentric spheres, the characteristics of the school staff would be found in the layer nearest the core. In the outer sphere, influencing the schools through the spheres within, is the wealth of the community.

Mort, in following the line of thinking listed previously, classified the fourteen simple and complex status measures that had evolved through his status research according to their logical remoteness in four concentric spheres of influence. For convenience these spheres are represented by the four panels which were termed "individual school," "school system policy," "educational climate," and "community." This simplex of characteristics was drawn together through correlation and factor analytical studies, many of which were carried out by graduate students under the direction of Mort.[1]

Mort and Furno in 1960 authored a book that explained in detail how the Sequential Simplex Theory could be applied.[2] They believed that it provided a systematic method of

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[1]Don D. Bushnell and Dwight W. Allen, The Computer in American Education (New York: John Wiley and Sons, Inc., 1967), p. 193.

[2]Paul R. Mort and Orlando F. Furno, Theory and Synthesis of a Sequential Simplex (Teachers College, Columbia University: Institute of Administrative Research, 1960).

analyzing the relation to school quality of any influence which can be successfully subjected to measurement in terms of its impact on the various school systems in a group for which the control data is available. The method is presumably applicable to the evaluation in terms of effects on school quality of legal provisions, state regulations, local systems of administration, and systems of supervision. It appears to be applicable, also, to the evaluation of policies and practices within and beyond the community influencing community wealth, community posture toward school support, expenditure policy, staff recruitment, staff development, and methods of classroom procedure.

Mort and Furno believe that the simplex can bring into the open the various constellations of latent forces operating in any community for good or ill and can show how they run with, or counter to, the factor under study. It appears that the simplex seeks to marshall facts about the interplay of a factor under study with the other key facets of the system of forces operating on the schools. Thus, a more enlightened concept of the operation of the factor under study can be achieved, and a more effective practical handling of the factor can be evolved.

The Sequential Simplex is a method designed to equalize out of a group of communities the major factors of community and school which, together, account for the major differences in community potential to produce education. The

authors of the simplex believe that if factors are allowed to run free, they would overwhelm the differences in effects of variation of any one legal arrangement, administrative policy, or operational plan. Mort and Furno state that administrative research cannot be pursued profitably by the method of studying a single force with other forces allowed to run free. They believe that the relatively low productiveness of many studies seeking to evaluate administrative practices over the years can be traced to the fact that all factors were not equalized.

Kowitz and Sayres in 1959 made a statistical study of the data from selected school districts in New York State.[1] They analyzed the relationships among secondary school size, cost, and educational opportunity. Their stated purpose was to clarify those relationships and to identify certain size intervals which tend to give district taxpayers, in at least some respects, the most for their money. The authors first examined cost-size relationships and relationships between those two variables, on the one hand, and various indices of educational opportunity on the other. Their efforts to identify relationships existing among the indices of educational opportunity is of value to this study. The inter-correlations among indices of educational opportunity, cost and size were

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[1]Gerald T. Kowitz and William C. Sayres, Size, Cost, and Educational Opportunity in Secondary Schools (New York: The University of the State of New York, 1959).

computed and presented. Using the cluster analysis technique, the correlations of greatest magnitude in each column were identified. Beginning with the highest correlations in the correlation matrix, the relations with the other components were diagrammed. The diagrams presented a picture of the maximum correlations present. This did not mean that there were no other relationships among the indices or that the other correlations were insignificant, but rather that the clusters represent patterns of maximum correlation among the contained indices with a minimum of correlation between the clusters. It was interesting to note that two and only two distinct clusters emerged. Kowitz and Sayres viewed these two clusters as the dimensions, or factors, of the indices of educational opportunity. The largest and strongest cluster was dominated by the size of the school while the other cluster was dominated by the cost of operation. The analysis of this part of their study seemed to indicate that various indices of educational opportunity not only tend to show significant relationships to cost and size, but among themselves.

Schultz, in 1959, completed a factor analysis of academic achievement and community characteristics.[1] This study developed out of the investigations of the social-cultural characteristics and school achievement of a

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[1]Richard E. Schultz, "A Factor Analysis of Academic Achievement and Community Characteristics," Educational and Psychological Measurement, XX (No. 3, 1960), p. 513.

community. Interest had been centered in the power of the community characteristics for predicting achievement. The studies had typically obtained low zero-order correlation coefficients with the criterion measure which, when pooled, resulted in multiple correlations ranging from the high .20's to the low .60's.

Schutz utilized factor analytic methods in an attempt to achieve a better understanding of the functional unities involved when both academic achievement and social-cultural measures are considered as descriptive characteristics of a local community. Twenty variables were included in the study. The variables included indices of the educational background of adults in the community, the labor situation in the community, the racial and national origin of the inhabitants, financial income, and academic achievement in the community.

Five factors were extracted using Thurstone's complete centroid method. Analytic orthogonal rotations were carried out using Kaiser's Varimax method. No further rotation adjustments were made. The analysis of 20 sociological, economic, and educational achievement measures based on 84 local communities yielded five orthogonal factors. They were characterized as: (1) Urban-Financial, (2) Intellectual Climate, (3) Economic Stability, (4) Academic Achievement, and (5) Low Socio-Economic Status. With the exception of Factor 5, each factor parallels a previously isolated factor

at the state level. The study thus provided evidence for the existence of these factors at another geographical and political level.

Cline, Richards, and Needham in 1964 completed a study, under the direction of the Cooperative Research Branch of the U.S. Office of Education, in which they explored the factor structure of various indices of achievement in high school sciences and also self and teacher ratings of characteristics which presumably are related to such achievement.[1] This study was inspired by educational researchers who believed that it is highly important that potential scientists be identified as early as possible, and certainly no later than the senior year in high school.

The sample consisted of 396 students at two high schools in a suburban Salt Lake City school district. The subjects were selected on the basis of having completed at least two science courses, and they were seniors at the time of the data collection. The two sexes were treated as separate groups. For each group, all variables were intercorrelated and factor analyzed, using the factor technique based on eigenvalue analysis, and rotated to a final solution using the varimax rotation procedure. All factors having an eigenvalue greater than one were retained and rotated, and unity was placed in the diagonal cells of the correlation.

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[1]Victor B. Cline, James M. Richards, Jr., and Walter E. Needham, "Factor Analysis of Self Ratings, Teacher Ratings, and Indices of Achievement in High School Science," Journal of Educational Research, September, 1964, p. 10.

The study included an analysis of fifty-one items. The means, standard deviations, and communalities of the variables for both sexes were computed. The intercorrelations, final rotated factors, eigenvalues, and cumulative variance accounted for after extraction of each factor for both females and males were presented in a table. The results revealed considerable complexity of factorial structure, a finding in contrast with the results of earlier research.

For female high-school students, nine factors relating to science achievement were found. The factors were identified as: Teacher Rating Halo, Self Rating Halo, Involvement with Science, Athletic Ability, Academic Achievement in Science, Practical Mindedness, Social Dominance, Academic Motivation, and Self Confidence.

For male high-school students, eight factors relating to science achievement were found. The factors were identified as: Teacher Rating Halo, Self Rating Halo, Sociability, Academic Achievement in Science, Teacher Stereotype of the Scientist Role, Involvement with Science, Athletic Ability, and Self Rated Creativity.

In the opinion of the authors this study demonstrated that meaningful factors can be extracted from various tests and measures of high school science achievement, and while there is considerable overlap in the factors extracted for the male and female sexes separately, the differences which also appear are most important. It appears that one of the

major outcomes of the study was the identification of characteristics that could be used to help identify students with high science ability at a very early age.

Ohnmacht, in 1965, completed a study on factor analysis of ranked educational objectives as an approach to value orientation.[1] The stated purpose of the study was two-fold: (1) to investigate utility of factor analysis of ranked educational objectives for the purpose of identifying value orientation in terms of the relative importance attributed to educational objectives as contained in a selected list; and (2) to identify the value orientation within the context of a sample of objectives of a College of Education faculty. The author used the ten classifications of general educational objectives developed by the Commission on the Relation of School and College of the Progressive Education Association. Twenty professors associated with the College of Education at the University of Maine were asked to perform the task of rating the objectives in the rank of importance.

After obtaining the rankings from the 20 professors, the author checked to see whether the rankings were random across the respondents, or whether there was a systematic agreement among groups of professors. To answer the above question, an obverse factor analysis was undertaken using

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[1]Fred W. Ohnmacht, "Factor Analysis of Ranked Educational Objectives: An Approach to Value Orientation," Educational and Psychological Measurement, XXV (No. 2, 1965), p. 437.

each professor as a variable. The matrix of intercorrelations containing the relationships of each person's rankings with every other set was computed. The matrix then represented the intercorrelations among individuals rather than the relationships among a set of tests.

The matrix was factored, with unities in the diagonal, using the principal axes method. All of the principal components whose latent root exceeded one were retained for the purpose of rotation. Using the above procedure the author extracted six factors. The six factors representing systematic agreement among various sub-groups of the sample were tentatively identified as: (1) process, (2) self-sufficiency, (3) content, (4) controlled personal-social adjustment, (5) reflective awareness, and (6) adjustment. Ohnmacht believed the results of his study proved that factor analysis of ranked educational objectives had been demonstrated to be an effective method for differentiating among a group of individuals in terms of the relative importance they attribute to the elements of a set of objectives. The author further believed the method seemed to have utility with any set of objectives, of reasonable length, as a heuristic prelude to the posing of hypothesis with regard to interpersonal perception, interaction patterns among groups, teacher behavior in the classroom, and similar investigations.

Hendrix in 1965 completed a study of the relationship between personnel policies relating to college faculty rank,

tenure, and evaluation and student perceptions of the college environment.[1] The central hypothesis of this study was that the presence or absence of these administrative policies and procedures is related to perceptions of the college environment held by students in the colleges. The independent variables consisted of the presence or absence of administrative personnel policies and procedures relating to academic rank, tenure, and the formal evaluation of faculty members. The dependent variables were various measures obtained from the College Characteristics Index.

The design of the Hendrix study was conceptualized as a 2 X 2 X 2 factorial. The Texas public junior college student population was selected as the "subject" group within which the experimental situations were identified according to the presence or absence of the independent variables in the colleges. Through an instrument submitted to the presidents of the twenty-nine Texas public junior colleges and through subsequent correspondence and interviews, the personnel policies and procedures of each college were determined. Results from the College Characteristics Index were obtained from 254 full-time students in regular academic programs. In addition to the original thirty scale scores, three other sets of variables were computed for each respondent. This

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[1]Vernon L. Hendrix, "Academic Personnel Policies and Student Environmental Perceptions," Educational Administrative Quarterly, Winter, 1965, p. 32.

computation was done to find the variables that lent themselves best to analysis and interpretation. The first set of such variables consisted of factor scores for each respondent resulting from the factor analysis of the original thirty scale scores. The second set was obtained by combining the thirty scales into eleven clusters. The third set of variables consisted of factor scores for each respondent on the two factors resulting from a factor analysis of the eleven clusters.

The factor analysis was produced by a computer program using the principal axes solution, extraction ceasing if an eigenvalue equal to or less than 1.0 was obtained with varimax rotation. The factor analysis of the thirty College Characteristics Index resulted in seven factors. The variables which define each factor and their loadings are as follows: (1) Humanism .77, (2) Adaptiveness and Pragmatism .66, (3) Harmavoidance -.82, (4) Supplication .0, (5) Play .83, (6) Abasement -.74, and (7) Deference .83.

Hendrix believed that the basic hypothesis of his study was tenable, as significant relationships are indicated between independent and dependent variables. Direct causality could not be assumed since a multitude of factors influences the environment in any particular situation. The author believed that the results of his study indicated sociometric analysis as a promising focus for further research. It was pointed out that from the standpoint of the practicing

administrator, this study perhaps emphasizes the need for a systems approach to the administration of educational institutions.

Gulo, in 1968, completed a study that analyzed data about teacher characteristics and student attitudes toward teachers.[1] An attempt was made to investigate rural students' attitudes toward teachers by employing a forty-item rating scale. A randomized sample of eight school districts was selected in a predominantly rural state. All students in grades 7-12 in these eight schools took a battery of tests including a modified version of the semantic differential. The instrument had forty scales devoted to the concept "Your Teacher." The study included responses from 820 students.

Means and standard deviations were computed, followed by formation of a 40 by 40 correlation matrix. The larger matrix was reduced to a 27 by 27 correlation matrix because the available program could only handle 27 variables. The 27 by 27 correlation matrix was factor analyzed, using the principal components method, and resulting factor matrix was rotated, using Kaiser's varimax procedure.

A major hypothesis of the investigation was that varying attitudes accompanied different grades. Seven of the forty original "Your Teacher" scales seem to demonstrate a

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[1]E. Vaughn Gulo, "Rural Students' Attitudes Toward Their Teachers," Journal of Educational Research, (October, 1968), p. 87.

pattern of attitudinal change by grade. In most cases the means progress in the direction of the more unfavorable response and show an increase in the unfavorableness of the ratings from grade 7 to 12.

The second part of the study was a factor analysis of the scores of the entire population. Factor I appears to have the attributes of a general evaluative factor. It accounts for 39.44 percent of the total variance and is the largest factor. Factor II appears to be a Teacher Success factor because the scales reveal teacher activities which make for teaching success or failure. Factor II accounts for 5.17 percent of the total variance. Gulo had difficulty naming Factor III because it was composed of what appeared to be two separate components. Factor III was in part made up of personality variables such as "responsible," "adjusted," "normal," and in part made up of scales having to do with how the teacher relates to students, e.g., "thoughtful," "easy to get along with," and "appreciative attitude to students." It was tentatively called a teacher-adjustment factor.

One of the prominent conclusions of Gulo's study was the strong positive endorsement of the teacher concept. The second most prominent conclusion was drawn from the factor analysis of all data which revealed three factors. They reflected perceptions of the teacher as primarily viewed, as well as scrutiny on the part of the subjects.

Horn, in 1967, published an article that discussed subjectivity in factor analysis.[1] The basic question asked in the study was: What confidence can we have in a factorial solution which is arrived at by means of a subjective rotational procedure? The problem was one of determining the extent to which meaningless variables can be found to yield up a meaningful factorial solution when such procedures are used.

Seventy-four random variables, each based upon N of 300 and drawn from a normally-distributed population of real numbers, were separately generated. The intercorrelations for the 74 variables were obtained and the resulting matrix was initially factored by a principal axes procedure. The number of factors was estimated at 21 and factoring proceeded iteratively to determine communalities such that all one calculation differed by less than .01 from corresponding communalities obtained on the immediately following calculation.

The study aimed to demonstrate that by use of subjective rotational procedures, random, completely nonsensical variables could be made to define what seemed to be meaningful factors. Seventy-four random variables for an N of 300 were generated, arbitrarily named, intercorrelated, factored

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[1] John L. Horn, "On Subjectivity in Factor Analysis," Educational and Psychological Measurement, XXVII (No. 4, 1967), p. 811.

and rotated into a best approximation to an hypothesis factor matrix. The resulting factors were found to be quite interpretable and to have high hyperplane counts, although communalities and factor loadings were low.

Kerlinger, in 1967, reported the results of his study on the factor structure and content of perceptions of desirable characteristics of teachers.[1] The basic questions asked in the study are:

> 1. What factor or factors underlie perceptions of the desirable traits of teachers, and what is the nature of the factor structure of such perceptions?
>
> 2. Are the factor structures behind perceptions of desirable traits of teachers and the factor arrays associated with the factor structures invariant over different samples?

