AN ANALYSIS OF THE RELATIONSHIPS BETWEEN OPEN SYSTEMS AND INNOVATIVE HIGH SCHOOLS

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GLEN KAY GERARD
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This is to certify that the

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presented by

GLEN KAY GERARD

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John Holucka
Major professor

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ABSTRACT

AN ANALYSIS OF THE RELATIONSHIP BETWEEN
OPEN SYSTEMS AND INNOVATIVE HIGH SCHOOLS

By

Glen K. Gerard

The primary purpose of this study was to determine whether high schools which were classified as innovative would show evidence of being more open systems than high schools which were classified as non-innovative. The test instrument used to assess the degree of openness in high schools was developed from the body of concepts known as systems theory. The scale contains five sub-scales: adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, and wholeness independence.

The instrument "Characteristics of Openness Scale" was administered to five groups within each school: administrators, counselors, department chairmen, teachers, and students.

The basic design of the study was an analysis of variance for repeated measures involving four factors. "School type" had two levels: "innovative and non-innovative".

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Within the school type there were four replications of "school building" the unit of analysis. "Within-school groups" was crossed with school type and contained five levels: (1) administrators; (2) counselors; (3) department chairmen; (4) teachers; and (5) students. The final factor, "repeated measures", was crossed with both school type and within-school groups. It contained five levels: (1) adaptiveness; (2) hierarchial order; (3) stability; (4) progressive systemization-progressive segregation; and (5) wholeness-independence. This produced a 2 x 4 x 5 x 5 design for which the last factor is repeated measures.

The data obtained in the study indicated no significant difference between innovative and non-innovative high schools when compared on the mean scores of the "Characteristics of Openness Scale". The paired groups across innovative and non-innovative schools also showed no significant difference when compared on the mean scores of the "Characteristics of Openness Scale". All testing was done at the $p < .05$ level.

Significant data was also obtained for two other main effects: (1) type by measures interaction; and (2) the groups by measures interaction.

In order to test the main effect types by measures interaction the T-test for significant differences among means was used. A significant difference is reported between innovative and non-innovative schools when compared on the

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sub-scale measures of adaptiveness and stability. Innovative schools score significantly higher on the adaptiveness sub-scale measure than do non-innovative schools. However, on the stability sub-scale measure innovative schools scored significantly lower than did non-innovative schools. Testing was done at the $p < .05$ level.

The main effect for groups by measures interaction also indicated significant differences. Tukey's Honestly Significant Difference (HSD) test was used for the post-hoc analysis.

Administrators scored significantly higher than teachers on the sub-scale measures of adaptiveness, hierarchial order, progressive systemization-progressive segregation, and wholeness-independence. Administrators scored significantly higher than department chairmen on the sub-scale measures of adaptiveness, hierarchial order, progressive systemization-progressive segregation, and wholeness-independence. Administrators scored significantly higher than students on all five sub-scale measures.

Counselors scored significantly higher than department chairmen on the wholeness-independence measure. Counselors scored significantly higher than teachers on the sub-scale measures of progressive systemization-progressive segregation and wholeness-independence. Counselors scored significantly higher than students on the sub-scale measures

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of hierarchial order, progressive systemization-progressive segregation, and wholeness independence. There were no other significant differences observed between groups on sub-scale measures.

AN ANALYSIS OF THE RELATIONSHIPS BETWEEN OPEN SYSTEMS AND INNOVATIVE HIGH SCHOOLS

By

Glen Kay Gerard

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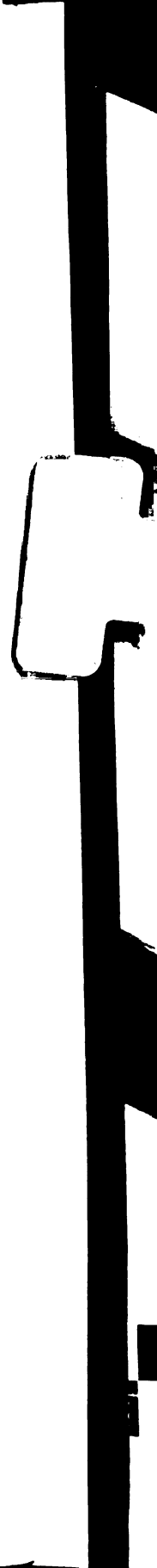

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DEDICATION

This work is dedicated to my father, William V. Gerard, in deepest gratitude for all of the stimulus and support he has offered during my many years of growth and education. Without him, this work might never have come to fruition.

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ACKNOWLEDGMENTS

There is no way to describe the love and support which I have received from my wife, Jean, during my doctoral studies. She has been a tremendous source of encouragement and consolation throughout my studies.

The support and stimulation of my parents has had a great impact upon my graduate education. Without their attention and assistance, the completion of my studies might never have become a reality.

My special thanks to Dr. John Suehr who has provided the guidance, direction, and freedom, necessary for me to have a positive and creative learning experience during my doctoral studies. I feel privileged to have worked with and known him.

A word of appreciation is extended to the members of my doctoral committee. Dr. Van Johnson, Dr. Dale Alam, and Dr. James McKee were ready to help and advisé at a moment's notice.

Lastly, I wish to thank Robert Wilson for the many long hours he spent with me as a friend and research consultant. His friendship and assistance will never be forgotten.

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CHAPTER I

THE PROBLEM

Introduction

Over the past few decades, the American high school has been called on to assume increasing responsibility for the education of the country's citizenry. The public has rightfully come to demand a high quality education for all youth. Equal education for all youth, a phrase often heard in education circles, may no longer be passed by the wayside. The needs of individuals must be taken into consideration and sincere attempts made to meet them.

The communities of America have varied and complex needs. They expect the schools to provide and maintain programs which can satisfactorily meet those needs. Larger numbers of students must be prepared for attendance at colleges and universities. The increasing demands of an advanced technological society require the training of highly skilled workers. Immediate attention must be directed at the ills of society and its ecological imbalances. There must be an opportunity for young people to develop into responsible citizens. These are only a few of the demands facing schools today.

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We must also note the implications of these demands for future generations. There is little doubt that the years ahead will bring great changes in our way of life. Halverson, discussing society and the changes to come, states:

> . . .the process of change at times will be evolutionary, at others chaotic and revolutionary. But the trend will continue, or humanity will be lost.[1]

Relationships among people will have to become more complete with fewer distinctions based on the present emphases of race, color, creed, and the power of nations. People will be different; but they will be respected for what they can give to that which is human.

Halverson continues his remarks and relates the changes of a new society to the impact on schools. He concludes:

> . . .the shift in values will not come without institutional arrangements for value clarification and value change. . . .Out of such a maelstrom of change, louder and more insistent clamor for institutional innovations to serve society will emerge. The schools will not be the least affected, and some will argue that education as broader than schooling will be the target of many proposals of the most profound order for social change.[2]

All appearances point toward new forms for family, government, and religion. Those institutions will place new

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[1]Paul M. Halverson, "The Demands of Society Upon The Schools", The High School Journal, Vol. 2, No. 4, (January, 1969), p. 170-71.

[2]Ibid., p. 171.

and larger demands on the schools. Schools will have to be flexible and open to change as society and communities evidence certain needs. Well considered change and innovation will be vital for those schools. In recent years, however, innovation has often been an educational catchword. Frequently, the essence of innovating has amounted to only minor tinkering with the educational process. Some programs have been successful in honest attempts to change. Others have failed. Many more have simply perpetuated mediocrity.

Innovation and change must be well considered and effective. William Van Til writing in the 1965 ASCD Yearbook, stated:

> Educators face the choice of accepting and reflecting tendencies and forces or appraising and fostering reflection upon tendencies and forces. The school may be a mirror or an improver of society. Uncritical acceptance and unthinking mirroring could lead to the powerless man in the powerful society. Preferable is appraisal and reflection upon tendencies through analysis of tasks and frontiers. Analysis must be followed by programs.[3]

If schools fail to change and better meet the needs of society and the community, the cries of the present will intensify in the future. As educators we dare not ignore the challenge before us. But, how can change and innovation be most effectively achieved?

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[3]William Van Til, "In a Climate of Change", Role of Supervision and Curriculum Director in a Climate of Change, ASCD Yearbook, 1965, p. 29.

Relatively little has been done in assessing how schools carry out innovation and change. We need to know more about the process of innovation and change in schools. Those charged with providing instructional programs must look closely at the administration of the complex functions of their organizations and find efficient financial and operational methods of providing effective schools.

In searching for possible methods of improving the organization and administration of schools, knowledgeable educators have often been lured by the advocates of the systems approach. Corporations, sciences, and branches of the military, have spoken highly of the merits of the systems approach. Often, it has been implied that educational institutions could benefit from its use. There have been few attempts, until recently, to apply systems theory to educational processes. A body of research to clarify and validate certain of the tenets of the systems approach as they relate to education is slowly appearing. Continued efforts in this direction will open new channels for exploration in developing instruments to improve education.

The dilemma before us is a difficult one. We must develop efficient schools; we must meet societal demands; and we must be flexible to change. Perhaps this study will assist in resolving that dilemma.

Theory

The systems approach proposes certain basic precepts upon which an effective organization, or system, is based. If a system is to be functional and also allow change to occur, those basic precepts should be followed. One of those important precepts of systems theory concerns the element of openness and closedness within an organization. A system which is more open maintains a greater receptivity to change. Assuming that concept to be important and valid, it follows that the fundamental components of openness should bear some relationship to the degree of innovation and change that takes place in a school.

Purpose

The purpose of this study is to determine whether there is any relationship between openness as explained in systems theory, and the degree to which public high schools have attempted to innovate and change. Can we find evidence that schools which show a willingness to innovate and change are more open than schools which have not?

Hypothesis

This study will attempt to test the following hypothesis: Schools which can be classified as innovative will show a higher degree of openness, as described by systems theory, than will non-innovative schools.

Significance of the Study

There are several reasons for conducting a study of this nature. First, if it could be verified that schools which tend to innovate portray certain distinctive features, there would be great value and insight gained for school administrators. Second, this study might well become one important part of a growing body of knowledge regarding the methods of change. So often we hear the comment, "we would really like to effect certain changes in this school, but we just can't get people to move." Perhaps this study will shed some light on the problem of effecting change. For, if there is a meaningful relationship between the openness of an organization and the degree to which it has committed itself to innovation, administrators can gain precious insights into the characteristics of an environment and climate for change.

Third, of crucial importance is the opportunity to expand our understanding of openness and how it relates to the effective functioning of a social organization like a school. Fourth, the study will be another step in the direction of applying the concept of systems analysis to the field of education. It will hopefully provide more evidence pertinent to a new way of solving the many problems which face administrators in our schools.

Assumptions

The study has been developed with certain basic assumptions clearly important to its validity. They are listed below:

1. The eight high schools selected for the study are a representative sample of the innovative and non-innovative high schools in Oakland County, Michigan.
2. The persons selected for completing the openness scale at each high school are a fair representation of the school's beliefs regarding existing conditions in that particular school.
3. The panel of judges chosen to select the innovative and non-innovative schools are competent and knowledgeable regarding the innovativeness of each school.
4. The scale used by the judges to define innovativeness in a high school is an accurate description of innovativeness.
5. The instrument used to measure openness in the schools is an accurate representation of the characteristics of openness as described by systems theory.

Limitations

Certain limitations are evident for this study. They are as follows:

1. Due to factors of time and cost, the study is limited to four innovative and four non-innovative schools in Oakland County, Michigan. Therefore, the potential to generalize is scientifically limited to that county and others demographically similar to it.
2. The study does not concern the total effectiveness of the specific innovations in the individual schools. The interest of the study deals with the tendency of the schools to innovate.
3. The study may be limited by any weaknesses in the instrument used to assess openness in each school.

4. The study could be influenced by the prejudices of the subjects toward innovation and openness.

Terminology

In order to guarantee some common base for studying this research report, it is necessary to indicate the definitions for key terms which are accepted in writing the report. They are as noted below:

1. High School: For the purposes of this study, high school will refer to the culminating three or four years of schooling for children in the public school system; specifically, grades ten, eleven, twelve, or grades nine, ten, eleven, and twelve. The term also implies a school with curricular offerings that are basically comprehensive in nature.

2. Change: Any alteration in the structure, processes, goals, or purposes of the organization between two points in time.

3. Innovation: A specific, planned change for the purpose of more effectively achieving the goals and objectives of the organization.

4. System: Any recognizable delimited aggregate of dynamic elements that are in some way interconnected and interdependent and operate together according to certain laws and in such a way as to produce some characteristic total effect.[4]

5. Systems Theory: A series of related definitions, assumptions, and propositions about all levels of systems ranging from atomic particles, organisms, institutions, societies, and galaxies.

6. Systems Analysis: The analysis and selection of elements, relationships, and procedures, in a system, to achieve a specific goal.

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[4]Floyd H. Allport, Theories of Perception and the Concept of Structure, (New York: John Wiley and Sons, 1955), p. 469.

Overview

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Overview

It is relevant at this point to note the general framework for the study. In Chapter II, the literature relating systems analysis to education is reviewed. Special note is made of the categorical divisions into which different types of systems approaches fall.

In Chapter III, attention is directed toward providing the theoretical basis for the study. Systems theory is discussed with emphasis placed on what it is, how it developed, and its relationship to social systems. Particular emphasis is placed on the construct of openness and closedness, which is central to the formulation of the study.

Included in Chapter IV are the methods used in carrying out the study. The procedures for selecting schools is carefully defined as well as the selection of subjects from each school. The administration of the instrument is thoroughly explained.

Described in Chapter V is the treatment of the data collected. The data is analyzed and given careful interpretation.

In Chapter VI, the findings of the study are summarized and general conclusions drawn for the possible use of the findings. Thoughts about future research are related and some potential challenges proposed.

With the general sketch of the dissertation in mind, it is appropriate to move directly into the review of the literature relating the systems approach to education.

CHAPTER II

A REVIEW OF THE LITERATURE RELATING SYSTEMS THEORY TO EDUCATION

A study of the current literature on education reveals frequent references to an idea described as the "systems approach". Most often writers are exhorting educators to use the systems approach to improve education. They advocate the systems approach for more efficient budgeting, improved instructional programs, technological applications, and a more logical method of planning and evaluating.

The idea of a "systems approach" is both popular and unpopular. It is popular because to many it seems theoretically sound to consider the whole system when planning and analyzing. On the other hand the systems approach is often unpopular because of the "real" evidence that is brought forth regarding the functions of the system. Some even fear the possibility of the systems approach reaching the point of serving the whole system to the exclusion of consideration for the individual parts.

Certain writers advocate the "systems approach" of looking at the total organization. One of those writers who argues for the importance of looking at the whole system is

John Goodlad.[1] He feels that most educational change has been peripheral in nature. To redesign the whole system is too great a task. Thus, only a tinkering with the parts has taken place and some change has been given an innovative label. The result is no real significant change. Goodlad indicates that making a significant change without redesigning the several parts which are related to the change is meaningless and often makes conditions worse than before.

Donald Meals says that today's educator must respond to the call of the systems approach. The educator must:

> see his activity as a whole--not only the whole child but also the curriculum and the media and the teacher and the management system for putting these and other resources together in a functional system.[2]

The systems approach has been described as a near absolute tool for effective problem solving. Some have pictured it as a way of thinking about things. Logicians have long said that when we want to solve problems we should first consider the thinking process.

C. West Churchman states, "when you postpone thinking about something too long, then it may not be possible to

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[1]John Goodlad, "The League of Cooperating Schools", (Los Angeles: The Institute for the Development of Educational Activities, April, 1966). (Mimeographed.)

[2]Donald W. Meals, "Heuristic Models for Systems Planning", Phi Delta Kappan, Vol. 48, No. 5, (January, 1967), p. 200.

think about it adequately at all.[3] Bela Banathy discusses the systems approach as a means of solving problems. He says:

> The systems approach is a pragmatic application of the scientific method; it is a synthesis of successful methodologies in problem solving, planning, and development, used by many people in many fields over a long period of time.[4]

In proceeding through a review of the literature available on the "systems approach" one is initially confused at the various terminology and the general random use of the term. However, we can, for the purpose of a basic understanding, identify basic patterns of writing in the literature. First, there are those writers who view the systems approach as a plan or strategy for approaching such educational problems as budgeting, instructional programs, and efficient planning. Second, there are those writers who would equate the systems approach with the use of technology in education.

There is a third group of writers whose views are not directly related to the systems applications in education. It is their general view that social organizations

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[3]C. West Churchman, The Systems Approach, (New York: Dell Publishing Co., 1968), p. 8.

[4]Bela H. Banathy, Instructional Systems, (Palo Alto: Fearon Publishers, 1968), p. 16.

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are systems and must be analyzed in that light. Schools are social organizations and thus, can be classified as systems. We must take note of the writings of these men if we are to more thoroughly understand the nature of schools in terms of the systems approach. Therefore, we take a look first at some of the writers who view social organizations as systems.

Social Organizations as Systems

The writers who view social organizations as systems would maintain that it is the total organization, not merely key individuals, which must be looked at if there is to be an understanding of how it meets the challenge of changing, growing, and adapting, to meet the demands of the environment.

E. H. Schein says that "perhaps the most important argument for a systems conception of organizations is that the environment within which organizations exist is becoming increasingly unstable".[5] He feels that the total organization must be studied if one is to understand the complex relationships between organizations and their environments.

One of the most vigorous groups of advocates of the systems approach to organizational phenomena has been the social scientists associated with the Tavistock Institute in London. Their studies of changing technology in the coal

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[5]Edgar H. Schein, Organizational Psychology, (Englewood Cliffs: Prentice-Hall, Inc., 1965), p. 89.

mining industry and the redesign of work in Indian textile mills brought forth two important systems concepts.

The first of those two concepts is described by E. L. Trist.[6] He implies that any productive organization or part thereof is a combination of technology (task requirements, physical conditions and available equipment) and a social system (a system of relationships among those who must perform the job). The technology and the social system (socio-technical system) are in mutual interaction with each other.

The second important concept is described by A. K. Rice.[7] He argues that any given organization "imports" various things from its environment, utilizes these imports in some kind of "conversion" process, and then "exports" products, services, and waste materials which result from the conversion process. This description is labeled by Rice as the "open-system" definition of organization.

Another writer has proposed a model of social systems which is useful for both the small group or large organization. G. C. Homans talks of "external and internal" systems.[8] The external system is a combination of activities,

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[6]E. L. Trist, et al., Organizational Choice, (London: Tavistock Publications, 1963).

[7]A. K. Rice, The Enterprise and its Environment, (London: Tavistock Publications, 1963).

[8]G. C. Homans, The Human Group, (New York: Harcourt, Brace and World, 1950).

interactions, and sentiments which are primarily determined by the environment. He proposes that these activities, interactions, and sentiments are mutually dependent on one another. The internal system, according to Homans, describes a pattern which arises out of the inter-relationships of the interactions, activities and sentiments of the external system.