The first question implies the number of factors, the structure of the factor space, the content of the factors, and the relations among the factors. The study used 90 items selected from a pool of 350 to 400 traits originally culled from the Allport-Odbert list of some 18,000 traits on the basis of their relevance to the teaching function. The items were administered to five samples, each consisting of teachers or graduate students of education or both. The data collected were analyzed by first computing an intercorrelation matrix and then factor analyzed by the principal axes

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[1]Fred N. Kerlinger, "The Factor Structure and Content of Perceptions of Desirable Characteristics of Teachers," Educational and Psychological Measurement, XVII (No. 4, 1967), p. 643.

method. The analysis of the data items produced three clear factor arrays. Four psychologists of recognized competence in the study of teacher characteristics were asked to judge the arrays. Although different words were used, the judgements in essence agreed with each other: "Person-Oriented," "Affective Merit," "Humane," and "Positive Social Reinforcement" were the expressions used to describe Factor A. The Factor was labeled "Positive Person Orientation." The judges' categorizations of Factor B were: "Responsibility-Orientation," Managerial Merit," "Systematic-Orderly," and "Organization for Task Accomplishment." The factor is named "Systematic Task Organization." Factor C was called by the judges "Functional Flexibility." It included such items as: "Divergent Thinking," "Motivational Merit," "Creative-Surgent," and "Freedom from Functional Fixity."

Kerlinger, in his conclusions, states that his study tentatively identified three principal factors underlying perceptions of desirable traits of teachers. He believes that to tell what an effective teacher is like requires, for an understandable answer, knowledge of the judges basic educational orientation and knowledge of the underlying criteria he is using in making the judgements.

Dziuban and Elliott, in 1968, completed a study in which they analyzed urban disadvantaged children's interests

by means of factor analysis.[1] One aspect of the study was a survey of students' interests as measured by the "What I Like To Do" inventory. The published norms, developed on 3,803 urban and rural pupils, represented nine geographic regions in the United States. The study by Dziuban and Elliott investigated performance of educationally disadvantaged students to determine if they responded similarly to the published norms on the eight scales: (1) art, (2) music, (3) social studies, (4) active play, (5) quiet play, (6) manual arts, (7) home arts, and (8) science.

The inventory was administered by the authors to 223 students in grades four through seven in schools in disadvantaged areas during November, 1967. The means of the disadvantaged students were compared with the published norms and their scale scores factor analyzed. Unity was utilized in the diagonals of the correlation matrix. The analysis, using the BMD03M Factor Analysis computer program, yielded eight factors which were rotated through six iterative cycles.

The results were significant in that, while the disadvantaged students received lower scores, the manifest interests were in consonance with the national norms. In the case of each factor, one of the inventory's scale scores emerged as contributing decisively more to that factor than

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[1]Charles D. Dziuban and Jess P. Elliott, "A Factor Analysis of Urban Disadvantaged Children's Interests," Educational Leadership, (November, 1968), p. 161.

any other scale score. The authors concluded that the instrument does adequately sample interest levels of disadvantaged children in grades four through seven. It was further concluded that while there is a difference in the level of response on each scale, there is no significant discrepancy in the interaction of interests of disadvavtaged pupils and those of the norm group.

Walberg, in 1967, completed a study in which he attempted to identify the dimensions in which prospective teachers conceive themselves in the role of teacher.[1] The study was based on a sample of 1,009 women enrolled in a teacher training program at Illinois Teachers College in Chicago who responded to the Tatso Questionnaire in large lecture sessions. The 26 scale items included in this study were the 7-point Semantic Differential format. The responses to the 26 scale items by the 1,009 women were intercorrelated and the resulting matrix was subjected to a principal component's factor analysis. The author identified five factors, all of which appeared to be interpretable. Eighteen of the 26 scale had loadings of .45 or higher on one of the rotated factors. The first factor accounts for about 32 percent of the total variance among the 18 scale items and combines what appears to be two clusters of meaning which are labeled

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[1]Herbert J. Walberg, "The Structure of Self-Concept in Prospective Teachers," Journal of Educational Research, (October, 1967).

"Neatness" and "Brightness." The second factor accounts for 31 percent of the variance and also appears to have two meanings that were labeled "Stability" and "Goodness." Walberg pointed out the fact that women who rate themselves clear, sure, and strong also rate themselves good, happy, and familiar. When the ratings for the two aspects of the first two factors were totaled and correlated, the strength of the associations between the separate clusters became even more apparent as the correlations between neatness and brightness and between stability and goodness were .652 and .848. The third, fourth, and fifth factors accounted respectively for 17, 12, and 7 percent of the common variance.

Walberg concluded his study by suggesting that student teachers do not see themselves in the same dimensions that pupils see teachers, nor do they see themselves in the same dimensions as they see school teachers in general. Education students first think about school teachers in terms of their general goodness and second in terms of the various forms of rigidity. When student teachers rate themselves in the role of teachers, they invoke the pupil-centered dimensions of empathy and competence, but mingled with these factors are the overtones of emotional reserve and intellectual caution found in the conventional stereotype of the teacher.

Randall, in 1967, used the factor analysis approach in an attempt to describe effective administrative

behavior.[1] The author investigated relationships among the following areas: Problem-attack behavior of junior high-school principals as described by the principals' teaching staffs, as indicated by principals' responses to simulated problems, and as rated by central staff groups. The instrument used to obtain behavior-descriptions of the principals from teachers was the Problem-Attack Inventory. A second method of studying behavior of the principals was based on having a principal report his own behavior in terms of responses to simulated-problem materials.

The data was subjected to factor analysis and revealed four factors. The factor analysis was accomplished by means of a computer program which extracted a matrix of principal axes factor loadings from an item intercorrelation matrix and carried out a varimax rotation of the principal axes to yield factors with eigenvalues greater than unity. Factor I was characterized by serious, definitive actions and a sensitivity to problem-situations. Factor II was characterized by actions focused on problems primarily involving parents, curriculum, and teachers. Factor III was characterized by behavior of a clerical nature, a lack of awareness of problem-situations, and an avoidance of problems that involve teachers. Factor IV was characterized

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[1]Robert S. Randall, "Problem-Attack Behavior and Effectiveness of Selected Junior High School Principals in Texas," Journal of Educational Research, (December, 1967), p. 169.

by an avoidance of decision-making of problems involving students.

The analysis of responses revealed that the principals did respond differently to each conflict, however, no pattern could be determined that related to the other data. Randall concluded that in general, correlations between effectiveness ratings and the four factors of problem-attack behavior were not statistically significant.

Brown, in 1967, completed an analytical study of reactions to leadership.[1] The conceptual basis for the study rests chiefly in Stogdill's theory of role differentiation and group achievement, which suggests such factors as tolerance of uncertainty, tolerance of member freedom of action, integration of the group, reconciliation of conflicting demands, predictive accuracy, and persuasiveness as significant variables in the leadership phenomenon. Four other behaviors indicated by earlier empirical research-role assumption, production emphasis, orientation toward superiors, and representation of group interests--were also included in the study. The twelve scales mentioned above are included in Stogdill's Leader Behavior Description Questionnaire Form XII.

The questionnaire was administered to 1,551 teachers in 170 schools in Alberta, Canada. The data were secured only from the teachers and not from any principals.

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[1]Alan F. Brown, "Reactions to Leadership," Educational Administration Quarterly, (Winter, 1967), p. 62.

From an intercorrelation matrix, a factor analysis using a principal axes factor solution was performed. The solution called for the extraction of six factors of which only two were found to be significant or had eigenvalues greater than unity. In order to separate the factors more clearly, a two-factor varimax rotation was performed. The two factors together accounted for 76 percent of the total test variance.

Brown emphasized that no attempt was made to precondition the factor solution, nor was the rotation directed to conform to any particular leadership theory. The variables found in Factor I were identified as clearly defining perceived leader behavior that responds to the needs of the school system. It was an institutional factor, which the author labeled as System-Oriented Leadership. The variables found in Factor I are Production Emphasis, Initiating Structure, Representation, Role Assumption, Persuasion, and Superior Orientation. The variables that make up Factor II are Tolerance of Freedom, Tolerance of Uncertainty, Consideration, Demand Reconciliation, Integration, and Predictive Accuracy. Factor II was identified as a measure of perceived behavior that responds to the needs of staff members. It is an interpersonal factor and was labeled as Person-Oriented Leadership.

In Brown's study, administrative outputs were interpreted in terms of (1) teacher satisfaction, (2) confidence

in the principal, and (3) school performance estimate. By using multiple linear-regression analysis, each output criterion was tested against leadership variables in terms of (1) each of the 12 standardized subscale scores, and (2) system and person factor scores. The results clearly indicated that teacher satisfaction and confidence in the principal are sensitive to the perceived leadership of the school, but teachers' estimate of the school's performance is not. It was further evident that output criteria are most sensitive to variations in those leadership subscales that cluster about the middle of the system-person continuum. In general, these refer to activities that respond to the need for an effective transaction between the institution and the person.

Teacher preference between the two general factors was uncertain. School staffs appear to express reactions of high satisfaction and strong confidence in the principal, who in leadership situations are strong on either factor. Weakness on both factors or weakness on one without corresponding strength on the other is thought to generate reactions of low teacher satisfaction and low estimates of principal effectiveness.

The statistical and conceptual structure of leadership developed by Brown has quite recently received compelling support from a study conducted independently by Keith Punch at Ontario Institute for Studies in Education, whose

factor analysis of the Leader Behavior Description Questionnaire Form XII data from 48 Ontario elementary schools turned up the same two factors with substantially the same subscale loadings on each factor as did the analysis of the 170 Alberta schools included in the Brown study.[1]

Farquhar, in 1968, reported the findings of a research study that applied factor analysis to selected data to determine the effects of the existence of Catholic schools upon the operations of public schools, as perceived by public school superintendents and principals in "Medium-sized" U.S. cities.[2] An attempt to approach an understanding is represented by a study which was conducted during 1966 by two staff members of the Midwest Administration Center at the University of Chicago. This research explored certain aspects of the societal effects of nonpublic schools in selected cities and the effects of the existence of nonpublic schools upon the operation of public schools in those cities. For the purposes of their analysis the authors defined nonpublic schools as being classified into two structurally-oriented categories: (1) systemic schools as those which are members of a national religiously supported system of schools, and (2) independent schools as those which operate independently

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[1] Ibid., p. 73.

[2] Robin H. Farquhar, "The Public School Administrator Views The Catholic School--Or Does He?" Educational Administration Quarterly, (Autumn, 1968), p. 2.

of any formal educational system. While the effects on public schools of both of these major types of nonpublic schools were investigated by Farquhar, his report was limited to a report of findings related to systemic school effects.

A comprehensive list of postulated effects was developed primarily through a rather thorough review of the relevant literature, including research reports, standard tests, judicial dicta, and supplemented by discussions with scholars and administrators knowledgeable in the problem area. The result was a list of 23 postulated effects which the researcher gave descriptive names and arranged alphabetically by name on an opinionnaire.

A sample of public school administrators to whom the final version of the opinionnaire was administered was limited to those in cities with populations ranging from 100,000 to 200,000 according to the 1960 United States census, primarily because it was believed that these cities were large enough to exhibit many of the problematic characteristics of urbanization yet small enough that their public school administrators were likely to be aware of nonpublic school effects as they operated throughout the cities. A total of 218 public school administrators in 41 cities constituted the participants in the study.

The opinionnaire data were subjected to a variety of statistical analyses. The means were computed for scores on each of the postulated effects, these effect scores were

factor analyzed utilizing the principal component's model. Varimax convergence was achieved after 11 rotations and 6 common independent factors emerged which accounted for 57.5 percent of the total effect-score variance. Scores on each of these factors were then computed for each respondent, and these factor scores were related to a variety of personal and situational variables by means of t-test, f-test, and chi-square tests applied at the .05 level of statistical confidence.

The central perceptual tendencies reflected in the six factors which emerged from the principal components analysis were determined by examining those effects which loaded at a high or moderate level on each factor. Farquhar named and defined operationally the six factors as follows:

> Valued-Alternative Factor (Associative, Color-Separation, Dumping, and Escape)--The quality of systemic schools is sufficiently high that they attract desirable pupils and staff members, and both programs and personnel in the public schools tend, as a consequence, to be of lower quality than they might be if systemic schools did not exist.
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> Community-Dissension Factor (Divisive, Inhibition, and Pauper-School)--Systemic schools create cleavages between public and non-public school proponents, with the result that programs in and support for the public schools suffer.
>
> Special-Interests Factors (Competitive, Escape-Value, and Pilot-School)--In catering to clientele who are dissatisfied with the public schools, systemic schools relieve the public schools of some problems and contribute significantly to educational advances, but they also create problems for the public schools in terms of program development.

Inferior-Quality Factor (Depressant, Federal, Foil, and Inferiority)--The educational programs provided by systemic schools are inferior, partly for financial reasons, to those provided by the public schools.

Mixed-Blessing Factor (Relief)--While substantial systemic school enrollments afford the public schools some financial relief, dysfunctional outcomes also result, particularly in the areas of financial and moral support and pupil personnel.

Pupil-Enrichment Factor (Superiority and Supplementary)--Systemic schools have developed programs which have enriched the education of the public school students who were enrolled in them.[1]

While the interpretation of factors was relatively simple statistically, substantively some of them appear rather complex. One apparent reason for this is that although participants were asked to respond in terms of the effects' perceived impacts upon public school operation, their responses appeared to cluster more in relation to the effects' perceived sources in the Catholic schools. The author believes that the participants' views of what Catholic schools are like, rather than their perceptions of how public school operations are influenced, may have been primarily reflected in their responses.

Shoemaker, in 1967, at a national meeting of School Business Officials remarked that administrators must make our systems serve us and not we the system.[2] It is important

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[1] Ibid., p. 9.

[2] Paul Shoemaker, "Observations on Integrated Data Processing As A Management Tool," Annual Volume of Proceedings, Addresses, and Research Papers of the National Association of School Business Officials, 1967, p. 325.

that we determine what is essential to know and distinguish and disengage it from what is merely useful or nice to know. He believes we must use considerable imagination in devising means to obtain all the necessary, relevant and timely information economically throughout the district's total operations.

Ramseyer in his writings on the computer and educational administration states that many of the controversial situations in our large institutions occur because of the tremendous increase in the number of variables and the amount of data that must be dealt with.[1] The greatest single factor in the changing role of an administrator in a computerized system appears to be the manner in which he relates himself and his staff to the beneficial and productive aspects of the computer. The unique achievement of the computer is that it enables the administrator to clear away some of the uncertainty that surrounds him, to subtract some of the variables from the circumstances that fret him and change ill-structured and inherently insoluble problems into well-structured and soluble ones. Ramseyer believes that administrators will have to rely less on hunches and intuition and more on analysis.

Hoy in his writings in educational administration mentions a new approach in the sociology of complex

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[1]John A. Ramseyer, Computer Concepts and Educational Administration (University of Iowa: Iowa Educational Information Center, 1966), p. 135.

organizations.[1] There appears to be an emerging interest in the study of the relationship between the organization and its external environment. The analysis of organizations and their environments, with emphasis on the interlock of the two, provides an interesting conceptual reference for beginning to study and analyze relationships between the organization and external social units, an area of organizational study that has been neglected for most kinds of organizations, including the public schools.

In terms of attacking the organizational information problem, Diebold believes that it is no longer necessary to think in terms of individual machines; instead, for the first time, it is practical to look at an entire production or information-handling process as an integrated system and not as a series of individual steps.[2] On the one hand are the automatic producers of material objects and, on the other hand, the sophisticated analyzers and interpreters of complex data. In the middle zone are the mixed systems in which computers control complicated processes on the basis of interpretations that they make of data automatically fed to them about the environment.

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[1]Wayne K. Hoy, "Essay Review," Educational Administration Quarterly, (Autumn, 1968), p. 92.

[2]Donald N. Michael, Cybernation: The Silent Conquest (Santa Barbara: Center for the Study of Democratic Institutions, 1962), p. 5.

The theory and practice of cybernetics underlie all systematic design and application of automation and computers.[1] Cybernated systems perform with a precision and a rapidity unmatched in humans. Dechert believes that cybernetics today possesses great relevance for the social scientist.[2] It has begun to provide conceptual tools of the greatest importance for the analysis of complex systems and their interrelations. It establishes a focus on the critical importance of control and communications relations and on individual and institutional modes of perception and values.

Cybernated systems can provide more potent information than merely rapidly produced summaries and tabulations of data. They can quickly provide information on relations among data and also provide information in the form of extrapolations of the consequences of specific strategies and the probabilities that these consequences will arise.[3] The United States Government has introduced cybernated systems in many areas of management. Business and industry appear to be introducing cybernated systems into their organizations as quickly as they can adapt to the new technology. The importance of cybernated systems to the social scientist in

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[1] Ibid., p. 6.

[2] Charles R. Dechert, The Social Impact of Cybernetics (Notre Dame: University of Notre Dame Press, 1966), p. 34.

[3] Michael, op. cit., p. 34.

his search to better understand our social organizations appears to be of increasing value.

Summary

Factor analysis as developed by the behavioral scientist has made inroads into the repertoire of used methods by the social scientists in their attempt to identify relationships that exist in our social organizations. It appears that today's educational researcher is not content to prove that a relationship between variables exists but wants to know the strength of the relation, the precise quantitative form, and even more fundamentally, the precise conceptualization of the "factors" involved.

Automation and the development of efficient computers have placed the handling of organizational information in a new perspective. Cybernated systems that make it possible to analyze very large amounts of data by means of large-scale input-output matrices, network analysis, factor analysis, simulation, etc., are being used in increasing numbers by business and industry.

The literature seems to indicate that the administrator of tomorrow must be able to effectively capitalize on the beneficial and productive aspects of the computer. The educational administrator's success will depend on his ability to derive from the available information the relationships that exist among the data with which he is called upon to make decisions.

CHAPTER III

DESIGN AND METHODOLOGY

Introduction

This study was designed to ascertain if there is a high degree of correlation among the educational data which administrators are reporting to the State Department of Education. One of the major purposes of this study was to identify areas in which the dimensions of educational data could be tentatively identified in terms of shared variance. This study was also designed to explore the possibilities of factor analysis in the reduction of educational data that educators must deal with by identifying not only the data that show a high correlation but also the strength of the relation. A basic motivation of this study was the belief that a more concise understanding of the relationships that exist among the data being used by the local school districts in reporting to the State Department of Education might provide a more accurate assessment of the total educational program.

This chapter will identify the characteristics of the schools included in the study, the nature of the data selected for analysis, and the method used in this analysis.

Public School Systems

The school system population of this study included all the 170 Oklahoma school systems having an average daily attendance of 500 or higher, and offering programs through the 12th grade for the school year 1967-68. School systems ranged in average daily attendance from a low of 500 to a high of 66,978. This provided a sample which was manageable in that data could be collected within reasonable limits of time and expense, and was sufficiently large to provide data broadly representative of those encountered in the operation of the schools of the state.

Data To Be Analyzed

The purpose of this study was to determine if there is a high degree of correlation existing among the educational data which administrators are reporting to the State Department of Education. The data reported to the state educational agency by local school districts relates to a wide variety of school activities.

The data selected for analysis in this study were taken from the following reports: the (1) Annual School District Expenditures Report, (2) Annual Personnel Report, (3) Annual Statistical Report, (4) Estimate of Needs, (5) Application for Accrediting, and (6) District Transportation Reports, as filed with the State Department of Education for the 1967-68 school year. The information on these reports

was selected for further analysis because the data represents a pool of information which educators use most often in describing public schools and because it has been identified by officials at the state level as being of sufficient importance that most of it is recorded on computer tape. Also, the information included in the above-mentioned reports was selected because the information appeared to be used extensively in the planning of new activities and in the evaluation of existing programs.

Much of the data selected was recorded on computer tape at the Statistical Services Section of the Oklahoma State Department of Education. That information which was not recorded on computer tape was secured from the various reports filed by the individual school districts.

Lists of the items selected from each of the six reports indicated above are given in Figures 1 through 4. A description of each item follows each tabular presentation.

Data Derived From School District Expenditure Reports

Data derived from school districts expenditure reports to the State Department of Education are identified in Figure 1. The total of each item selected was reduced to a manageable size by dividing the total average daily attendance in grades one through twelve into the total expenditure reported for each item. This calculation was performed for each of the 170 school districts included in the study.

FIGURE 1

DATA DERIVED FROM SCHOOL DISTRICT EXPENDITURE REPORTS

A. General Fund Expenditures

1. Expenditures for Administrative Salaries per ADA
2. Expenditures for Administrative Services per ADA
3. Expenditures for Instructional Salaries per ADA
4. Expenditures for Library and Audio-Visual Materials per ADA
5. Expenditures for Teaching Supplies per ADA
6. Expenditures for Instructional Services per ADA
7. Expenditures for Attendance Services per ADA
8. Expenditures for Health Services per ADA
9. Expenditures for Pupil Transportation Services per ADA
10. Expenditures for Operation of Plant per ADA
11. Expenditures for Maintenance of Plant per ADA
12. Expenditures for Fixed Charges per ADA
13. Expenditures for Student Body Activities per ADA
14. Expenditures for Community Services per ADA
15. Expenditures for Capitol Outlay per ADA
16. Expenditures for General Fund per ADA

B. Building Fund Expenditures

17. Expenditures for Erection of New Building per ADA
18. Expenditures for Remodeling and Repair per ADA
19. Expenditures for Purchase of Furniture per ADA

C. Sinking Fund Expenditures

20. Total Debt Service Expenditures from Sinking Fund per ADA

The following descriptions of the items included in Figure 1 are summaries of the state guidelines used by all public school administrators in Oklahoma when reporting

school district expenditures.[1]

Expenditures for administrative salaries include all costs for the supervision of those activities which have as their purpose the general regulation, direction, and control of the affairs of the school district that are system wide and not confined to one school, subject, or narrow phase of school activity. Expenditures are prorated when administrators also teach in proportion to the time spent in teaching.

Expenditures for administrative services include salaries and other expenses for administration. Administrative services consist of those activities which have as their purpose the general regulation, direction, and control of the affairs of the school district that are system wide.

Instructional salaries include the full-time salaries and prorated portions of salaries of principals, assistant principals and other personnel performing the functions of a principal. Salaries of consultants, supervisors, teachers, special education teachers, substitute teachers, part-time teachers, librarians, audiovisual personnel, guidance personnel, psychological personnel, television instructional personnel, secretaries, secretarial and clerical assistants, and teacher assistants or aides are all included in this expenditure account.

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[1]State Board of Education, Finance Division. The School Finance, Transportation and Activity Fund Laws Including the State Board of Education Regulations for Administration and Handbook on Budgeting and Business Management. Oklahoma City: the Board, 1967.

Expenditures for library and audiovisual materials include the cost of purchasing library books, periodicals and newspapers, audiovisual materials, and other school library expenses. Expenditures for library services to public schools in lieu of maintaining a school library and expenditures for school library supplies such as paper, pencils, index cards, and other office supplies are included in this account.

Expenditures for teaching supplies include the total cost for all supplies which are actually or constructively consumed in the teaching-learning process, including freight and cartage on them. Tests, chalk, paper, test tubes, ink, pencils, paints, crayons, etc., are examples of those supplies which are recorded in this account.

Expenditures for instructional services are the cost of those activities dealing directly with or aiding in the teaching of students or improving the quality of teaching. Included in this account are the cost of salaries for instruction, textbooks, school library and audiovisual materials, teaching supplies, and miscellaneous expenses for instruction.

Expenditures for attendance services include the cost of those activities which have as their primary purpose the promotion and improvement of children's attendance at school through enforcement of compulsory attendance laws and other means. The salaries for attendance personnel, secretarial and clerical personnel, cost of travel expense, and miscellaneous supplies are recorded in this account.

Expenditures for health services include the cost of those activities in the field of physical and mental health which are not direct instruction. These activities consist of medical, dental, psychiatric, and nurse service in the nature of inspection, treatment, weighing, etc. Under this account are recorded expenditures for all health services for public school students and employed personnel, including examinations prior to employment. The cost of the administration of health services provided for children in anticipation of their enrollment for the first time is also recorded in this account.

Expenditures for pupil transportation services include the cost of those activities which have as their purpose the conveyance of pupils to and from school activities, either between home and school or on trips for curricular or co-curricular activities. Included in this account are expenses such as salaries for pupil transportation, contracted services and public carriers, replacement of vehicles, pupil transportation insurance, expenditures in lieu of transportation, and expenses for the operation and maintenance of district-owned pupil transportation vehicles.

Expenditures for operation of plant include the cost of those activities concerned with keeping the physical plant open and ready for use. These activities include cleaning, disinfecting, heating, lighting, communications, power, moving furniture, caring for grounds, and such activities as are

repeated somewhat regularly on a daily, weekly, monthly or seasonal basis. Operation of plant does not encompass the repairs and replacements of facilities and equipment.

Expenditures for maintenance of plant include the cost of those activities that are concerned with keeping the grounds, buildings and equipment at their original condition of completeness or efficiency, either through repairs or by replacement of property. Expenditures in this account include salaries for maintenance of plant, contracted services for maintenance of plant, and miscellaneous expenses necessary for purchase of supplies and material used in the maintenance of plant.

Expenditures for fixed charges are those expenditures of a generally recurrent nature which are not readily allocable to other expenditure accounts. Examples of expenditures from this account would include school district contributions to employee retirement, insurance and judgements, rental of land and buildings, interest on warrants, and refunds on money received.

Expenditures for student body activities include the cost of those activities which provide a direct and personal service for public school pupils. Interscholastic athletics, entertainments, publications, clubs, bank, orchestra, and any other activity managed or operated by the student body under the guidance and direction of adults are not a part of the regular instructional program.

Expenditures for community services include the cost of those services provided by the school district for the community as a whole or some segment of the community, excluding public school and adult education programs operated by the school district. Expenditures in this account are recorded under the headings recreation, civic activities, public libraries, custodial and detention care of children, welfare activities, and services provided non-public school pupils as authorized by Oklahoma law.

Expenditures for capital outlay include those actions which result in the acquisition of fixed assets or additions to fixed assets. This account includes expenditures for land or existing buildings, improvements of grounds, construction of buildings, additions to buildings, remodeling of buildings, and initial or additional equipment. The salaries and other expenses of school district employees, such as architects and engineers, who are hired or assigned to capitol improvement projects, are recorded in this account.

Expenditures from the general fund, as defined by the Oklahoma State Constitution, are limited to those moneys which may legally be used for current expense purposes within a fiscal year, and an appropriation may be made therefrom for capital outlay.[1] The general fund total used in this study included all of those accounts listed in the School District

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[1]School Laws of Oklahoma, 1967, Art. I, Sec. 19.

Expenditures Report and the total amount spent in the Capital Outlay account.

The Building Fund, according to Oklahoma School Law, consists of all moneys and interest and profits therefrom derived from the proceeds of a building fund levy of not to exceed five (5) mills in any year, voted by the people of a school district.[1] The law states that all money derived from a building fund levy shall be deposited in a single account which may be used for erecting, remodeling or repairing of school buildings, and for purchasing of furniture.

Expenditures for erection of buildings include such costs as professional services for sites, sites and site additions, improvements to sites, salaries and wages, social security, professional services for buildings, and new building or building additions.

Expenditures from the account of remodel and repair of buildings include such costs as contracts for remodeling, salaries for the repair of buildings, contracted services for the repair of buildings, social security, social security administrative charge, and employee insurance.

Expenditures for furniture and equipment include costs for professional services for equipment. From this account furniture for administration, instruction, attendance and health services, pupil transportation, operation of plant,

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[1]School Laws of Oklahoma, 1967, Art. I, Sec. 20.

maintenance of plant, food services and student body activities, community services and investment property may be purchased.

Expenditures from the sinking fund for debt service include the cost of interest paid on bonds and judgements and commissions paid to fiscal agencies. The total expenditure for this account does not include bond payments.

Data Derived From The Annual Personnel Reports

Data derived from school district annual personnel reports to the State Department of Education are identified in Figure 2. The total of each item selected, with the exception of those dealing with average salary, was reduced by calculating the number listed per 100 average daily attendance in grades one through twelve. This calculation was performed for each of the 170 school districts included in the study.

The total number of professional personnel employed by each school district is defined in this study to include all personnel listed on the Annual Personnel Report. The positions listed are administrator, elementary teacher, secondary teacher, counselor, supervisor or consultant, librarian, adult education, etc. Maintenance personnel, bus drivers, cooks and clerical personnel are not listed in this category, but they are listed as non-teaching staff.

The average salary of all professional personnel is the average salary of all professional personnel listed on each school district's Annual Personnel Report. This average

includes the salary of the administrators, classroom teachers, librarians, special education teachers, etc.

FIGURE 2

DATA DERIVED FROM THE ANNUAL PERSONNEL REPORTS

1. Total Number of Professional Personnel per 100 ADA
2. The Average Salary of all Professional Personnel
3. Total Number of Administrators per 100 ADA
4. The Average Salary of Secondary School Principals
5. The Average Salary of Elementary School Principals
6. Total Number of Vocational Teachers per 100 ADA
7. Total Number of Supervisors and Consultants per 100 ADA
8. Total Number of Counselors per 100 ADA
9. Total Number of Librarians per 100 ADA
10. Total Number of Nurses per 100 ADA
11. Total Number of Special Education Teachers per 100 ADA
12. The Average Salary of Professional Personnel with Bachelors Degree
13. The Average Salary of Professional Personnel with Masters + Degree
14. Total Number of Professional Personnel with "0" Years Experience per ADA
15. Total Number of Professional Personnel with Masters Degree or Above per 100 ADA

The total number of administrators in each district includes all of the personnel reported on the annual report as having some administrative responsibilities. Included in this total are administrative assistants and assistant teaching principals.

The average salary of secondary principals is defined as the average salary of the personnel listed on the Annual Personnel Report as being secondary school principals. In a majority of the school districts there was only one principal,

and the salary listed for that position was the average. Many of the smaller school districts had a teaching principal, but no attempt was made to prorate the administrative salary.

The average salary of elementary school principals is defined as the average salary of all the elementary principals employed by a school district. This average salary does not differentiate between non-teaching and teaching principals.

The total number of vocational teachers listed for each school district includes only those listed by the home schools. The vocational teachers employed in Area Vocational-Technical School operated by a single school district are not included in this total. In a large percentage of the school districts only one vocational agriculture teacher and one home-economics teacher were listed.

The total number of supervisors and consultants employed by each district was reported as shown on the personnel report. It is recognized that some of these supervisors and consultants may have been performing some administrative duties, but for this study those persons reported as supervisors and consultants were counted as full-time supervisory or consultative personnel. Only 23 school districts reported employment of personnel in the positions of supervisor and consultant.

The total number of counselors listed on the Annual Personnel Report was the total used for this study. In many of the smaller schools the counselor may have been teaching one or two classes, but this did not appear on the report.