Thus, Homans would hold that the internal and external systems are mutually dependent. In addition, these two systems and the environment are also mutually dependent. Just as change in the environment will produce changes in the formal and informal work organization, so the norms and activities developed in the internal system will eventually alter the physical, technical, and cultural environment.

R. Likert adds two important ideas to those of Rice, Trist, and Homans.[9] One, notes that organizations can be usefully conceptualized as systems of interlocking groups. The second, notes that the interlocking groups are connected by individuals who occupy key positions of dual membership, serving as linking pins between groups.

Kahn's study emphasizes the great degree of interdependence of organizational variables like rank, location of position in the structure, role expectations, perception

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[9]R. Likert, New Patterns of Management, (New York: McGraw-Hill, 1961).

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of such expectations, coping patterns in response to perceived conflict, and effectiveness of role importance.[10]

Schein feels strongly that there must be a "redefining of organization in systems terms". This new definition must take note of the fact that:

> the organization must be conceived as an open system. . . the organization must be conceived of as a system with multiple purposes or functions which involve multiple interactions between the organization and its environment. . .the organization consists of many subsystems which are in dynamic interplay with one another. . . because the subsystems are virtually dependent, changes in one subsystem are likely to affect the behavior of other subsystems. . .the organization exists in a dynamic environment which consists of other systems, some larger, some smaller than the organization. . .the multiple links between the organization and its environment make it difficult to specify clearly the boundaries of any given organization.[11]

Another group of writers has attempted to look at organizational effectiveness in terms of systems-level criteria. Bennis[12] and Argyris[13] acknowledge that every system has multiple functions and that it exists within an environment which provides unpredictable inputs. They feel that

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[10] R. L. Kahn, D. M. Wolfe, R. P. Quinn, J. D. Snoek, and R. A. Rosenthal, Organizational Stress: Studies in Role Conflict and Ambiguity, (New York: John Wiley and Sons, 1964).

[11] Schein, op. cit., p. 95.

[12] W. G. Bennis, "Toward a 'Truly' Scientific Management: the Concept of Organizational Health," in General Systems Yearbook, (Ann Arbor: Society for General Systems Research, 1962), pp. 7, 269-82.

[13] C. Argyris, Integrating the Individual and the Organization, (New York: John Wiley and Sons, 1964).

a systems effectiveness can be defined as its capacity to survive, adapt, maintain itself, and grow, regardless of the particular function it fulfills.

Bennis makes a very concise statement to this effect:

> If we view organizations as adaptive, problem-solving organic structures, then inferences about effectiveness have to be made, not from static measures of output, though these may be helpful, but on the basis of the processes through which the organization approaches problems. In other words, no single measurement of organizational efficiency or satisfaction--no single time slice of organizational performance--can provide valid indicators of organizational health.[14]

Bennis instead would propose three criteria of organizational health which he feels are vital: adaptability, a sense of identity, and capacity to test reality.

C. Argyris adds a fourth criterion to those listed above by Bennis.[15] He speaks of the "state of integration" among subparts of the total organization such that the parts are not working in opposition to each other. Argyris emphasizes those conditions which will permit an integration of individual needs and organizational goals. He regards certain conditions as unhealthy or ineffective. Restrictions on output, destructive competition, and apathy, in order to fulfill personal needs at the expense of organization goals, are unhealthy.

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[14]Bennis, op. cit., p. 273.

[15]Argyris, op. cit.

McGregor would basically concur with the above conception. According to his theory, if management develops practices built on a more valid set of assumptions about man, it will produce integration and thus greater effectiveness.[16]

It appears that systems conceptions take us a great deal farther than did the simple mechanical models of early organizational theory. The analysis of organizations as "wholes" and the important relationships among subparts is tremendously important. However, we have a great deal yet to discover about the systems approach to organizations and organizational effectiveness. Perhaps this study will help in that concern.

The Systems Approach and Technology

There are several writers who equate the "systems approach" to education with the use of technology. Present-day schools cannot meet the demands of changing society and educational needs without the use of technological systems. Schools must be aware of the nature of contemporary technology, its rate of change, and the technical orientation of our age. Not only must schools be prepared to use this

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[16] D. M. McGregor, The Human Side of Enterprise, (New York: McGraw-Hill, 1960).

technology but they must help prepare today's youth for a society which is highly technological in nature.

Unless schools are able to respond to and draw from the communication and computer technology systems at a highly sophisticated level, they will soon find themselves becoming irrelevant to the needs of society. John Loughary points out the importance of technological systems for education when he says:

> individual educators will become increasingly dependent upon support systems, especially those concerned with instructional resources, information storage and retrieval, and multi-media instructional packages.[17]

Loughary perceives the systems approach as a man and machine working together in all educational training programs. As the public demands more for the educational dollar, the working together of man and machine will become vital to education. The pace will speed up and we must be ready for the changes to come in education.[18]

S. Leonard Singer writes about the systems approach being utilized at Florida State University.[19] The University

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[17]John Loughary, "Can Teachers Survive the Educational Revolution", Phi Delta Kappan, Vol. 48, No. 5, (January, 1967), p. 206.

[18]John W. Loughary, Man-Machine Systems in Education, (New York: Harper and Row, 1966).

[19]S. Leonard Singer, "A Systems Approach", New Media in Higher Education, Edited by James W. Brown and James W. Thornton, Jr., (Washington, D. C.: National Education Association, 1963).

may very well be the first institution of higher education planned and developed around the instructional media and technological system. According to Singer, the approach is the creative and imaginative use of the total complex of media and technology by (a) determining the character, nature, and quality of required learning experiences; and (b) designing a combination of media and technology (library, television, audio-visual materials, computers, electronic learning labs, etc.) to bring that experience to fruition.

The experience of the military and aerospace programs has, according to Allen and Bushnell, proved the value of the systems approach. They view it as the "planned evolutionary development of a unified information processing system". Their discussion refers to the implementation of new hardware components into their "instructional system", facilitation of information flow among subsystems, simulation, computers, data banks, and automation.[20]

Patrick Suppes has said of computer systems and computer assisted instruction (CAI): "just as books freed serious students from the tyranny of very simple methods of oral recitation, so computers can free students from the

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[20]Dwight W. Allen and Don D. Bushnell, "Developing EDP Systems: Issues and Recommendations", The Computer in American Education, (New York: John Wiley and Sons, 1967).

drudgery of doing exactly similar tasks unadjusted and untailored to their individual needs.[21]

Johnson and Otero state that in their opinion, "the school that educators must design and build today for tomorrow will draw heavily upon the talents of machines and machine systems.[22]

Silberman and Carter list individualization of instruction, solutions to management problems, and computer based counseling as some of the major advantages they observe for the systems approach.[23] These things would be found in their conception of the "ideal" school. Students would be allowed to learn at their individual levels through the use of new developments in media and technology. Flexible scheduling, allocation of resources, and ready access to student records could be greatly reduced as managerial problems by use of computers. Counselors could supplement their programs with the use of student interaction with computer linked teletype consoles.

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[21]Patrick Suppes, "Computer Technology and the Future of Education", Phi Delta Kappan, Vol. 49, No. 8, (April, 1968), p. 420.

[22]Ted Johnson and Hector Otero, "The School and Technology", Theory into Practice, Vol. 7, No. 4, (October, 1968), p. 139.

[23]H. F. Silberman and L. F. Carter, "The Systems Approach, Technology and the School", New Approaches to Individualizing Instruction, (Princeton: Educational Testing Service, 1965).

To Cogswell, the systems approach is looking for new solutions for implementing instructional media through analysis and simulation of school organizations.[24] Hoban argues that the use of systems concepts are intellectually and practically, inescapable if we are to cope adequately with educational media research and findings.[25] Karl Zinn also would contend that the systems approach means computer-instructional programs.[26]

James Finn indicates that two concommitant developments have been taking place: one, a technology associated with mass instruction; the other, a technology associated with individualized instruction.[27] These two technologies are being united in an all encompassing instructional technology that is forcing the educational administrator to consider new patterns of staff deployment and new logistics of instruction. Finn notes that administrators themselves will

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[24]John F. Cogswell, "Systems Technology in Education", Man-Machine Systems in Education, Edited by John W. Loughary, (New York: Harper and Row, 1966).

[25]Charles F. Hoban, "From Theory to Policy Decisions", AV Communication Review, Vol. 13, (Summer, 1965), pp. 121-39.

[26]Karl Zinn, "Computer Assistance for Instruction: A Review of Systems and Projects", The Computer in Education, Edited by Dwight W. Allen and Don D. Bushnell, (New York: John Wiley and Sons, 1967).

[27]James D. Finn,"Instructional Technology", Bulletin of the National Association of Secondary-School Principals, Vol. 47, No. 5, (May, 1963), pp. 99-119.

be forced to change their functions as these new technological developments become more widespread.

Lindley Stiles relates the systems approach to technology in education when he writes:

> Basically the system idea is one of planned development. It makes full use of interdisciplinary resources to project and refine hypotheses. It relies heavily on computer technology to simulate models and assess alternatives. It designs, develops and tests hardware for specific use.[28]

Stiles poses the serious question of whether or not this process will become merely a money making tool for business. It is his contention that educators must in some way keep the goal as one of "educational development for all".

VanderMeer emphasizes that the particular system that developed from an analysis of any given situation would be dependent upon one's views concerning the function of the school.[29] Differing views would inevitably lead to differing systems, since any analysis must begin with specifications of goals. Since system design requires an analysis

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[28]Lindley J. Stiles, "Policy and Perspective: The System Approach in Education", Journal of Educational Research, Vol. 60, No. 5, (January, 1967), Inside Cover.

[29]A. W. VanderMeer, "Systems Analysis and Media--A Perspective", AV Communication Review, Vol. 12, (Fall, 1964), pp. 292-301.

of system components, a searching analysis of the characteristics of the different resources must be made to enable their combination into meaningful components and subsystems of larger systems called the "school" and "education".

We have seen that the use of the systems approach is viewed by many as primarily technological in nature. They, of course, do not feel that the systems approach is only a technological one. They acknowledge that the systems approach is legitimately proposed for other educational applications and areas as well. With that in mind we progress to look at another group of writers: those who discuss the systems approach and instruction.

The Systems Approach and Instruction

An instructional system, according to Randall, is that part of the learner's environment which is purposely controlled by a school for the purpose of securing for the learner the attainment of specific learning objectives. He cites the following components of an instructional system as defined on the basis of resource categories: "(1) men who interact with the learner; (2) materials which contain and present to the learner information and various forms of meaningful stimuli; (3) machines, which aid in the presentation of the materials to the learner, master facilities which architecturally house and support the learner, men, materials, and machines; and (4) methods, which prescribe

how the men, materials, machines, and master facilities are to be employed in interaction with the learner to secure the attainment of the specified learning objectives.[30]

The social, home, work, and community environment are not seen by Randall as part of the instructional system because they are not controlled by the instructional institution. However, one of the serious drawbacks of many instructional systems is the ignoring of these external environmental factors. The risk of failure for an instructional system will be very high unless the home, social, work, and community environments are made relevant.

The principal components and purposes of an instructional system, as cited by Knirk and Childs, are:

> students (background, ability, and objectives), teachers, and instructional materials. The purposes of instruction or learning are as broad as knowledge itself, but at any moment in time a teacher has a delimited set of objectives. . .It is the link between instructional objectives and the way the various components are arranged and made available for student use which result in a specific instructional system.[31]

Another view of instructional systems is offered by J. Lloyd Trump. He summarizes that "a carefully planned instructional system in any subject area, at any grade level

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[30]Ronald K. Randall, "Perspectives on the Instructional System", Educational Technology, Vol. 9, No. 2, (February, 1969), pp. 8-9.

[31]Frederick G. Knirk and John W. Childs, eds., Instructional Technology, (New York: Holt, Rinehart and Winston, 1968), p. 43.

of schooling, varies the educational setting as the purposes and content of what is to be learned change.[32]

The designer of instructional systems has a difficult task. There are many ways of arranging instructional components to achieve a set of objectives. The many variables which need to be considered have to be available and logically developed for use by the learner.

Robert Corrigan notes the difficulty of this problem for educators when he writes about the use of the systems approach in designing instructional systems.[32] It is his feeling that the systems approach is a grand strategy or plan. It is the process of design and control for establishing the objectives of a system, identifying the functions which must be performed to achieve the objectives, determining how those functions may be best performed, organizing resources, and implementing, and checking the efficiency of the operating system. If necessary, adjustments and corrections must be made on the basis of recognized efficiency and changing requirements.

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[32]J. Lloyd Trump and Dorsey Baynham, Focus on Change--Guide to Better Schools, (Chicago: Rand McNally and Co., 1961).

[33]Robert E. Corrigan, "Developing and Validating Instructional Materials Through the Instructional Systems Approach", (Anaheim, California: Litton Instructional Materials, Inc., 1966). (Mimeographed.)

The development of a system for learning is thus basically a decision-making process. Decisions have to be made about what should be learned, how, by whom, when and where; how learning should be evaluated and improved, and what resources should be involved in preparing for, providing for, and evaluating learning.

It is not the purpose of this paper to go into great detail about the development of instructional systems. Several models have been developed and used in the systems approach to instructional planning. Most models have certain basic characteristics which can be represented in chart form. Figure 1. gives a very basic picture of the overall structure of the design of instructional systems.[34]

The Systems Approach and Resource Allocation, Planning, and Evaluation

One plan or strategy involving the systems approach which is receiving much attention in the literature is concerned about planning and efficient allocation of resources. In 1965 President Lyndon B. Johnson directed the adoption of a more modern approach to planning and budgeting within the federal government. As a result, new methods for budgeting and planning were developed and adopted. These

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[34]Banathy, op. cit., p. 28.

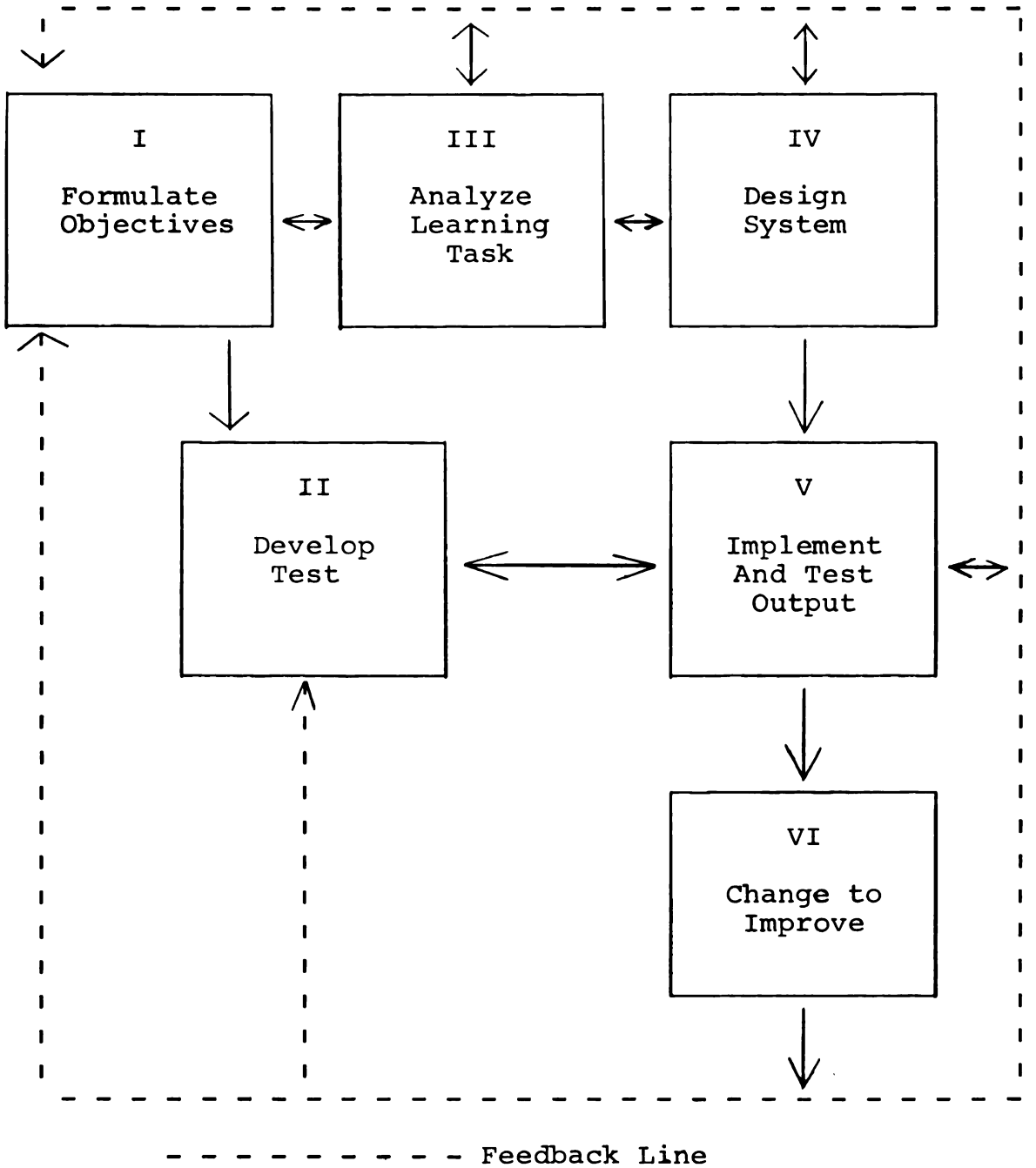

Figure 1.--An Over-All Structure of the Design of An Instructional System

methods were evident not only in the federal government, but soon began to appear in the private sectors of the nation as well.

Many of the advocates of the new approaches are enthused about their potential. One approach is called the Planning-Programming-Budgeting System (PPBS). Joeseph McGivney says: "PPBS (and other planning-budgeting systems) represents an approach which requires the decision-maker (or his systems analyst) to ask (1) what his objectives and outputs are, and (2) what and how information should be created, organized, and utilized in order to properly assess the potential and actual achievement of those objectives and their alternatives."[35]

Thus, to the extent that the decision-maker is successful, decisions relative to the allocation of scarce resources will be improved over other decisions that might have been made while employing the more traditional techniques of budgeting.

Clay Thomas Whitehead notes that, "program budgeting is a very simple concept. It is basically a different way of presenting the allocation of an organizational budget.

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[35]Joeseph H. McGivney, "The new 'Systems' Approaches to Resource Allocation Decision: A Second Look", Educational Technology, Vol. 9, No. 8, (August, 1969), pp. 31-34.