The total number of librarians listed on the personnel report was the total used for this study. There were 103 schools who listed at least one full-time librarian. It must be recognized that in some schools a classroom teacher might have been devoting one or two class periods each day to library supervision, but this did not appear on the report.

The total number of nurses listed for each school district was limited to the number reported on the personnel report. There were twenty-five school districts who reported the employment of at least one full-time nurse. It should be pointed out that some counties have a county health program and that a registered nurse makes regular visits to each school in those counties.

Special education teachers listed for each school are those defined and listed on the personnel report as performing teaching duties designated as special education. There were 95 school districts which reported employing a special education teacher for at least a fraction of the day.

The average salary of professional personnel with a Bachelor's Degree includes all personnel listed with the Bachelor's Degree on the Annual Personnel Report. Included in the average listed for each school may be individuals with

fifteen years experience, individuals in administrative positions, individuals beginning their first year teaching, etc., but they all have as their highest degree earned a Bachelor's Degree.

The average salary of professional personnel with a Master's Degree or above is defined as all personnel listed on the Annual Personnel Report with the Master's or Doctor's Degree regardless of position or number of years experience. This average may include some personnel with Doctor's Degrees and more than fifteen years teaching experience, but it may also include some personnel who have a Master's Degree and are beginning their first year of teaching.

The total number of professional personnel with "0" years of experience includes all personnel, regardless of degree earned or position held, listed on the Annual Personnel Report as beginning their first year of public school work.

The total number of professional personnel with Master's Degree or above may include a beginning classroom teacher and it may include a supervisor or consultant with a Doctor's Degree. The number of years of experience does not enter into this item. The purpose of this item is an attempt to measure the different levels of educational preparation of the different school districts.

Derived and Selected Data From the Annual Statistical Report

Derived and selected data from the Annual Statistical Report are identified in Figure 3. The items were not all recorded on computer tape and therefore had to be secured by looking at the source document as filed by each school district. Item numbers 1, 5, 6, and 7 were available on computer tape and were secured by a computer print-out.

FIGURE 3

DERIVED AND SELECTED DATA FROM THE ANNUAL STATISTICAL REPORT

1. Total Average Daily Attendance in Grades One Through Twelve
2. Total Number of Students Transported per 100 ADA
3. Total Number of High School Graduates per 100 ADA
4. Total District Enrollment
5. Total Number of Full-time Secretaries and Clerks per 100 ADA
6. Total Number of Full-time Plant Operators per 100 ADA
7. Total Number of Full-time Non-teaching Staff per 100 ADA

The total average daily attendance in grades one through twelve is determined by taking the total days attendance of all students in those grades who meet the legal requirements of Oklahoma School Law and dividing this number by the total number of days school was in session. Those students in kindergarten, headstart, underage tuition, etc., are not included in this total.

The total number of students transported is defined as the average daily attendance of all transported students in legal attendance and on which state aid may be paid. It should be recognized that many students living less than one and one-half miles from school may be transported but cannot, according to state law, be used in calculating state aid and, therefore, would not show up in the totals used in this study.

The total number of high school graduates includes all those students in a school district who are reported on the Annual Statistical Report as having graduated from the twelfth grade.

The total district enrollment in grades one through twelve was the total used for each school district included in this study. Enrollment is defined as the recording of the name of a child on a class roll. Total enrollment for the 1967-68 school year is the total number of students who were enrolled regardless of the length of attendance in that particular school district.

The total number of full-time secretaries and clerks recorded by each school district on the non-teaching staff section of the Annual Statistical Report is the total used for each school district. It should be recognized that many part-time employees may not have been recorded on this report.

The total number of full-time plant operation personnel was limited to only those individuals who spend the

majority of their time in this area. It should be recognized that in many schools there are individuals who drive school buses or perform some other duties and are still counted as plant operation personnel. For this study the number of personnel listed on the Annual Statistical Report was the total used for each school district.

The total number of full-time non-teaching staff employed by each school includes such positions as business manager, local district treasurer, doctors, dentists, clerical employees, plant operation personnel, bus drivers, cafeteria workers, etc. The accuracy of the totals recorded for each school district on the items is dependent upon the accuracy with which each district recorded all of their non-teaching personnel on the Annual Statistical Report.

Items 5, 6, and 7 taken from the Annual Statistical Report are items on which schools are not audited for accuracy and since there is no state aid per number employed, some school districts may not have reported all non-teaching staff personnel. While recognizing the possible inaccuracies, these items were included in this study because it was believed they would contribute to the overall picture of services that a school district provided in the total educational program.

Data Derived From Estimate of Needs, Application for Accrediting, and District Transportation Reports

The items listed in Figure 4 include those items selected from the Estimate of Needs, Application for

Accrediting, and District Transportation Reports as filed with the State Department of Education.

FIGURE 4

DATA DERIVED FROM ESTIMATE OF NEEDS, APPLICATION FOR ACCREDITING, AND DISTRICT TRANSPORTATION REPORTS

A. Estimate of Needs
   1. Net Valuation per ADA
   2. Sinking Fund Mills Levied
   3. Unmatured Bonds Outstanding per ADA

B. Application for Accrediting
   1. Number of Non-Vocational Units
   2. Number of Vocational Units

C. District Transportation Report
   1. ADA per Square Mile of Transportation Area Served

Data for the items listed in Figure 4 were not available on computer tape, and it was necessary to examine the source document filed by each school to collect most of the information. Data for the items taken from the Application for Accrediting were available in summarized form from the Administrator's Handbook, Bulletin No. 113-0, published by the State Department of Education.[1]

The net valuation of each school district listed is the amount of the gross valuation less the amount of all Homestead Exemptions in the school district as finally equalized and certified by the State Board of Equalization for the

[1]State Board of Education, Division of Instruction. Annual Bulletin for Elementary and Secondary Schools. Oklahoma City: the Board, 1968.

year of 1967-68. The figure used in this study for each school district was taken from page 12 of the Estimate of Needs which lists the total net valuation from all counties included in the school district and the total valuation of all real, personal, and public service included in the school district.

The sinking fund mills levied for each district are defined as those tax levies certified by the County Excise Board as being sufficient to collect the necessary money from ad valorem taxes or otherwise as provided by law for the payment of bonds, judgements, and interest thereon. The amount of mills levied for the sinking fund of each school district was taken from Exhibit "Y" on page 12 of the Estimate of Needs filed with the State Board of Equalization.

The unmatured bonds outstanding for each school district are defined as those reflecting that indebtedness which the school district voters have legally incurred and which has not been paid for through money derived by sinking fund mills levied by the County Excise Board. The total unmatured bonds outstanding for each school district is found in Exhibit "B" on page 7 of the Estimate of Needs filed by each school district.

Non-vocational units offered by each school district are defined as those units listed as language arts, mathematics, social science, science, foreign language, business education, industrial arts, fine arts and health and safety

education. This definition includes all subjects offered by a school which are not vocational. For this study the secondary school offering the largest total number of units in a school district was used as being representative of that school district.

Vocational units offered by each school district are defined as those offered in the home school and recognized by the State Department of Education as approved vocational classes. This item is limited to that school in a district which offers the largest number of total units. Units gained through participation in an Area Vocational-Technical School were not included in this number.

The transportation area served by each school district is defined as that total area within two miles of the approved bus routes and within the approved transportation area. Bus routes over winding roads in very hilly or mountainous areas are calculated as serving all of the area within two and one-half miles on each side of the route, if within the approved transportation area. The Transportation Section of the State Department of Education states that in nearly all instances the transportation area includes the total local school district plus any approved transportation area located in an adjoining dependent district. This item was included in this study to provide a measure of school population density.

Collection of Data

Data for the 48 items previously described were collected from each of the 170 school districts in Oklahoma which had an average daily attendance of 500 or higher in grades one through 12.

The information selected had all been reported by the local districts on annual reports to the State Department of Education and much of the information included on these reports had been recorded on computer tape by the Statistical Services Section. The Statistical Services Section of the State Department of Education provided valuable assistance in providing computer print-outs of summarized information from the Annual Personnel Report and the Annual Statistical Report. All of the information used in this study from the two reports just mentioned were available on computer print-outs with the exception of the number of students transported, number of high school graduates, and total district enrollment; these three items of information had to be secured manually by reviewing the original reports sent in by each school district. These three items were recorded on computer tape but could not be secured without writing a special computer program which would have been expensive and time consuming.

The information included on the School District Expenditures Report was available on computer tape in the

form of state totals, and additional programming would have been necessary to have secured the information needed for this study. It was more expedient to collect all of the information to be used from the Expenditures Report from the original reports filed with the Finance Division of the State Department of Education.

The information from the Estimate of Needs was secured by examining the records on file in the office of the State Equalization Board. The net valuation, and sinking fund mills levied are recorded in the Finance Division of the State Department of Education, but it was more expedient to take these items from the original reports.

The information from the Application for Accrediting Reports was secured from the Administrator's Handbook, Bulletin No. 113-0, issued by the Division of Instruction of the State Department of Education.[1] This information included only those units of instruction for which the home school had been accredited and does not include those available through participation in an Area Vocational-Technical School. When more than one high school was present in a school district, the school offering the largest number of total units was used to represent that school district.

The transportation area served by each school district was secured from the transportation reports filed by

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[1] Ibid.

each school district with the Finance Division of the State Department of Education. For comparative purposes, the area of school districts which do not provide a transportation system, Bethany and Cushing, was determined by counting the number of square miles in those districts as shown on the county maps maintained by the State Department of Education.

The accuracy of the data collected is limited to the degree which school districts were accurate in reporting. A large number of the data items used in this study had been audited by State Department of Education personnel, and items recorded on computer tape had been checked for accuracy by the Statistical Services Section of the State Department of Education.

Analytical Procedure

The figures for each of the 48 items described earlier in this chapter were collected for each of the 170 schools included in the study and constitute the data for this analysis. The data were reduced to more manageable numbers by calculating the "per average daily attendance ratio" or "per one hundred average daily attendance ratio" where it was appropriate. Those items of information which could not be reduced in a meaningful way were used in their original forms. The exact method used in preparing each item for inclusion in this analysis is discussed earlier in this chapter.

Pearson product-moment correlations among the 48 variables were calculated and arranged into a correlation

matrix. The correlation matrix was factor analyzed by the principal factors method and the results presented in a rotated factor matrix. The variance of each loading on each factor, the communalities of the variances, the total variances, and the percent of variances were computed for each factor.

Chapter IV will present the analysis and interpretation of the data, listed and described in this chapter, pertaining to the number and characteristics of underlying factors among the selected items of information reported to the State Department of Education.

CHAPTER IV

STATISTICAL ANALYSIS

Introduction

Figures for each of the forty-eight items, selected from the (1) Annual School District Expenditures Report, (2) Annual Personnel Report, (3) Annual Statistical Report, (4) Estimate of Needs, (5) Application for Accrediting, and (6) District Transportation Reports as filed with the Oklahoma State Department of Education for the 1967-68 school year, were collected for each of the 170 schools included in this study and constitute the data for this analysis.

The data were processed on the 360-40 IBM Computer through the facilities of the Merrick Computing Center of the University of Oklahoma. The specific routine was the principal axes factor analysis and Varimax rotation. This routine provided means and standard deviations for the variables, a table of intercorrelation among all variables, and a rotated factor matrix.

Means and Standard Deviations

The means and standard deviations for the 48 variables (Figure 5) reveal some unusual figures. The extremely high

FIGURE 5

MEANS AND STANDARD DEVIATIONS OF SELECTED DATA

No.	Variables	Mean	Standard Deviation
1.	Average Daily Attendance Grades 1-12	2501.29	7299.19
2.	Administrative Salaries Per ADA	20.69	9.89
3.	Administrative Services Per ADA	25.04	10.85
4.	Expenditures for Instructional Salaries Per ADA	309.97	42.94
5.	Expenditures for Library and Audio-Visual Per ADA	5.76	4.53
6.	Expenditures for Teaching Supplies Per ADA	10.74	7.32
7.	Expenditures for Instructional Services Per ADA	335.38	47.02
8.	Expenditures for Attendance Services Per ADA	.28	.76
9.	Expenditures for Health Services Per ADA	1.01	1.74
10.	Expenditures for Transportation Services Per ADA	24.14	14.08
11.	Expenditures for Operation of Plant Per ADA	33.28	10.77
12.	Expenditures for Maintenance of Plant Per ADA	12.68	10.14
13.	Expenditures for Fixed Charges Per ADA	20.74	4.64
14.	Expenditures for Student Body Activities Per ADA	1.04	3.67
15.	Expenditures for Community Services Per ADA	1.51	8.25
16.	Expenditures for Capital Outlay Per ADA	18.56	40.23
17.	Expenditures from General Fund Per ADA	473.35	76.47
18.	Building Fund Expenditures for Erection of New Building per ADA	8.81	22.83
19.	Building Fund Expenditures for Remodeling and Repair per ADA	7.46	10.15
20.	Building Fund Expenditures for Purchase of Furniture per ADA	2.83	4.28
21.	Sinking Fund Debt Services per ADA	7.52	7.79
22.	Number of Students Transported per 100 ADA	.40	.22
23.	Number of High School Graduates per 100 ADA	6.92	1.41
24.	Total District Enrollment	3130.00	9337.32
25.	Number of Professional Personnel per 100 ADA	5.10	.59
26.	Average Salary of Professional Personnel	6105.42	435.30
27.	Number of Administrators per 100 ADA	.45	.13
28.	Average Salary of Secondary-School Principal	8718.65	1253.86
29.	Average Salary of Elementary-School Principal	7449.71	1028.96
30.	Number of Vocational Teachers per 100 ADA	.26	.16
31.	Number of Supervisors and Consultants per 100 ADA	.01	.02
32.	Number of Counselors per 100 ADA	.06	.06
33.	Number of Librarians per 100 ADA	.05	.05
34.	Number of Nurses per 100 ADA	.01	.03
35.	Number of Special Education Teachers per 100 ADA	.07	.11
36.	Average Salary of Professional Personnel with B.A. Degree	5625.11	340.45
37.	Average Salary of Professional Personnel with Masters +	6906.64	512.46
38.	Number of Professional Personnel with "0" experience per 100 ADA	.41	.24
39.	Number of Professional Personnel with Masters Degree + per 100 ADA	1.86	.71
40.	Number of Full-time Secretaries and Clerks per 100 ADA	.25	16.92
41.	Number of Full-time Plant Operators per 100 ADA	.45	.21
42.	Number of Full-time Non-Teaching Staff per 100 ADA	1.12	.66
43.	ADA Per Square Mile of Transportation Area Served	35.05	96.83
44.	Non-Vocational Units	42.68	13.47
45.	Vocational Units	16.49	15.49
46.	Net Valuation Per ADA	4713.46	3422.39
47.	Sinking Fund Mills Levied	9.25	4.95
48.	Unmatured Bonds Outstanding per ADA	231.26	177.57

standard deviation on Variable Number One, Average Daily Attendance in grades 1-12, reflects the fact that five school districts contained 33.5 percent of all students included in this analysis. This standard deviation becomes more understandable when it is realized that only 27 schools, of the 170, had an average daily attendance that exceeded the mean of 2,501.29. The Tulsa and Oklahoma City school districts account for 24.3 percent of all students and exceed the mean by an average of 62,701.

The high standard deviation on Variable Number 16, General Fund Expenditures for Capital Outlay per ADA, may be explained by the fact that the larger metropolitan school districts, Tulsa and Oklahoma City, had an expenditure much lower than the mean while some of the smaller districts had expenditures that ranged as high as $450 per ADA.