Program budgeting displays expenditures by objectives rather than by expenditure items as in line-item budgeting."[36]

Whitehead feels strongly that for purposes of strategic planning, the program budget is clearly more relevant. He does, however, differentiate between systems analysis and program budgeting. He states:

> a program budget could be adopted without using systems analysis to help make the decisions on resource allocation, and vice versa. However, in order to institute program budgeting into the organizational budgeting process, the objectives of the organization must be set out explicitly and their interactions explored. . . .In short, systems analysis and program budgeting are natural partners in the stragegic planning and decision-making process.[37]

George A. Chambers says, "the conceptual framework of PPBS is keyed upon planning and includes objectives, alternatives, inputs, costs, time dimensions, outputs, analysis, and evaluation."[38] Thus, Chambers feels that PPBS is oriented toward output and in education this means planning for learning. It is not a panacea, but provides a new approach to the old problem of improving learning.

Lichtenberger summarizes the prime benefits of PPBS for education:

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[36]Clay Thomas Whitehead, Uses and Limitations of Systems Analysis, (Santa Monica, California: The Rand Corporation, September, 1967), pp. 62-63.

[37]Ibid., p. 63.

[38]George A. Chambers, "PPBS--New Challenge and Opportunities for the Principal in Financial Planning and Management," North Central Quarterly, Vol. 42, No. 4, (Spring, 1968), p. 306.

1. Improved assessment of the efficiency of allocation of educational resources.

2. More continuous and consistent consideration and review of educational resources.

3. Sharper and more consistent examination of essential sequences of educational development.

4. More effective communication through all levels of management concerning process and operation as they relate to the achievement of objectives.

5. Better understanding of how educational resources and effort relate to accomplishment.

6. Disclosure of the kinds of educational development foregone when resources are limited.

7. Better opportunity to set educational priorities.[39]

One other systems approach that is often advocated for education is entitled the "Program Evaluation and Review Technique" (PERT). PERT originated and developed in the United States in the wake of the rapid progress in technology following World War II. New techniques for managing the development, production, and installation of U. S. weapon and support systems were needed if they were to be maintained. PERT emerged with the Fleet Ballistic Missile Program of the Navy in 1958.

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[39]Allan R. Lichtenberger, "Program Planning, Budgeting, and Accounting in School System Operations--A Position Paper," (Washington, D. C., September, 1967), pp. 3-5. (Mimeographed.)

PERT is basically a managerial tool employing networks. The networks used are "flow diagrams consisting of the activities and events which must be accomplished to reach the program objectives, showing their logical and planned sequences of accomplishment, interdependencies and interrelationships.[40]

Schoderbek underscores the idea that ". . .the PERT network depicts not only the many and varied components making up a system or subsystem, but also the all important, intricate interrelationships that prevail among these."[41]

David G. Boulanger describes PERT in more specific terms:

> PERT, as a dynamic tool, uses linear programming and statistical probability concepts to plan and control series and parallel tasks which appear only remotely interrelated. Many tasks involve extensive research and development which itself is difficult to schedule, least of all to find a "one best way" of doing it. PERT's objective is to determine the optimum way by which to maximize the attainment, in time, of some predetermined objective that is preceded by a number of constraints--hence its linear programming feature. A measure of the degree of risk is predicted in probabilistic terms to foretell the reasonableness of accomplishment on scheduled time--hence its statistical probability feature.[42]

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[40]PERT FUNDAMENTALS, (Washington: PERT Orientation and Training Center, 1963), Vol. III, p. 16.

[41]Peter P. Schoderbek, Management Systems, (New York: John Wiley and Sons, Inc., 1967), pp. 379-80.

[42]David G. Boulanger, "Program Evaluation and Review Technique", Advanced Management, (July-August, 1961), p. 8.

Desmond L. Cook has studied the application of PERT in educational planning. He points out:

> after examining the nature and purpose of educational research and development projects, the general characteristics of such projects appear to be sufficiently similar to research and development projects in other areas (e.g., military and industry) that the education project manager does indeed have a need to know about the time, cost, and performance status of his project to make the necessary decisions to complete the project successfully.[43]

It is Cook's contention that there is so much similarity that the benefits accruing to project managers who use PERT for planning in non-educational situations, can accrue also to project managers in the educational situation.

Problems of the Systems Approach

Although the proponents of the systems concept in education are in the majority, there are writers who note that there are significant problems and some limitations.

T. C. Helvey discusses the difficulties of changing to a systems approach. He cites such problems as, "teacher preparation, the availability of data handling systems which require a new dimension in expenditures, suitable and display systems for class operation."[44] He warns that the new

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[43]Desmond L. Cook, "PERT Applications in Educational Planning," Paper presented at the Annual Meeting of the Association of Educational Data Systems, (Philadelphia: Educational Resources Information Center, May 3, 1966), pp. 5-6.

[44]T. C. Helvey, "Cybernetic Pedagogy", Educational Technology, Vol. 9, No. 9, (September, 1969), p. 21.

trend in education will bring about an upset in the educational hierarchy. Teachers may very well become the experts while administrators and professors become the tools for the output of data.

Kraft and Latta point out the difficulties inherent in using models in the systems approach. They say, "(1) Models are subject to the usual dangers encountered in dealing with abstractions. For example, the model may be greatly oversimplified and/or not a valid model of the desired object system; (2) The symbolic language used to represent a model may not lend itself to being stretched to encompass the model; and (3) Some people have a tendency to become "hung-up" or infatuated with a model; and, as a result their effectiveness in offering a solution to the problem becomes very limited."[45]

According to Harry Hartley, there are "twelve hurdles to clear before you take on systems analysis." They are: shortage of trained personnel, political factors, increased costs, distortion of goals, the cult of testing, measurement difficulties, overemphasis of efficiency, the centralization

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[45]Richard H. P. Kraft and Raymond F. Latta, "Systems Engineering Techniques: Embarrassment or Opportunity for Today's Educators?", Educational Technology, Vol. 9, No. 9, (September, 1969), p. 28.

syndrome, organizational strains, teacher resistance, transfer problems, and the wisdom lag.[46]

The problems primarily associated with the systems approach in education are those of human elements. There are very few who feel that the systems approach in itself is of no importance. It is apparent, however, that the problems of the human factor must be dealt with if the systems approach is to be effectively utilized.

Summary

The "systems approach" concept is still in its infancy. There are many questions yet to be asked and much research to be done. The trend toward systems approaches in all fields has brought on the possibility of a "systems era" that in reality encompasses the jet age or space age or the atomic age. If the systems approach can assist educators in providing more meaningful learning experiences for our youth, then we should become knowledgeable and capable in its use. However, there is no guarantee that it is the panacea for educational problems. The hope is that

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[46]Harry J. Hartley, "Twelve Hurdles to Clear Before You Take on Systems Analysis," American School Board Journal, Vol. 156, (July, 1968), pp. 16-18.

it can help us solve the problems of today and tomorrow in administering our schools.

It appears that education has reached a significant point in twentieth century systems approaches. We are ready to consider its value in change and innovation in our schools. The review of the literature indicates that the systems approach is now being used in areas of instructional programs, technology, allocating resources, evaluating, and planning. The literature indicates that we had better be ready to use the "systems approach."

In Chapter III we take a very thorough look at the "general systems theory" upon which the system approach is based. If we are to continue to apply the systems approach wisely to problems in education, we must have a sound understanding of the theoretical concepts upon which it is based.

CHAPTER III

SYSTEMS THEORY

Introduction

The present study is centered around the body of concepts known as "systems theory". Hearn says, "A constructural framework for theory building is only as good as the central construct around which it is organized".[1] The central construct used in this study is "system" and more specifically the open, organismic type of system.

One extremely important characteristic of "systems" is the degree to which they can be classified as open or closed. In general, systems may be described as being one of two types: open or closed. Closed systems are isolated from their environment. Open systems are related to and exchange matter with their environment. A living organism is a good example of an open system. A typical example of a closed system is a chemical experiment in which materials are confined to a reaction vessel and once the experiment

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[1]Gordon Hearn, Theory Building in Social Work, (Toronto: University of Toronto Press, 1958), p. 38.

has begun there is no material exchanged between the reaction mixture and its environment.

In this Chapter we deal with Part I: Systems in General; and Part II: Open and Closed Systems. The intent is to lay a theoretical base for the study of the "systems approach" in education.

Part I: Systems in General

Development of Systems Theory

During the past twenty-five years many scholars from several fields of science have come to believe that there are certain basic commonalities to be found in all systems and the way in which they function. It is their conviction that all forms of animate and inanimate matter can be represented as systems. These men, now called "systems theorists", would suggest that atoms, cells, organs, individuals, ecological communities, societies, and galaxies, can be thought of as systems.

Systems, contend the theorists, are subject to certain common definitions, principles, and hypotheses. They also believe that systems contain common properties, although manifested in different forms, and that there are universal truths which characterize the structure and functions of systems. Thus, the interdisciplinary analysis of systems and the discovery of common principles, has led to the development of a "general systems theory".

Von Bertalanffy states:

> . . .there exist models, principles, and laws that apply to generalized systems or their subclasses, irrespective of their particular kind, the nature of their component elements, and the relations of "forces" between them. It seems legitimate to ask for a theory, not of systems of a more or less special kind, but of universal principles applying to systems in general.
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> In this way we come to postulate a new discipline, called General Systems Theory. Its subject matter is the formulation and derivation of those principles which are valid for "systems" in general.[2]

Perhaps the most instrumental man in the development of "general systems theory" has been Ludvig von Bertalanffy, the distinguished biologist from Austria. He first suggested the basic concept in 1947 when writing an article for the German publication, Der Student. In 1950 he wrote an article for the British Journal of Philosophical Science titled, "An Outline of General System Theory".[3] The work is seen today by many as a classic in the field of systems theory.