The high standard deviation on Variable Number 24, Total District Enrollment, again reflects the condition of having a large percent of the students enrolled in a small number of school districts. The original figures ranged from a minimum of 557 to a maximum of 84,242.

The mean and the standard deviation on Variable Number 46, Net Valuation per ADA, appear to indicate a wide range in potential local funds to support the school programs at the district level. An examination of the original figures revealed a minimum of $1,021 per ADA to a maximum of $27,011 per ADA. The five school districts which account

for 33.5 percent of all students included in this study had a net valuation per ADA very similar to the mean. The very low valuations per ADA were found in eastern Oklahoma and the higher net valuations per ADA were found in western Oklahoma. The extremely high valuations were found in school districts in which public service utilities were located.

Correlation Matrix

The obtained Pearson product-moment coefficients of correlation were arranged into a correlation matrix. These coefficients of correlation, ranging in size from r = 0.00 to r = 0.99, are presented in Appendix A.

Using the cluster analysis technique, the correlations of greatest magnitude in each column were identified.[1] Beginning with the highest correlation in the table, the relations with the other components were diagrammed. When the first series was exhausted, a second dimension was diagrammed. The diagrams present a picture of the maximum correlations present. This does not mean that there are no other relationships among the data or that the other correlations are insignificant, but rather that the clusters represent patterns of maximum correlation among the data analyzed with a minimum of correlation between the clusters. It

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[1] L. L. McQuitty, "Elementary Linkage Analysis for Isolating Orthogonal and Oblique Types and Typal Relevancies," Educational and Psychological Measurement, XVII (1957), pp. 207-229.

should be noted that identified clusters represent factors in the cluster method of factor analysis.

Kerlinger states that the cluster analysis technique is most useful in preliminary or exploratory work.[1] The McQuitty cluster analysis method is often preferred to the Varimax rotation, where markedly skewed distributions are present or the inclination is toward non-parametric statistics. This technique was used to tentatively identify clusters and presumed factors by searching for interrelated groups of correlation coefficients.

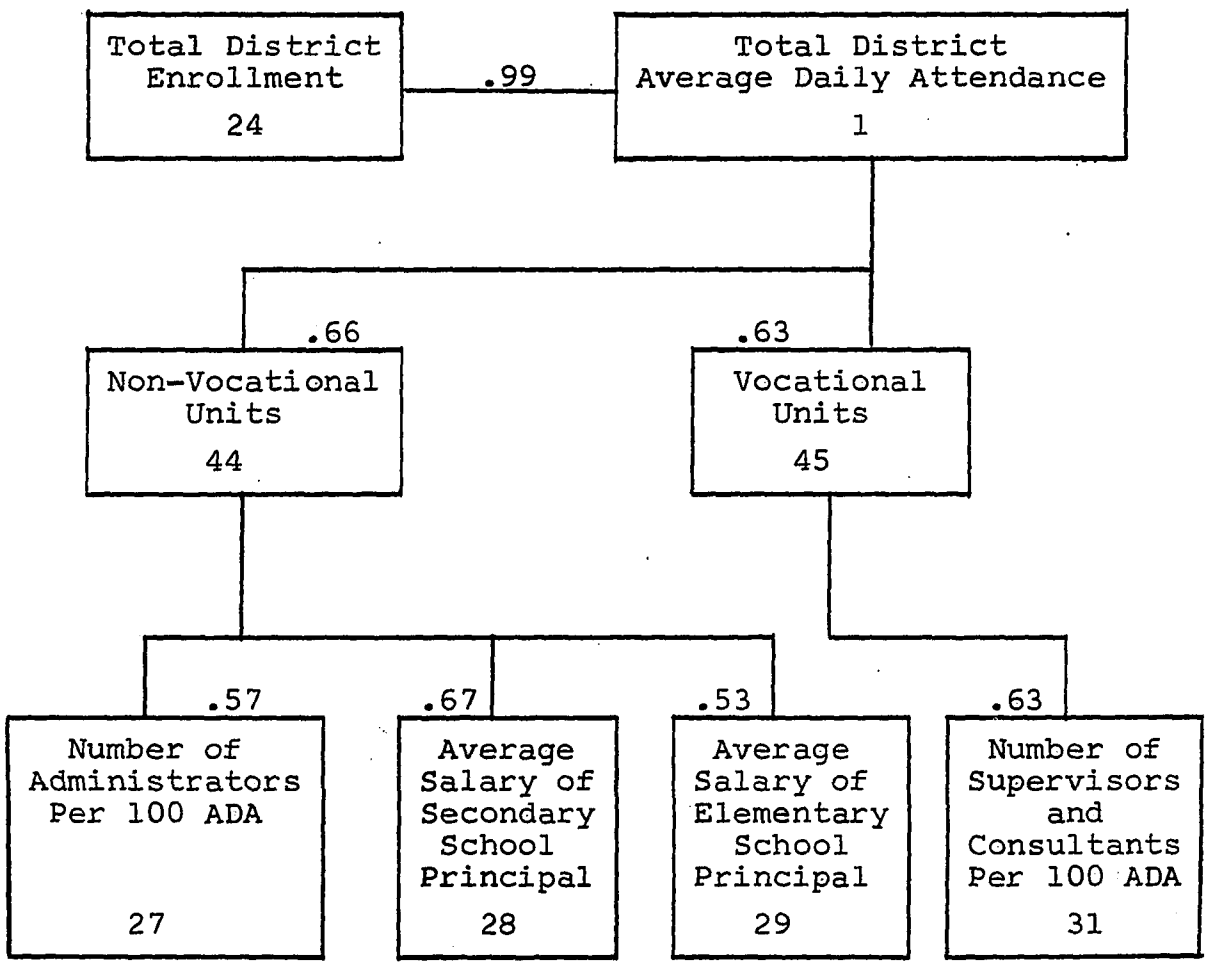
The strongest relationship is presented in Figure 6 and is composed of variables related to size in terms of average daily attendance and enrollment. Variable Number One, Total Average Daily Attendance in Grades 1-12, and Variable Number 24, Total School Enrollment, are data items that would normally have a high degree of correlation. Variable Number 31, Number of Supervisors and Consultants per ADA, is a logical data item to be in this cluster because only the school districts with large enrollments normally provide the services of supervisors and consultants. Variables Number 44, Non-Vocational Units, and Variable Number 45, Vocational Units, are items that would normally be expected to change as the size of enrollment changed in a school district.

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[1]Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1964), p. 661.

FIGURE 6

CLUSTER I. SIZE RELATED DATA ITEMS

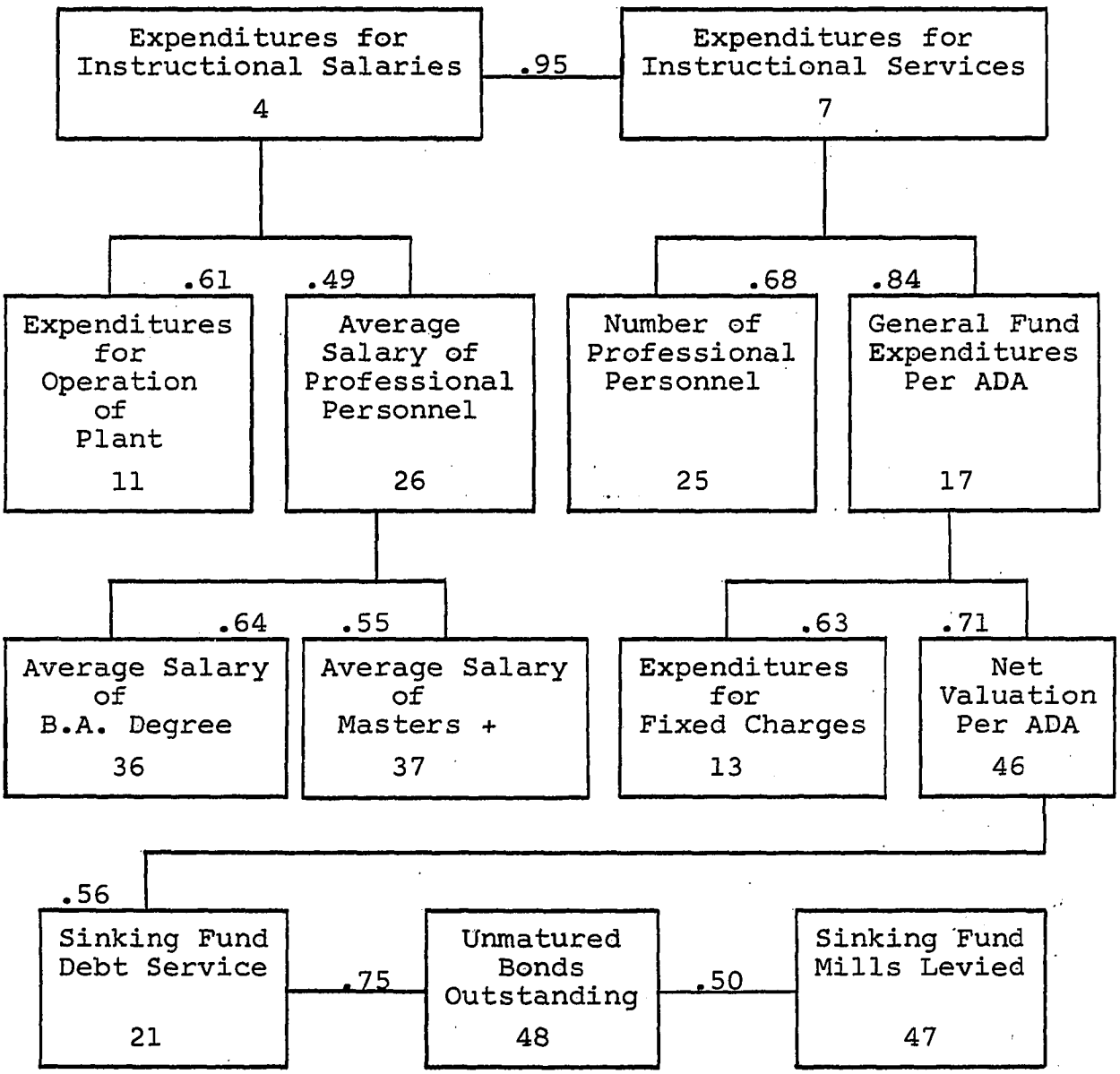


The largest cluster, thirteen variables, is presented in Figure 7 and is composed of variables related to cost or expenditures. The correlation between Variable Number 4, General Fund Expenditures for Instructional Salaries per ADA, and Variable Number 7, General Fund Expenditures for Instructional Services per ADA, are data items that would normally have a high degree of correlation. Variable Number 17, General Fund Expenditures per ADA, showed a high correlation with Variable 7, but it was not as high as the writer had expected. Variable Number 11, Expenditures for Operation of Plant per ADA, Variable Number 13, Expenditures for Fixed Charges per ADA, Variable Number 25, Number of Professional Personnel per 100 ADA and Variable Number 46, Net Valuation per ADA, are data items that appear to fit comfortably in Cluster II.

Variable Number 26, Average Salary of Professional Personnel, Variable Number 36, Average Salary of Professional Personnel with B.A. Degree, and Variable Number 37, Average Salary of Professional Personnel with Master+, are data items that would normally have a high degree of correlation. The variables found on the fourth level of Cluster II, Variable Number 48, Unmatured Bonds Outstanding, Variable Number 21, Sinking Fund Debt Service, and Variable Number 47, Sinking Fund Mills Levied, are data items that are concerned with long term finance and would normally have a high degree of correlation.

FIGURE 7

CLUSTER II. EXPENDITURE OR COST DATA ITEMS



Cluster 1 and Cluster 2 account for all of the variables with a correlation coefficient of .50 or higher with the exception of Variable Number 2, Administrative Salaries per ADA, and Variable Number 3, Administrative Services per ADA. These two variables correlated with each other at a .91 level, but did not correlate with any of the other variables at the .50 or higher level necessary to be included in Cluster 1 or Cluster 2. Since all variables with a .50 or higher level of correlation had been accounted for, no other cluster of variables was identified.

There were twenty-five data items which did not yield coefficients of correlation equal to .50. This does not mean these items did not contribute to the overall study, but that in the preliminary analysis of the correlation matrix by the cluster analysis method they did not show a correlation significant enough to be included in any cluster of variables.

Rotated Factor Matrix

Most factor analytic methods supply raw data in a form that is difficult or impossible to interpret. Thurstone states that it is necessary to rotate factor matrices if one wants to interpret them adequately.[1] A principal factors matrix and its loadings account for the common factor variances of the data values, but they do not in general provide

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[1] L. Thurstone, Multiple Factor Analysis (Chicago: University of Chicago Press, 1947), p. 508.

scientifically meaningful structures. It is the configuration of variables in factor space that are of fundamental concern.[1] In order to explore these configurations adequately, the arbitrary reference axes must be rotated.

Orthogonal rotation was accomplished by means of the Varimax method. Orthogonal rotation maintains the natural perpendicular relationship of the axes, which maintains the independence of factors. The resulting factor loadings were arranged into a rotated matrix as presented in Figure 8. Examination of the rotated factor matrix led to the following observations.

The loadings on Factor One as presented in Figure 9 were highly significant with Variable Number One, Average Daily Attendance in grades 1-12, having a .910 loading. Variable Number 24, Total District Enrollment, was highly significant with a saturation of .895. The first two variables with the highest loadings on Factor One appear to indicate that Factor One is a size Factor and is highly correlated with Cluster One identified from the correlation matrix. Variable Number 44, Non-Vocational Units, had a loading of .660 on Factor One and this would seem to indicate that the number of Non-Vocational Units a school offers is dependent upon the size of the school in terms of average daily attendance. Variable Number 45, Vocational Units, had a loading

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[1]Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart and Winston, Inc., 1964), p. 667.

FIGURE 8

ROTATED FACTOR MATRIX

Variables	Factors														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	h2
1	.910	.071	.007	.058	.031	.102	-.085	-.045	.005	-.124	.001	.051	-.017	.087	.883
2	-.164	.075	-.104	-.010	-.043	.005	.037	.917	.040	.063	.016	-.034	.045	-.052	.900
3	-.181	.190	-.012	-.019	.002	.014	.027	.913	.047	.090	.006	-.014	-.023	-.053	.918
4	.037	.901	.121	.023	.028	.067	.010	-.008	.073	-.166	.109	-.067	.020	.025	.883
5	-.103	.235	.003	-.172	-.177	.094	.587	-.074	-.041	.156	.146	.141	.175	-.099	.593
6	-.107	.350	-.006	.012	-.514	-.161	-.143	-.141	.082	.111	-.083	-.019	-.010	.035	.492
7	-.002	.937	.116	-.014	-.068	.077	.073	-.014	.068	-.123	.098	-.022	.045	.018	.940
8	.200	-.035	.043	-.098	-.119	.141	-.177	-.017	-.042	.014	-.162	.049	.025	.733	.688
9	.337	.054	.537	-.014	.219	.002	-.003	-.056	-.014	.002	-.061	.159	.019	.019	.486
10	-.243	.264	-.154	-.038	-.006	-.002	.126	.165	.068	.509	-.481	.064	-.144	-.155	.741
11	.109	.613	-.089	.340	-.105	.387	-.024	.044	.163	-.143	.056	.037	-.185	.107	.771
12	-.008	.165	-.118	-.031	.027	.006	.657	.193	.057	.163	-.194	.051	.002	-.205	.624
13	.111	.683	-.077	-.095	-.065	.091	-.029	.076	-.019	-.054	-.125	-.071	-.065	-.071	.546
14	-.066	.027	.119	.101	.078	.228	-.012	.076	.071	.122	-.022	-.724	-.071	-.014	.643
15	-.017	.012	.104	-.072	-.027	.017	-.055	-.091	.070	-.032	-.720	-.074	.023	.181	.592
16	-.060	.191	.161	.116	-.001	-.235	-.060	-.099	-.078	-.089	-.085	.120	-.646	-.116	.615
17	-.063	.878	.010	.066	-.097	.069	.188	.169	.077	.008	-.189	-.059	-.154	-.052	.930
18	-.044	.187	-.110	.104	.014	-.283	.101	.060	.685	-.020	.181	.018	-.065	.173	.691
19	.135	.152	-.142	-.136	-.166	-.012	-.675	.057	-.083	.185	-.099	.173	.236	-.074	.709
20	-.117	-.009	.113	.360	.062	-.034	-.166	-.075	.073	-.200	-.050	.217	.586	.006	.634
21	.075	.276	-.071	.806	-.017	.146	-.037	-.066	.077	-.056	.019	-.037	-.114	.024	.788
22	-.115	-.167	.001	.129	-.134	-.119	.108	.213	-.109	.323	-.489	.069	-.249	-.390	.721
23	-.027	.245	.073	-.023	.374	-.036	-.301	-.101	.036	.409	.169	-.362	.156	-.121	.677
24	.895	.074	.001	.019	.004	.124	-.070	-.029	.003	-.166	-.004	.044	-.043	.078	.865
25	-.097	.725	.185	.131	-.019	-.027	.018	.135	.051	.340	.029	-.093	.202	.005	.775
26	.121	.389	-.101	-.070	.151	.125	.044	.067	.065	-.682	.014	.006	-.101	.002	.706
27	-.278	.275	-.059	-.093	.035	-.064	.033	.427	-.177	.588	-.017	.008	.048	-.043	.718
28	.409	.106	.031	.140	.017	.130	-.014	-.173	-.025	-.673	.036	.098	.152	.064	.737
29	.312	.215	-.037	.185	.047	.057	-.106	-.044	.100	-.714	-.044	.044	.046	-.034	.724
30	-.077	.121	-.053	-.153	-.025	-.174	.263	-.064	-.154	.415	-.287	-.416	.133	.103	.630
31	.538	-.034	.022	.183	.102	.023	.008	-.188	-.003	-.098	.053	.001	.105	.527	.672
32	.202	.140	.011	-.041	-.112	.015	-.094	-.107	.535	-.122	-.133	-.341	.146	-.225	.602
33	.030	.275	.215	-.038	.035	.050	.058	.120	.613	-.134	-.276	.094	.142	-.129	.661
34	.310	-.115	.312	-.013	.095	.298	.128	-.276	.215	.047	.008	.284	.196	-.087	.572
35	.251	.283	.291	-.018	-.176	-.250	-.068	-.007	-.208	-.261	-.034	-.347	.266	-.070	.635
36	.126	.483	-.376	.119	.365	-.021	.010	.015	.027	-.514	-.004	.113	.058	-.021	.821
37	.188	.448	-.502	.148	.076	.039	-.035	.207	.110	-.467	.044	.144	.090	.002	.823
38	.044	.069	-.185	.136	-.791	.152	.045	.112	-.024	.086	.002	.057	-.006	.018	.735
39	-.073	.128	.849	-.047	.075	.036	-.016	-.045	.061	.021	-.034	-.206	-.060	.048	.807
40	.161	.105	.056	.163	.019	.537	.088	-.160	-.124	-.204	-.055	.106	.222	.016	.509
41	.257	.215	-.003	.033	-.012	.601	-.044	.114	-.029	-.144	.014	-.063	.105	.065	.661
42	-.003	.154	.003	.093	-.065	.817	.044	.001	-.058	-.008	.035	-.174	-.047	.072	.749
43	.544	-.103	.012	.078	-.076	.133	-.116	-.083	.142	-.172	.198	.019	-.046	-.230	.500
44	.660	-.029	.059	.136	-.006	.080	-.023	-.224	.045	-.452	.155	.002	.006	.085	.754
45	.703	-.003	-.002	.070	-.006	-.047	.098	-.213	-.069	-.212	-.157	-.144	.082	.373	.797
46	-.049	.721	-.136	.351	-.023	.158	.007	.125	.235	-.128	-.054	.125	-.120	.009	.810
47	.101	-.298	.009	.745	-.062	-.003	.022	-.039	-.105	-.085	.031	-.085	.170	-.112	.727
48	.167	.308	-.052	.816	-.086	.112	-.012	.052	.037	-.108	.052	.016	.021	.026	.832
Var.	4.29	6.15	1.94	2.64	1.47	2.24	1.66	2.50	1.53	3.85	1.52	1.52	1.43	1.50	34.30
%	12.51	17.95	5.67	7.70	4.29	6.53	4.84	7.28	4.47	11.24	4.45	4.43	4.18	4.38	99.99

of .703 on Factor One and this would seem to indicate that Vocational Units are highly related to the size of a school in terms of average daily attendance or enrollment. This Factor accounted for 12.51 percent of the total communality of all variables.

FIGURE 9

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH COMMON FACTOR LOADINGS ON FACTOR I

Varimax Rotation	
Variables	Loadings of Variables*
Average Daily Attendance Grades 1-12	910
Total District Enrollment	895
Non-Vocational Units	660
Vocational Units	703
% of Total Communality	12.52

*Decimals have been omitted.

No loadings below .65 were considered as being significant enough to be included in a Factor. Fruchter points out that loadings of .2 or less are usually regarded as insignificant, loadings of .2 to .3 as low, .3 to .5 as moderate, .5 to .7 as high, and above .7 as very high.[1] Moreover,

[1]Benjamin Fruchter, Introduction to Factor Analysis (New York: Van Nostrand Co., 1954), p. 151.

Thurstone states that the naming of a factor cannot be made with confidence unless the projections are as large as .50 to .60 so that the factor accounts for a fourth or a third of the variance of a test.[1]

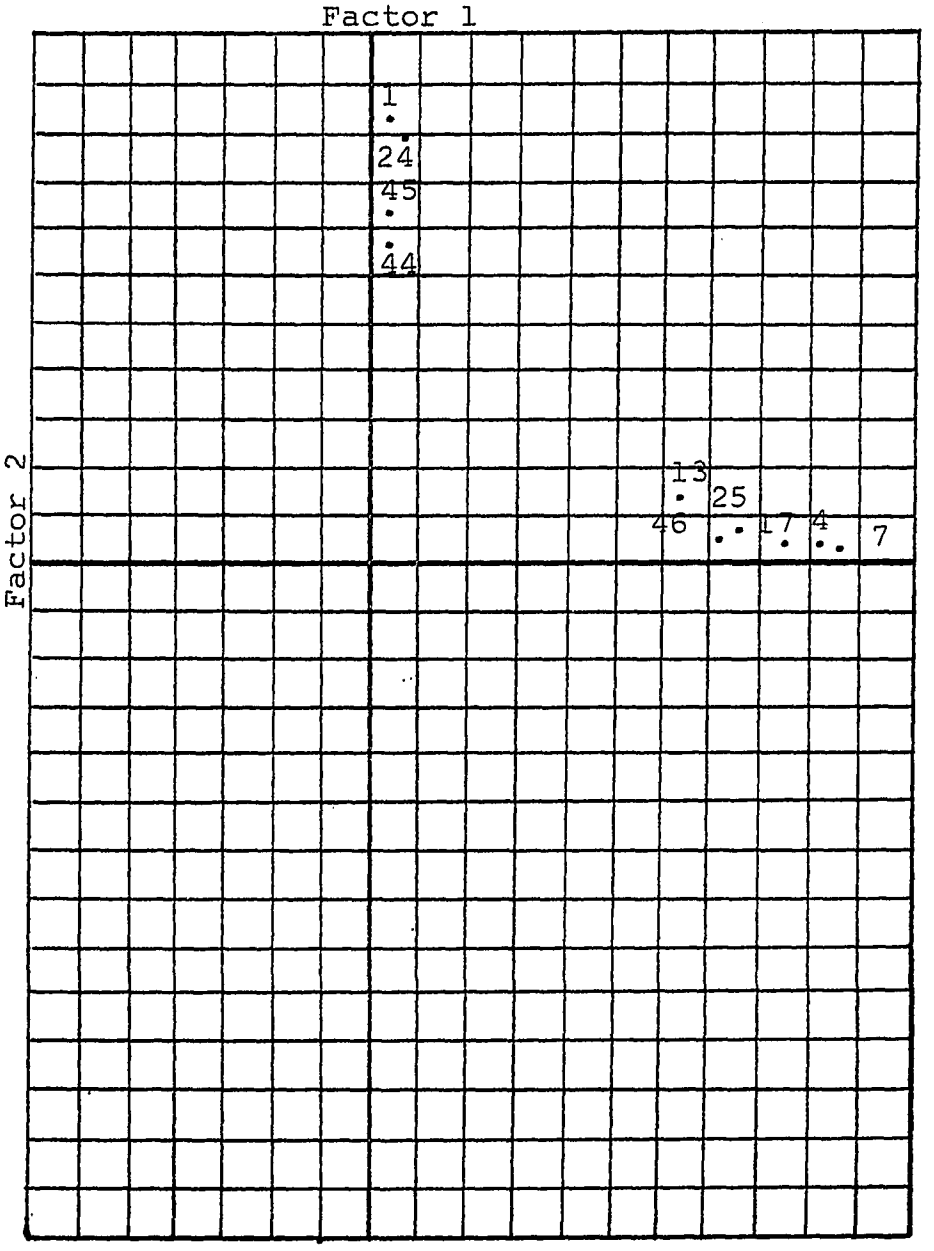
In Figure 10 the loadings of Factor One and Two have been plotted to show the relationship that exists among the variables found in these two factors. This graph shows a very clear picture of the relationship that exists among the data in these two factors.

There were six significant loadings projected on Factor 2. The variables with their loading are listed in Figure 11. Variable Number 7, Expenditures for Instructional Services per ADA, had a highly significant loading of .937 on Factor 2. Since Variable Number 4, Expenditures of Instructional Salaries per ADA, had the second highest loading of .901 on this factor it appeared to be a factor concerning cost of education. Expenditures from the General Fund per ADA, Variable Number 17, had a high loading on this factor. It is of interest to note that Variable Number 17, a data item used quite frequently by educators when discussing financial educational effort, did not have the highest loading on what apparently is a cost factor. Variable Number 25, Number of Professional Personnel per 100 ADA, has direct cost

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[1]L. L. Thurstone, Primary Mental Abilities, "Psychometric Monographs," No. 1 (Chicago: University of Chicago Press, 1938), p. 12.

GRAPHIC PRESENTATION OF RELATIONSHIPS AMONG VARIABLES IN FACTORS 1 AND 2



implications. Net Valuation per ADA, Variable Number 46, is a factor that would normally be expected to appear as a cost factor. This variable loaded on Factor 2 at a significant level of .721. In analyzing the loading of Variable Number 46, Net Valuation per ADA, on Factor 2 it is of interest to note that this item represents sources from which revenue is made available for school district expenditures and one might expect a higher loading on a cost or expenditure factor. Variable Number 13, Expenditures for Fixed Charges per ADA, had a low loading on Factor 2 of .682. This variable had a higher loading on Factor 2 than it had in the correlation matrix when it was identified in Cluster II as having a .63 correlation with General Fund Expenditures.

FIGURE 11

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH COMMON FACTOR LOADINGS ON FACTOR 2

Varimax Rotation	
Variables	Loadings of Variables*
Expenditures for Instructional Salaries per ADA	901
Expenditures for Instructional Services per ADA	937
Expenditures for Fixed Charges per ADA	683
Expenditures from General Fund per ADA	878
Number of Professional Personnel per 100 ADA	725
Net Valuation per ADA	721
% of Total Communality	17.96

*Decimals have been omitted.

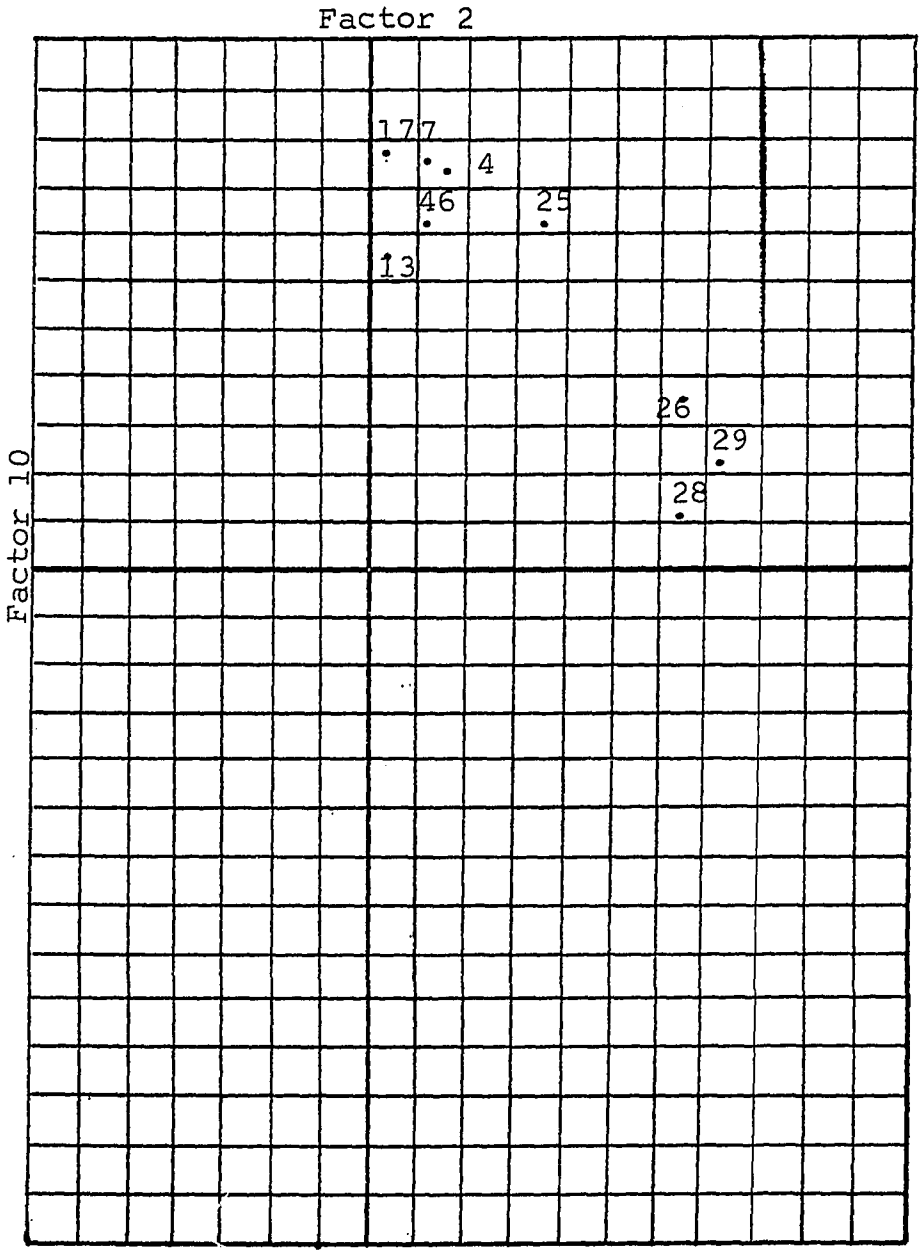
Many of the data items identified in the correlation matrix as having a significant relationship did not appear in Factor 2. This observation would appear to verify the statement by Kerlinger that the cluster analysis technique is quick and easy, but appears to be most useful in preliminary or exploratory work.