In the United States, scholars were meeting in Chicago to consider the same basic kind of ideas that Bertalanffy had proposed. A group representing the disciplines of anthropology, economics, psychology, psychiatry, medicine, sociology, history, biology, and mathematics, met

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[2]Ludvig von Bertalanffy, "General Systems Theory", Main Currents in Modern Thought, Vol. II, No. 4, (March, 1955), pp. 75-76.

[3]Ludvig von Bertalanffy, "An Outline of General Systems Theory", British Journal for the Philosophy of Science, Vol. 1, No. 2, (August, 1950).

in 1949 to determine whether a sufficient body of knowledge existed to justify developing an empirically testable general theory of behavior. Before long, theorems and hypotheses were being actively tested by the group. By 1955 considerable progress had been made. James G. Miller made this clear when he wrote a rather extensive report published in The American Psychologist, titled "Toward a General Theory for the Behavioral Sciences".[4]

The Society for the Advancement of General System Theory was formed in December, 1955, at Berkeley, California. A year later it published its first yearbook[5] and a journal, Behavioral Science, both for the purpose of furthering the knowledge and study of systems. Each is still in publication today.

Several men have made significant contributions to the literature on systems theory. Gordon Hearn in his book, Theory Building in Social Work, made a significant contribution to the field.[6] Bennis, Benne, and Chin in their text, The Planning of Change, produced a comprehensive work

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[4]James G. Miller, "Toward a General Theory for the Behavioral Sciences", American Psychologist, Vol. 10, No. 9, (September, 1955), pp. 513-531.

[5]General Systems--Yearbook of the Society for the Advancement of General Systems Theory, eds. Ludvig von Bertalanffy and Anatol Rapoport, (Ann Arbor, Michigan: Braun-Brumfield, 1956).

[6]Hearn, op. cit.

which emphasized systems theory.[7] Other scholars who have made important contributions to the literature include W. Ross Ashby, Anatol Rapoport, Kenneth E. Boulding, Mihajlo Messarovic, Russell L. Ackoff, A. D. Hall, Robert Gagne, and Walter Buckley.[8]

Definition of System

The idea of "system" is not a recent development. It has appeared since earliest times in almost every area of physical and social science. The Egyptian architects of the tombs of pharaohs relied on a system of measurement and labor for construction. Astronomers in ancient Phoenicia studied a system of stars and made predictions from their observations. Plato and other Greeks thought about a system for society in which philosophers would be kings. Adam Smith in his book, Wealth of Nations, described a system for setting up a pin factory.

There are economic systems, social systems, educational systems, information systems, industrial systems, military systems, and transportation systems, to mention a

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[7]Warren G. Bennis, Kenneth D. Benne, and Robert Chin, eds., The Planning of Change, (New York: Holt, Rinehart, and Winston, 1964).

[8]See Bibliography.

few. For physicists the system has been the machine, while for biologists it has been the organism. Sociologists have had the institution as a system, educators the whole child, and psychologists the Gestalt or the field.

The term "system" cannot be pinpointed to a single definition in easy manner. It is universally applied and often in a loose and colloquial manner. James G. Miller in a review of R. R. Grinkers book, Toward a Unified Theory of Human Relations, discussed the variation in usage. He says:

> . . .Like others before and after them, the participants in this conference found it hard to agree on exactly what a system is. The following three notions of systems often were confused and never were precisely distinguished: (a) Conceptual Systems--formalizations in the sense ordinarily employed in mathematics; (b) "Real" systems, living or non-living--objects in physical space-time which are observed and measured ordinarily by methods and procedures common to the natural sciences; (c) Abstracted Systems--either relationships of various sorts of classes of behavior or relationships which can be identified in, or exist between "real" systems.

Systems may also be distinguished in two important ways. Hearn describes them as follows:

> . . .systems may be differentiated in terms of the models they employ for purposes of symbolization. . . systems may very secondly, in terms of their openness or closedness.[10]

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[9]James G. Miller, review of R. R. Grinker, "Toward a Unified Theory of Human Behavior", in Behavioral Science, Vol. 1, No. 1, (January, 1956), p. 321.

[10]Hearn, op. cit., p. 40.

One of the more comprehensive definitions of systems is offered by Floyd H. Allport. He associates the term with:

> any recognizably delimited aggregate of dynamic elements that are in some way interconnected and interdependent and that continue to operate together according to certain laws and in such a way as to produce some characteristic total effect. A system, in other words, is something that is concerned with some kind of activity and preserves a kind of integration and unity; and a particular system can be recognized as distinct from other systems to which, however, it may be dynamically related. Systems may be complex; they may be made up of interdependent sub-systems, each of which, though less autonomous than the entire aggregate, is nevertheless fairly distinguishable in operation.[11]

Miller defines systems as, "bounded regions in space-time, involving interchange among their parts, which are associated in functional relationships, and with their environment."[12]

More concise terms are used by Hall and Fagen. Yet, their definition allows for a greater range of systems to be included. They conclude, "A system is a set of objects together with relationships between objects and between their attributes."[13]

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[11]Floyd H. Allport, Theories of Perception and the Concept of Structure, (New York: John Wiley and Sons, 1955), p. 469.

[12]James G. Miller, "Toward a General Theory for the Behavioral Sciences", American Psychologist, Vol. 10, No. 9, (September, 1955), pp. 516-517.

[13]A. D. Hall and R. E. Fagen, in General Systems--Yearbook of the Society for the Advancement of General Systems Theory, eds., Ludvig von Bertalanffy and Anatol Rapoport, Vol. 1, (Ann Arbor: Society for General Systems Research, 1956), p. 18.

For the purposes of this study we will accept the definition proposed by Allport. We will, however, attempt to further clarify this most important concept.

General Properties of Systems

Each system except the smallest has sub-systems which, according to Miller, "are any components of an organism that can affect a variable".[14] Every system except the universe, which is the largest system, has an environment. The system and its environment together make up a supra-system. The environment of a system is everything that is external to its boundary. Hearn notes that:

> Higher orders of systems. . .are always parts of the environment of lower orders. . . .For each system. . . there may be both a proximal and a distal environment. The proximal environment may be defined as that part of the environment of which the system is aware, whereas the distal environment affects the system but is beyond the awareness of the system.[15]

Within both the system and the environment are factors which affect their particular structure and function. Factors in a system or its subsystem which can affect it are called variables. Those affecting factors in the environment are called parameters.

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[14]Miller, op. cit., p. 514.

[15]Hearn, op. cit., p. 42.

Each system has a boundary that distinguishes it from its environment. Miller has defined the boundary of a system as that region where:

> greater energy is required for a transmission across it than for a transmission in the supra-system immediately outside it or in the system immediately inside it.[16]

Boundaries are arbitrary designations and thus have utility and reality as a concept only in the mind of the thinker.

To apply these characteristics we can use the example of a high school. The high school is the system. The school and the area which it serves comprise the suprasystem. The high school has several subsystems, some of which are pupils, teachers, departments, administrators, and service personnel. Variables within the system consist of items like class size, time schedules, and instructional methodologies. Examples of parameters would be the religious and political beliefs of the community, financial ability to pay for schools, pressure groups and socio-economic backgrounds of the citizenry. The distal environment of the school could include prejudices, or familial customs, while the proximal environment would be the community of which it is a part.

General Systems Theory

Until recently, sciences had largely followed a process of analysis. The specifc units were located, their

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[16]Miller, op. cit., p. 526.

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characteristics studied, and perhaps an attempt was made to study them in combined action. The rule, analyze into parts and study them one at a time was widely followed.

Von Bertalanffy initiated a movement toward a "general theory of systems."[17] He and other systems theorists believe that it is important and necessary to study the totality of things. They believe that it is better to study and understand the whole. W. Ross Ashby relates one of the first instances of a scientist, Sir Robert Fisher, who faced up to the fact that not all systems are best analyzed by the single-part method. Ashby writes:

> His (Sir Robert Fisher) problem was to get information about how the complex system of soil and plants would react to fertilizers by giving crops. One method of study is to analyze plant and soil into a host of little physical and chemical subsystems, get to know each subsystem individually, and then predict how the combined whole would respond. He decided that this method would be far to slow, and that the information he wanted could be obtained by treating soil and plant as a complex whole. So he proceeded to conduct experiments in which the variables were not altered one at a time.[18]

Initially scientists were stunned by Fisher's methods. Today it is quite apparent that his strategy was

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[17]Ludvig von Bertalanffy, in General Systems Yearbook, eds. Ludvig von Bertalanffy and Anatol Rapoport, Vol. 1, (Ann Arbor: Society for General Systems Research, 1956), p. 1.

[18]W. Ross Ashby, in General Systems Yearbook, eds. Ludvig von Bertalanffy and Anatol Rapoport, Vol. III, (Ann Arbor, Michigan: University of Michigan Press, 1958), pp. 1-2.

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sound. Sir Robert Fisher had confronted science with a new strategy. He had taken a complex system, realized the essential character of the complexity of the system and summarized that the complexity could not be ignored. The results proved Fisher to be correct and that others might profit by use of the same scientific approach.

Today, system oriented scientists are not so preoccupied with the analysis of the basic components of structure in isolation from the total system. Internal interactions are left intact and the system is studied as a unit.

Two methods of system study are defined by Ashby in the 1958 General Systems Yearbook:

> One. . .takes the world as we find it, examines the various systems that occur in it--zoological, physiological, and so on--and then draws up statements about the regularities that have been observed to hold. This method is essentially empirical. . . .The second method is to start at the other end. Instead of studying first one system, then the second, then the third, and so on, it goes to the other extreme, considers the set of "all conceivable systems" and then reduces the set to a more reasonable size.[19]

The systems theorist notes that separate disciplines have often found similar concepts and arrived at different principles independent from each other. Those findings have been based on totally different data and system theorists feel that a general theory based on the systems concept

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[19] Ibid., p. 2.

would eliminate much duplication of effort by allowing the transfer of principles from one field to another.

According to von Bertalanffy there are many instances where identical principles were discovered several times, because the workers in one field were unaware that the theoretical structure required was already developed in some other field.[20]

Von Bertalanffy clearly contends that the general theory of systems would eliminate much of the duplicated labor. Certain isomorphic laws of science are pointed out by him as examples of the duplication effort. Two of the laws which he mentions are "Paretos Law"[21] and the "Law of Allometric Growth".[22] Von Bertalanffy also points specifically to the similarities of "Volterras Principle of

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[20]Ludvig von Bertalanffy, "An Outline of General Systems Theory", British Journal for the Philosophy of Science, Vol. 1, (1950), pp. 137-38.

[21]Pareto's "Law of Income Distribution" holds that there are natural relationships between the distribution of income in an economy and such factors as intelligence, willingness to work, competitiveness, etc., with each individual, company, etc., taking its share according to its capacity as expressed in terms of these factors. Any distortion of this natural relationship results in a compensatory reaction in the opposite direction from the distortion.

[22]The "Law of Allometric Growth" is a series of Principles in Biology which describe the relative increase of organs, chemical compounds, or physiological activities with respect to body size.

Population Dynamics",[23] "Le Chateliers Principles",[24] and "Lenz' Rule".[25]

Von Bertalanffy feels strongly that these are sound arguments for the need of a general superstructure which develops principles and models that are common to different fields and which will speed up and make scientific research more efficient. He does, however, take caution and attempts to clear the air of any misconceptions regarding a preoccupation on his part with the search for analogies. He clarifies:

> . . .General System Theory is not a search for vague and superficial analogies between physical, biological, and social systems. Analogies as such are of little value, since beside similarities between phenomena, dissimilarities always can be found as well. The isomorphy we have mentioned is a consequence of the fact that, in certain aspects, corresponding abstractions and conceptual models can be applied to different phenomena.[26]

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[23]Volterra, working with homologous concepts such as demographic energy and potential, life action, etc., discovered a principle of minimum vital action, corresponding to the principles of minimum action in mechanics.

[24]Le Chatelier's Principle states that when a force such as heat, pressure, or a change in concentration is applied to a system in chemical equilibrium, chemical reaction takes place, shifting to equilibrium in that direction which opposes, nullifies, or uses up the applied force. Applying this principle enables the industrialist to predict yields or desired products.

[25]Lenz' Rule describes the relationship between electrical resistance and temperature increase.

[26]Ludvig von Bertalanffy, in General Systems Yearbook, eds. Ludvig von Bertalanffy and Anatol Rapoport, Vol. 1, (Ann Arbor: Society for General Systems Research, 1956), p. 2.

The aims of General Systems Theory are summarized very precisely by von Bertalanffy as follows:

a. There is a general tendency toward integration in the various sciences, natural and social.
b. Such integration seems to be centered in a general theory of systems.
c. Such theory may be an important means for aiming at exact theory in the non-physical fields of science.
d. Developing unifying principles running "vertically" through the universes of the individual sciences, this theory brings us nearer to the goal of the unity of science.
e. This can lead to much-needed integration in scientific education.[27]

Criticism of Systems Theory

The development of a general theory of systems has caused critical reaction from some scholars. The fact that the theory is relatively new, has perhaps, like many new ideas, brought forth the writings of more advocates than critics. However, some critiques and general discussions have been published.

Gordon Hearn, relies heavily on the theory of general systems in his work, Theory Building in Social Work. He does, however, note certain cautions when he writes, "General systems theory. . .is essentially a mode of thought rather than a well-developed body of theory."[28]

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[27] Ibid.

[28] Hearn, op. cit., p. 38.

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It is Hearn's contention that as research continues in the area of systems, a more concrete body of theory will evolve.

Another author has spoken with some caution regarding general systems theory. Kenneth E. Boulding indicates his concerns when he states:

> It is the contention of the General Systems Theorists that this optimum degree of generality in theory is not always reached by the particular sciences. The objectives of General Systems Theory then can be set out with varying degrees of ambition and confidence. At a low level of ambition but with a high degree of confidence it aims to point out similarities in the theoretical constructions of different disciplines, where these exist, and to develop theoretical models having applicability to at least two different fields of study. At a higher level of ambition, but with perhaps a lower degree of confidence it hopes to develop something like a "spectrum" of theories--a system of systems which may perform the function of a "gestalt" in theoretical construction.[29]

Boulding also discusses the merit of the interdisciplinary approach and the interest being generated toward it. He feels strongly that:

> If this excitement is to be productive. . .it must operate within a certain framework of coherence. It is all too easy for the interdisciplinary to degenerate into the undisciplined. If the interdisciplinary movement, therefore, is not to lose that sense of form and structure which is the "discipline" involved in the various separate disciplines, it should develop a structure of its own. This I conceive to be the great task of general systems theory.[30]

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[29]Kenneth E. Boulding, "General Systems Theory--The Skeleton of Science", Management Systems, Edited by Peter P. Schoderbek, (New York: John Wiley and Sons, 1967), p. 7.

[30]Ibid., p. 9.

Foster, Rapoport, and Trucco, have written a rather technical article dealing with the clarification of open and closed systems. They indicate that there may be some question about the application of commonly accepted definitions of open and closed systems. They conclude:

> The matter is not so simple as it looks. . .because of some ambiguities. For one thing, what is an "open system?". . .As we shall see "open" can by no means be taken as simply "non-isolated. . ."[31]

R. C. Buck offered an intense criticism of "General Behavior Systems Theory."[32] His attack was focalized on the writings of J. G. Miller and the systems group that had grown at the University of Chicago. The essence of Buck's article is "So What?". He feels that the analogies used by systems theorists are simple emptiness. Buck suggests the example of a scientist, A, who finds a formula for the rate of formation of frost in a refrigerator; of another, B, formulating the rate of carbon deposit in an automobile motor; and a "general systems theorist", C, who notices that both formulas are the same.

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[31]C. Foster, A Rapoport, and E. Trucco, in General Systems Yearbook, eds., Ludvig von Bertalanffy and Anatol Rapoport, Vol. II, (Ann Arbor: Society for General Systems Research, 1957), p. 9.

[32]R. C. Buck, "On the Logic of General Behavior Systems Theory", Minnesota Studies in the Philosophy of Science, Vol. I, Eds., H. Geiger and M. Scriven, (Minneapolis: University of Minnesota Press, 1956), pp. 223-238.

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It seems apparent that Buck has not really gotten the message that theorists are trying to put across. Bertalanffy reacted to Buck's criticism of Miller in the following manner:

> Although Buck justly criticizes certain unfortunate formulations, his misunderstanding of the basic problems involved makes one wonder how his essay found its way into a treatise on "Philosophy of Science."[33]

Whereas R. C. Buck has written off the feasibility of a theory of systems, two somewhat more concise authors have expressed valid concerns about general systems theory. The Russian authors, V. A. Lestorsky and V. N. Sadovsky, welcome the goals of general systems theory but carefully pinpoint certain imperfections in its construction.[34] It is their feeling that von Bertalanffy has not defined a theory but described one. If there is more "logical elegance" in definition and further research and development perhaps the imperfections can be eliminated. They make special note of the need to apply Marxist-Leninist methodological principles of analysis. They note:

> elementary methods of analysis and synthesis are insufficient for the investigation of systems. More complex methods are required, where the coordination

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[33]Ludvig von Bertalanffy, "General Systems Theory--a Critical Review", General Systems Yearbook, Vol. VII, (Ann Arbor: Society for General Systems Research, 1962), p. 9.

[34]V. A. Letkorsky, and V. N. Sadovsky, "On Principles of System Research", General Systems Yearbook, Vol. V, (Ann Arbor: 1960), pp. 171-179.

> and subordination of elements and processes of their function and development are taken into account. In Marx's works, methods of thought were developed in detail which made possible adequate representation of systems. . . .While Marx considers the classification of special techniques and methods of thought adequate for representing a given system as the most important problem of methodology, Bertalanffy completely abstracts himself from examining the problem. It is for this reason that his theory cannot play the role of a generalized scientific methodology.[35]

Thus, it is clear that systems theory does not exist in any pure or absolute form. Although the criticisms are not in great abundance, they are evident and in many cases valid. As with any new body of knowledge or theory, there must be continued definition and research of all fundamental concepts.

Systems Theory Today

Although systems theory is in need of continued research and definition, there has been little hesitancy to apply some of the basic precepts of systems theorists. Many systems oriented ideas are growing in importance today. As a matter of fact, many are seemingly accepted as entities in themselves.

Among the different systems approaches in use today are systems engineering, operations research, human engineering, information theory and systems, game theory,

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[35] Ibid., p. 177.

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simulation, decision theory, cybernetics, instructional systems, planning systems, budgeting systems, management systems, and systems analysis.

As the literature concerning these systems-centered methodologies is reviewed, there is continued reference to the need for more study, clarification and definition of the idea of system. However, this need is primarily centered in the specific system application being treated by the writer. Writers frequently talk about systems theory as an accepted idea but often avoid the importance of working to establish a clearly defined body of theory about systems in general.