Factor 2 and the variables with significant loading are plotted graphically in Figure 12. Factor 2 has been plotted on Factor 10 to show the relationship that exists among the factor variables and the correlation of the two factors. It should be noted that Factor 2 accounted for 17.95 percent of the total communality, which is the highest of all factors extracted. It accounted for 6.15 percent of the total variance.

Factor 4 and the variables with significant loadings are listed in Figure 13. There were only three variables with significant loadings on this factor and they appear to describe long term costs or expenditures. Variable Number 21, Sinking Fund Debt Services per ADA, had a loading of .806. Variable Number 47, Sinking Fund Mills Levied, had a loading of .745 and would have been expected to show a high degree of relationship with the other two variables as this variable is adjusted each year in relation to Variable Number 48, Unmatured Bonds Outstanding. Variable Number 48 had the highest loading on Factor 4 as should be expected since the

FIGURE 12

GRAPHIC PRESENTATION OF RELATIONSHIPS AMONG VARIABLES IN FACTORS 2 AND 10



other two variables change as it changes. This Factor accounted for 7.72 percent of the total communality.

FIGURE 13

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH COMMON FACTOR LOADINGS ON FACTOR 4

Varimax Rotation	
Variables	Loadings of Variables*
Sinking Fund Debt Services per ADA	806
Sinking Fund Mills Levied	745
Unmatured Bonds Outstanding per ADA	816
% of Total Communality	7.72

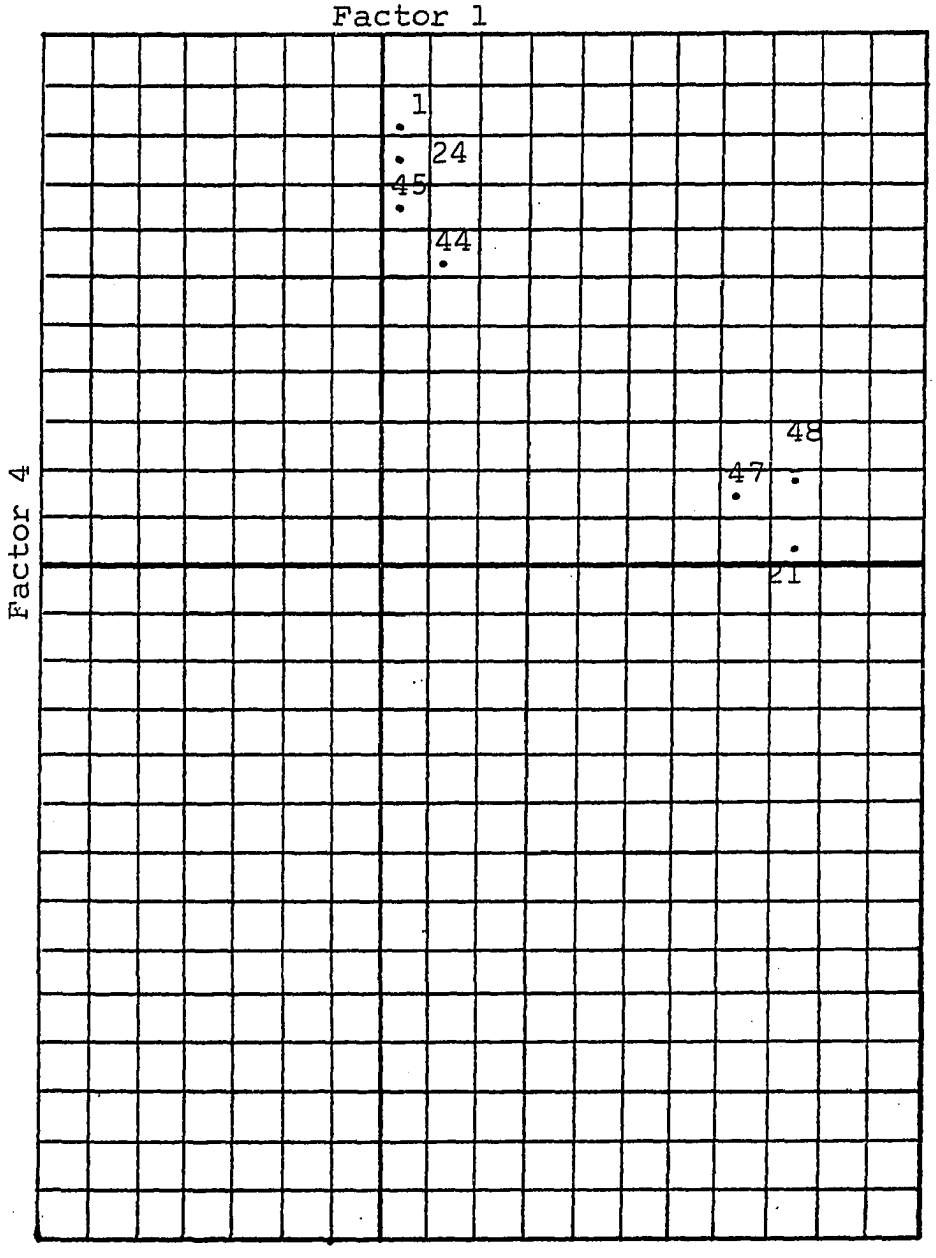
*Decimals have been omitted.

Factor 4 and the variables with significant loadings are plotted graphically in Figure 14. Factor 4 has been plotted on Factor 1 to show the relationship that exists among the factor variables and the correlation of the two factors. It should be noted that Factor 4 contains those variables that were identified on the fourth level of Cluster II as shown on page 87.

Factor 8 and the two variables which had significant loadings are listed in Figure 15. The variable with the highest loading was Number 2, Administrative Salaries per ADA, with a loading of .917. Since the other variable is Number 3, Administrative Services, Factor 8 is tentatively

FIGURE 14

GRAPHIC PRESENTATION OF RELATIONSHIPS AMONG VARIABLES IN FACTOR 1 AND 4



identified as related to administrative costs. It should be mentioned, however, that a larger number of variables would have to load on this Factor before it could be named with confidence. There were no other variables with a loading in excess of .225 on Factor 8.

FIGURE 15

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH COMMON FACTOR LOADINGS ON FACTOR 8

Varimax Rotation	
Variables	Loadings of Variables*
Administrative Salaries per ADA	917
Administrative Services per ADA	913
% of Total Communality	7.29

*Decimals have been omitted.

In Figure 16 the loadings of Factor 8 and Factor 10 have been plotted to show the relationships that exist among the variables found in these two factors. Factor 8 with Variable 2, Administrative Salaries, and Variable Number 3, Administrative Services, is the only one of the five factors identified as being of significance that was not part of Cluster 1 or Cluster 2.

Factor 10 and the variables with significant loadings are listed in Figure 17. Variable Number 29, Average Salary of Elementary School Principal, had the highest loading on

FIGURE 16

GRAPHIC PRESENTATION OF RELATIONSHIPS AMONG VARIABLES IN FACTORS 8 AND 10

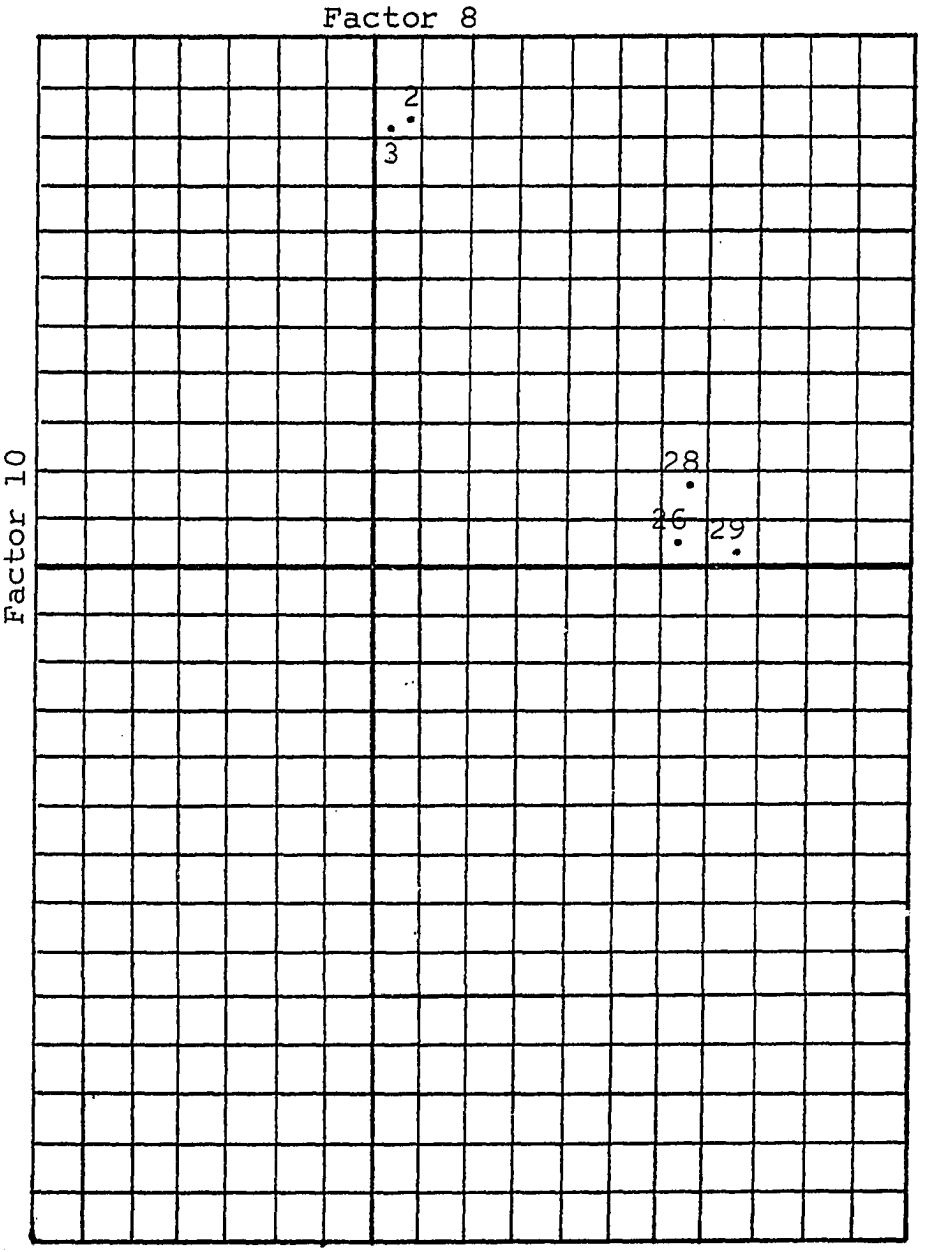


FIGURE 17

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH COMMON FACTOR LOADINGS ON FACTOR 10

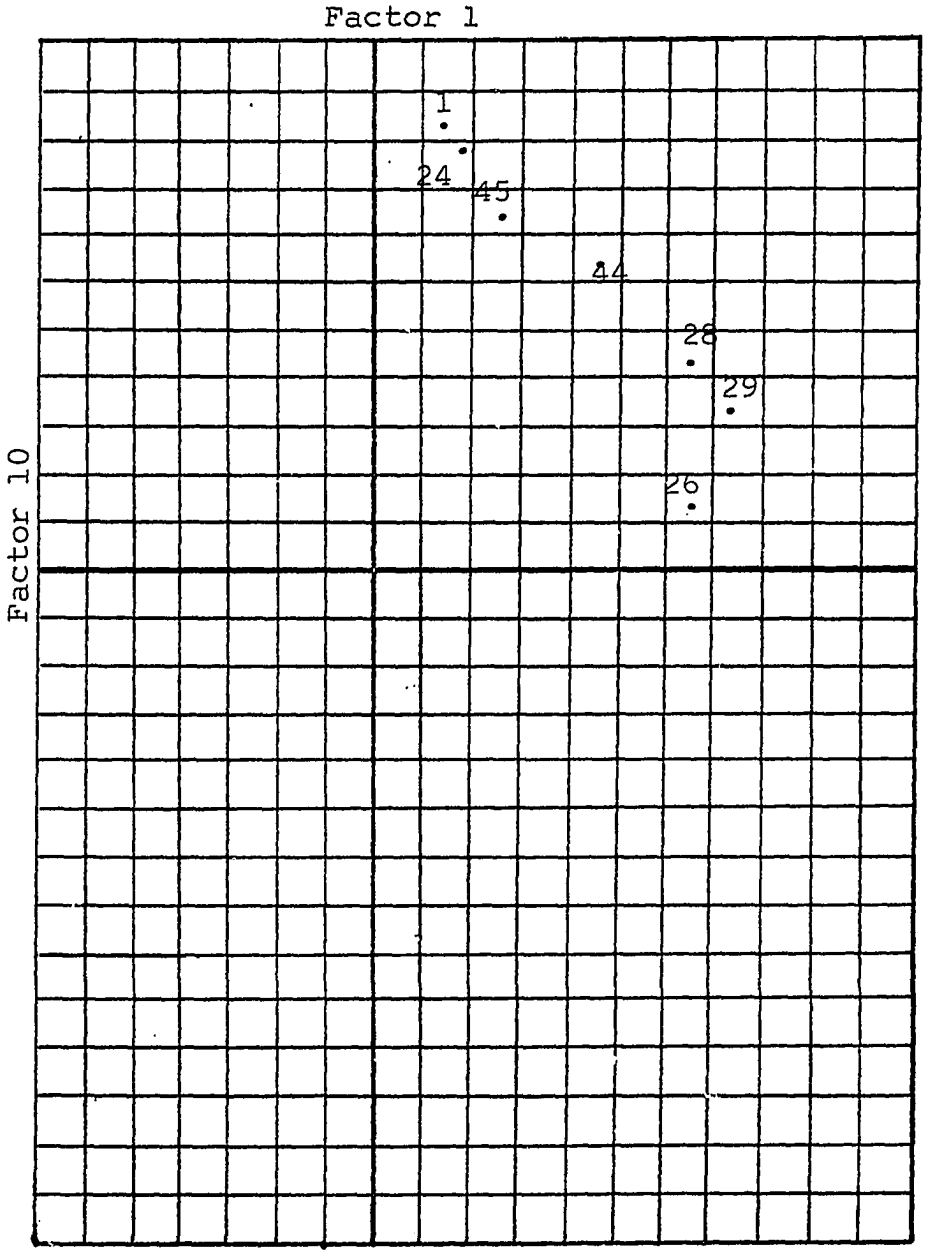
Varimax Rotation	
Variables	Loadings of Variables*
Average Salary of Professional Personnel	682
Average Salary of Secondary School Principal	673
Average Salary of Elementary School Principal	714
% of Total Communality	11.25

*Decimals have been omitted.

Factor 10, .714. Variable Number 26, Average Salary of Professional Personnel, had a loading of .682 and appeared to be describing a certain level of administrative or supervisory cost. It should be remembered that the Average Salary of Professional Personnel includes the salaries of administrative and supervisory personnel as well as classroom teachers. Variable Number 28, Average Salary of Secondary School Principal, with a loading of .673 would appear to strengthen the idea that Factor 10 is measuring a certain level of administrative or supervisory cost. Factor 10 is plotted on Figure 18 to graphically show the relationships that exist among the variables in Factor 10 and how they relate to the variables found in Factor One. Figure 18 shows how the factors are deteriorating as we move toward ever lower

FIGURE 18

GRAPHIC PRESENTATION OF RELATIONSHIPS AMONG VARIABLES IN FACTORS 1 AND 10



communalities. It should also be noted that many of the items identified on the third level of Cluster 1 appeared as separate factors in the Varimax rotation. Factor 10 accounted for the third largest amount of total communality found among the factors extracted.

FIGURE 19

PRINCIPAL AXES FACTOR ANALYSIS AND VARIMAX ROTATION WITH HIGHEST LOADINGS ON FACTORS NOT DISCUSSED

Verimax Rotation		
Factor Number	Variables	Loadings of Variables*
3	Expenditures for Health Services per ADA	537
5	Number of Professional Personnel with "0" Experience	791
6	Number of Full-time Non-teaching Staff	817
7	Building Fund Expenditures for Remodeling and Repair	675
9	Number of Librarians	613
11	Expenditures for Community Services	720
12	Expenditures for Student Body Activities	724
13	Building Fund Expenditures for Purchase of Furniture	586
14	Expenditures for Attendance Services	733

*Decimals have been omitted.

There were a total of fourteen factors identified in this factor analysis and the five factors that appeared to be of significance were analyzed and discussed. The nine factors that were not considered to be significant because they did not have more than one loading higher than .65 are listed above in Figure 19 with the variable that had the highest loading on that individual factor. Three of the factors did not have a single loading that exceeded the .65 loading level necessary to be considered as significant. Six factors had one variable loading of significant size, but there were no other variables on these six with loading large enough to give meaning to the factors.

In conclusion it should be pointed out that 23 variables did not have a significant loading on any of the fourteen factors extracted. This would seem to indicate that a large portion of the information reported to the State Department of Education is unrelated. It should be noted that employment of counselors, librarians, nurses, and special education teachers did not appear on any of the factors. It should also be observed that density of population did not appear on any of the factors. These data items were singled out for special mention because they are items that are used quite frequently in discussing characteristics and costs of educational programs.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Schools and various educational agencies in every state are now routinely collecting masses of information of many types and in many ways. However, the methods of data collection and of data processing now being employed, in view of modern technological advances, are in general antiquated, cumbersome, inefficient, and repetitious. It is impossible for schools and educational agencies to be too well informed about the problems with which they must deal. It is quite possible, however, to collect more detailed and non-related information than can be interpreted and used with real effectiveness. Much of the value of information presently being collected is not utilized because its meaning is frequently dependent upon complex interrelationships among the detailed items of information, rather than in the individual items themselves.

This study was designed to ascertain if there are high degrees of correlation existing among the educational data which school districts are reporting to the State Department of Education. In order to accomplish this, the

application of factor analysis was used to determine if significant relationships existed among selected items of information reported on the (1) Annual School District Expenditures Report, (2) Annual Personnel Report, (3) Annual Statistical Report, (4) Estimate of Needs, (5) Application for Accrediting, and (6) District Transportation Reports, as filed with the State Department of Education for the 1967-68 school year. The information on these reports was selected for analysis because it appeared to represent a pool of information which educators use most often in describing public schools, evaluating existing programs, and planning new activities. Much of the data selected were recorded on computer tape at the Statistical Services Section of the Oklahoma State Department of Education and that information which was not recorded on computer tape was secured from the various reports filed by the individual school districts.

The school system population of this study included all of the 170 Oklahoma school systems having an average daily attendance of 500 or higher and offering programs through the 12th grade for the school year 1967-68.

There were 48 items of information selected for inclusion in this study and figures for each of the items were secured for each of the 170 school systems. The data were reduced to more manageable numbers by calculating the "per average daily attendance ratio" or "per one hundred average daily attendance ratio" where it was appropriate. Those

items which could not be reduced in a meaningful way were used in their original forms.

The means and standard deviations were determined for each of the 48 variables and presented in a separate table. Pearson product-moment coefficients of correlation among the 48 variables were calculated and arranged into a correlation matrix. The correlation matrix was first analyzed by using the McQuitty cluster analysis technique and the results were presented on charts. The McQuitty technique identified two clusters of variables which were characterized by size related data items and cost or expenditure data items. The correlation matrix was then analyzed by the principal axes factor analysis method and the unrotated factor matrix was submitted to orthogonal rotation by the Varimax method. The fourteen extracted factors obtained by this procedure were arranged into a rotated factor matrix. The total variance, the percent of variance, and the communalities of the variances were computed for each factor.

Five factors were identified as being of sufficient strength to warrant further analysis. A profile of the five most significant extracted factors was plotted for graphical presentation.

Factor One revealed highly significant relationships among four loadings which appeared to indicate that it is a measure of size. Five minimally significant loadings seemed

to strengthen the indication that Factor One could be identified as a size relationship.

Factor 2 revealed highly significant relationships among six loadings. The relationships revealed by Factor 2 appeared to represent characteristics related to cost of educational activities. Seven minimally significant loadings seemed to indicate that Factor 2 could be named a cost factor.

Factor 4 revealed highly significant relationships among three loadings. These relationships appeared to represent characteristics related to long term finance. Factor 4 had no other loadings of even minimal significance.

Factor 8 revealed highly significant relationships among two loadings. These relationships appeared to be related to administrative cost.

Factor 10 revealed highly significant relationships among three loadings. The relationships represented by Factor 10 might be interpreted as describing a certain level of administrative or supervisory cost. Three minimally significant loadings appeared to strengthen the indication that Factor 10 was related to a certain level of administrative or supervisory cost.

There were a total of fourteen factors extracted in this factor analysis and the five identified as being of significance were interpreted. Three of the remaining factors did not have a single loading that approached the .65 loading level necessary in this analysis to be considered as

significant. Six factors had one loading of significant size, but there were no other loadings on these six factors large enough to give meaning to the factors.

Conclusions

The aim of this study was to determine how many factors exist in the selected data reported to the State Department of Education and the characteristics of these underlying factors if in fact they do exist. The analysis made in this study warranted a number of conclusions and they are as follows:

1. There were five factors with significant loadings in the 48 variables selected for this analysis.

2. School district size, as reflected in school district enrollment and average daily attendance, is highly significant in relation to the effect it has on the number of Non-Vocational and Vocational Units offered by a school district.

3. Cost or expenditures for instructional services appears to be the most significant measure with which the other expenditure variables correlate.

4. Long term indebtedness does not correlate with any significant degree with the other expenditure variables.

5. Administrative costs do not correlate to any significant degree with the other expenditure variables. However, they did achieve significance as a factor and as

such are highly significant in the total administrative picture.

6. A large portion of the information reported to the State Department of Education appears to be unrelated as 23 variables did not have a significant loading on any of the fourteen factors extracted.

7. Size of school district does not correlate with the employment of counselors, librarians, nurses, and special education teachers.

8. Density of population does not appear to be a variable which influences the cost of education.

Recommendations

Since the findings of this investigation may have been influenced by the extremely wide range in school district size it is recommended that further study be conducted in this area using school districts of similar size in terms of average daily attendance. The very large standard deviations in this study produced a badly skewed distribution, and as a result the correlation coefficients were lowered and the factor structure somewhat distorted. The findings of this report should be projected into future studies in which ratios such as ADA are not used, but rather, the raw data. A replication of this study using different data items would be of value in determining if the five factors identified in this study are factors that extend throughout the range of information collected on all phases of the school program.

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APPENDIX A

Correlation Coefficients

48 Variables

CORRELATION COEFFICIENTS OF SELECTED DATA ITEMS*

Variable	1	2	3	4	5	6	7	8	9	10
1										
2	-21									
3	-23	91								
4	13	01	15							
5	-14	06	03	13						
6	-06	01	00	19	05					
7	08	04	16	95	24	31				
8	23	-12	-12	-03	-12	01	-03			
9	28	-22	-12	07	-03	-07	07	09		
10	-29	24	30	08	20	15	13	-07	-12	
11	22	07	14	61	09	16	60	07	03	07
12	-12	21	25	08	30	-02	14	-17	-10	34
13	14	12	19	54	10	23	59	-01	01	17
14	-04	07	09	03	01	02	03	-03	02	09
15	03	-08	-08	-02	-06	06	-03	15	07	17
16	-03	-06	-04	12	-05	08	11	-07	-05	10
17	-02	22	36	79	23	29	84	-05	03	45
18	-02	08	10	21	01	09	21	-05	-05	08
19	10	06	05	03	-10	15	05	14	-03	07
20	03	-09	-10	04	-06	-02	03	-02	02	-17
21	16	-06	-03	27	-10	12	25	-03	02	-03
22	-24	19	23	-26	01	05	-24	-21	-08	52
23	-09	-02	05	21	-06	-01	15	-08	05	14
24	99	-20	-21	15	-13	-06	10	23	27	-28
25	-09	22	28	65	19	22	68	-06	01	30
26	24	03	07	50	04	-03	47	-02	06	-21
27	-32	46	49	11	15	15	17	-09	-16	48
28	48	-27	-29	22	-11	-10	19	18	16	-48
29	41	-12	-11	31	-14	-01	26	04	13	-33
30	-19	06	03	-01	20	15	04	00	-06	28
31	52	-28	-28	05	-14	-05	00	39	13	-36
32	16	-06	-05	21	-07	09	20	-02	02	-04
33	05	12	13	31	06	09	31	-06	13	16
34	27	-26	-26	-07	10	-06	-04	05	29	-16
35	22	-08	-07	31	-09	10	29	09	17	-13
36	23	05	02	45	01	01	44	-07	02	-15
37	27	21	21	42	02	04	41	00	-11	-05
38	01	12	12	04	15	22	10	07	-15	11
39	-03	-10	-01	22	05	04	22	01	27	-07
40	27	-14	-12	17	-02	-04	18	12	06	-15
41	32	06	03	27	07	-08	26	15	09	-12
42	10	01	03	21	04	-01	22	13	-03	02
43	46	-16	-19	01	-12	-08	-03	04	11	-37
44	66	-36	-37	12	-13	-17	06	14	22	-52
45	63	-31	-34	06	-12	-05	03	34	23	-31
46	06	16	25	64	06	21	67	-06	-06	15
47	09	-07	-14	-20	-12	-10	-24	-04	-02	-19
48	24	06	04	31	-02	10	29	-05	03	-06

*Decimals have been omitted.

CORRELATION COEFFICIENTS OF SELECTED DATA ITEMS*

Variable	11	12	13	14	15	16	17	18	19	20
1										
2										
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8										
9										
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11										
12	05									
13	41	09								
14	08	-01	04							
15	-01	00	06	04						
16	11	04	10	-02	-03					
17	62	37	63	11	12	22				
18	14	03	10	00	-03	03	21			
19	03	-23	10	-08	02	-03	-03	-13		
20	04	-12	-09	-05	00	-13	-08	04	10	
21	53	-05	19	08	-07	08	29	10	-08	16
22	-18	23	-08	03	13	15	07	-09	-01	-13
23	01	-06	03	26	00	-04	10	04	16	-02
24	24	-11	15	-04	02	-03	00	-03	10	03
25	33	17	41	16	06	04	65	18	09	06
26	44	-02	30	-05	00	08	36	12	-05	04
27	-06	28	14	07	-03	-03	31	01	12	-10
28	24	-11	08	-15	-02	-01	00	-01	-02	23
29	34	-14	19	-05	-01	08	14	10	03	21
30	-17	13	13	21	15	-07	12	-10	-03	-20
31	15	-11	-03	-05	-01	-05	-16	-03	02	14
32	17	05	14	13	04	-03	18	13	09	06
33	19	17	24	-03	11	05	30	26	00	12
34	02	-04	-08	-06	02	-09	-18	-02	-03	07
35	04	-07	21	12	02	00	20	00	06	08
36	38	04	30	-11	-03	08	35	18	01	11
37	47	02	32	-10	-07	-01	37	24	09	11
38	24	07	04	-03	05	-03	19	01	14	-05
39	-01	-08	00	24	18	13	11	-05	-09	01
40	24	02	12	-03	02	-10	09	-13	-08	19
41	44	-04	25	14	00	-19	18	-15	09	01
42	38	05	16	26	-04	-11	22	-13	-08	-03
43	12	-12	01	-07	-02	-04	-12	00	-02	05
44	19	-20	02	-12	-03	-03	-12	05	-03	08
45	11	-08	01	-03	16	-05	-06	-04	00	01
46	72	21	46	03	01	16	71	26	05	08
47	03	-08	-22	00	-07	-05	-24	-07	-08	22
48	56	-04	20	08	-07	-09	31	15	01	25

*Decimals have been omitted.

CORRELATION COEFFICIENTS OF SELECTED DATA ITEMS*

Variable	21	22	23	24	25	26	27	28	29	30
1										
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19										
20										
21										
22	-04									
23	-02	-10								
24	15	-24	-12							
25	18	-01	32	16						
26	18	-30	-13	33	-20					
27	-10	29	24	-32	43	-21				
28	20	-35	-20	47	-09	45	54			
29	26	-30	-18	40	-07	53	-52	69		
30	-10	17	15	-19	22	-24	31	-35	-31	
31	17	32	04	51	-14	15	-33	34	24	-11
32	09	-09	09	17	08	19	-11	15	15	00
33	10	-04	-02	05	23	19	-05	10	23	01
34	00	-12	-03	26	-09	02	-26	20	13	-11
35	02	-11	12	22	19	16	-14	21	21	02
36	28	-27	-04	22	12	64	-13	46	54	-22
37	28	-24	-11	27	16	55	-13	46	59	-25
38	13	12	-18	04	07	-06	08	-01	-03	-02
39	-03	-04	20	-03	24	03	04	02	-03	10
40	19	-18	-05	28	00	22	-21	34	22	-17
41	21	-21	-07	32	16	22	-11	34	30	-08
42	21	-10	03	11	12	12	01	12	08	-09
43	13	-15	-04	45	-13	12	-32	38	31	-24
44	20	-31	-14	64	-18	31	57	67	53	-38
45	09	-25	-10	62	-11	17	-44	52	39	07
46	56	-04	-01	05	52	35	12	19	30	-14
47	46	05	-05	07	14	-07	-20	17	14	-16
48	75	-08	-05	22	25	19	-11	30	38	-13

*Decimals have been omitted.

CORRELATION COEFFICIENTS OF SELECTED DATA ITEMS*

Variable	31	32	33	34	35	36	37	38	39	40
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32	08									
33	-02	32								
34	23	09	13							
35	14	17	09	03						
36	15	10	17	-03	12					
37	10	09	16	-06	08	71				
38	-06	00	-06	-09	02	-19	10			
39	02	11	18	17	16	-29	-43	-25		
40	24	07	02	30	09	18	18	07	02	
41	17	05	19	14	04	21	23	09	01	29
42	08	02	02	13	-02	04	08	17	05	43
43	17	12	04	19	05	09	17	02	-04	15
44	54	21	02	21	24	29	26	00	02	29
45	63	13	-02	20	23	16	17	01	00	19
46	-01	16	34	-08	05	51	55	17	-02	14
47	15	02	-10	08	07	00	00	09	-08	14
48	22	06	08	03	06	30	39	22	-04	24

*Decimals have been omitted.

CORRELATION COEFFICIENTS OF SELECTED DATA ITEMS*

Variable	41	42	43	44	45	46	47	48
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42	55							
43	19	06						
44	30	10	44					
45	20	05	29	62				
46	27	22	-02	04	-03			
47	03	05	16	21	12	-08		
48	26	18	16	24	18	52	50	

*Decimals have been omitted.