This study is concerned in part with continuing research in the theory of systems. In order that the purpose be met, we move to a more detailed study of an aspect of systems theory: open and closed systems. Part II of this Chapter contains that aspect of systems theory.

Part II: Open and Closed Systems

Introduction

In the study of systems theory it is important to note that there is in reality no system that is completely isolated from its environment. Likewise, there are living organisms that tend to act like closed systems. For example the schizophrenic often seems to be out of touch with life around him.

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It is also important to acknowledge that the distinction between open and closed systems is never absolute. Tsune Shirai has taken some note of this fact in his article "Systemic Models for Social Groups".[36] In summary, he feels that we cannot regard inorganic and organic systems simply as closed and open systems, respectively; the line is not so sharp. Whether a system is to be treated as open or closed must depend on the nature and degree of its relationship with its environment.

What we are concerned with in this study is a conceptual representation of the educational process, namely, people in groups--schools--who are experiencing unmobilizing forms and degrees of stress. Thus, we will accept the viewpoint of many system theorists that, as Hearn points out:

> human individuals and human aggregations. . .can be most appropriately represented as open, or more specifically, as organismic systems. Organismic systems are regarded as one type of open system.[37]

General Properties of Open Systems

Therefore, what has been previously delineated as characteristic of "systems" also applies to "open systems". They are a part of a suprastructure, and they have subsystems.

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[36]Tsune Shirai, "Systemic Models for Social Groups", Canadian Journal of Psychology, Vol. 7, (1953), pp. 126-32.

[37]Hearn, op. cit., p. 43.

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Each has a definite boundary; the objects of the system and its environment have attributes; the objects of the system itself are variables and the objects of the environment are parameters.

There are additional general characteristics of open and closed systems. Open and closed systems may differ in certain fundamental dynamic processes which govern their operations. The operation of closed systems is described by the second law of thermodynamics which holds that a certain quality, called entropy, or degree of de-organization, never decreases but tends to increase to a maximum until the process in which it is operating reaches a state of equilibrium. Therefore, closed systems are moving toward a state of maximum de-organization or toward homogeneity and the leveling of differences. The classical example of this law is the tea kettle of boiling water in a closed room. Upon being removed from the stove, the kettle gives off heat into the atmosphere and the atmosphere cools the water until the process stops. Entropy or a state of equilibrium has been reached.

The same law operates in open systems, but there is another force operating as well. In open systems, there is a movement toward the attainment of higher order and heterogeneity. Bertalanffy says:

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> . . .in open systems there is not only production of entropy or disorder but also the production of the opposite which may be called negative entropy, ordering or organization.[38]

Thus, both closed and open systems may attain stationary states, although the nature of each is different. A closed system must reach a state of equilibrium. According to Hearn:

> An open system may, provided certain conditions are given, attain a stationary state in which the system appears also to be constant, although maintaining its constancy in a continuous change, inflow and outflow of materials.[39]

This condition is called a steady state.

One danger that must be reemphasized at this point may come from thinking that systems are totally open or totally closed. A system is not absolutely open or closed. There is no system which is totally closed in the sense that it is completely independent of its environment. Conversely, there is no system which is always totally open. Some subsystems of an open system may be functioning as closed systems while the rest are operating as open systems.

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[38]Ludvig von Bertalanffy, "An Outline of General Systems Theory", British Journal for the Philosophy of Science, Vol. 1, (1950), pp. 156-157.

[39]Hearn, op. cit., p. 41.

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The clearest way of dealing with this problem is by assuming that an open system at any point in time may possess some degree of both openness and closedness. At certain stages of time, the system may be more open or more closed than at other times. We may speak, therefore, of a system as fluctuating through various degrees of openness as internal and external factors change.

It is that concept of "a degree of openness" which provides the basis for the present study. The hypothesis which this study seeks to test is repeated at this juncture, so that the properties of open and closed systems can be placed in perspective as they are described. The hypothesis states: Schools which are classified as innovative will show a significantly higher degree of openness than will schools which are classified as non-innovative.

Seven Specific Properties of Open Systems

Having noted the general description of open and closed systems, we can now in more specific terms make note of the properties ascribed to open and closed systems. Systems theorists, cite that open systems are more responsive to their environment and exchange information with it. Thus, they are likely to be more flexible and able to change. It is necessary, therefore, to enumerate those specific properties of open systems.

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There is generally common agreement among systems theorists that the principal properties of open systems are: adaptiveness, hierarchial order, stability or steadiness, progressive systemization, progressive segregation, wholeness or integration, and independence.

The first three of these properties are qualities which can be found in varying degrees in a system. The degree to which these qualities (adaptiveness, hierarchial order, stability) are present or absent, will initiate the processes of progressive systemization or progressive segregation. Wholeness and Independence are states or conditions toward which a system moves.

Open systems are more adaptive, more steady, with a greater degree of hierarchial order. They will be characterized by progressive systemization and movement toward wholeness. Closed systems will evidence less adaptiveness, less stability, and less hierarchial order. They will be characterized by progressive segregation and will be moving toward independence.

In Figure 2, the properties of systems and their relationships to each other are placed on a continuum.[40] They are precisely described as qualities, processes, and states.

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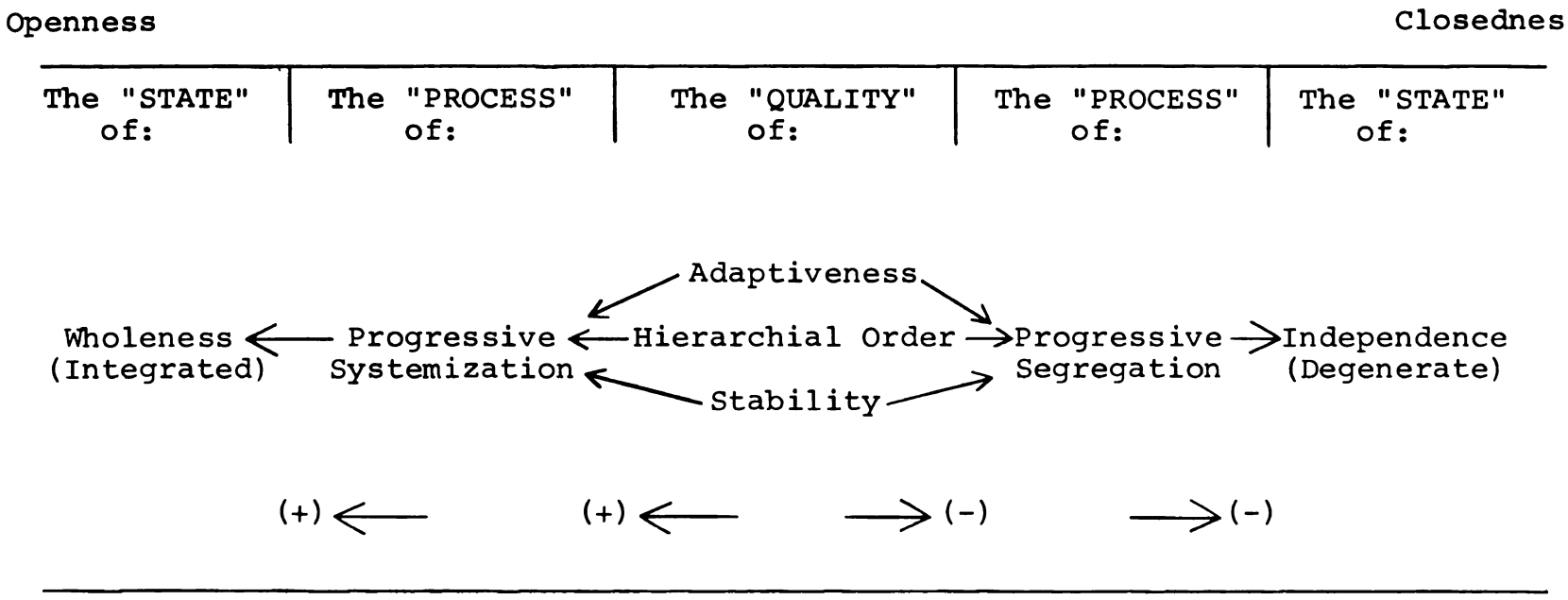
[40]Robert E. Keuscher, "An Appraisal of Some Dimensions of Systems Theory as Indicators of the Tendency to Innovate in Selected Public Junior Colleges", Unpublished Doctoral Dissertation, University of California, Los Angeles, California, 1968, p. 41.

Openness **Closedness**

The "STATE" of:	The "PROCESS" of:	The "QUALITY" of:	The "PROCESS" of:	The "STATE" of:



(+) movement toward openness

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Figure 2.--The Properties of Systems and Their Relationships.

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In Figure 3, an open system and its environment are represented as they might be viewed in a school. The system is characterized by three subsystems, input-output, and process.[41]

Having completed the discussion of the general properties of open systems, we move directly to a more specific study of the seven basic properties of open systems: adaptiveness, hierarchial order, stability, progressive systemization, progressive segregation, wholeness, and independence.

I--Independence

Independence is a property of a system and we have described it as the state of independence. According to Waetjen and Weisbrod:

> A system has independence to the extent that a change in one entity or subsystem effects change in that entity alone and does not effect change in the systems action.[42]

Hall and Fagen discuss the concept of independence and state that, "it describes a set of parts that are mutually independent and unrelated."[43]

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[41]Walter B. Waetjen and Kenneth C. Weisbrod, "The School and the Ego as Information Process", Learning and Mental Health in the School, Association for the Supervision and Curriculum Development, (1966), p. 151.

[42]Ibid., p. 157.

[43]Hall and Fagen, op. cit., p. 21.

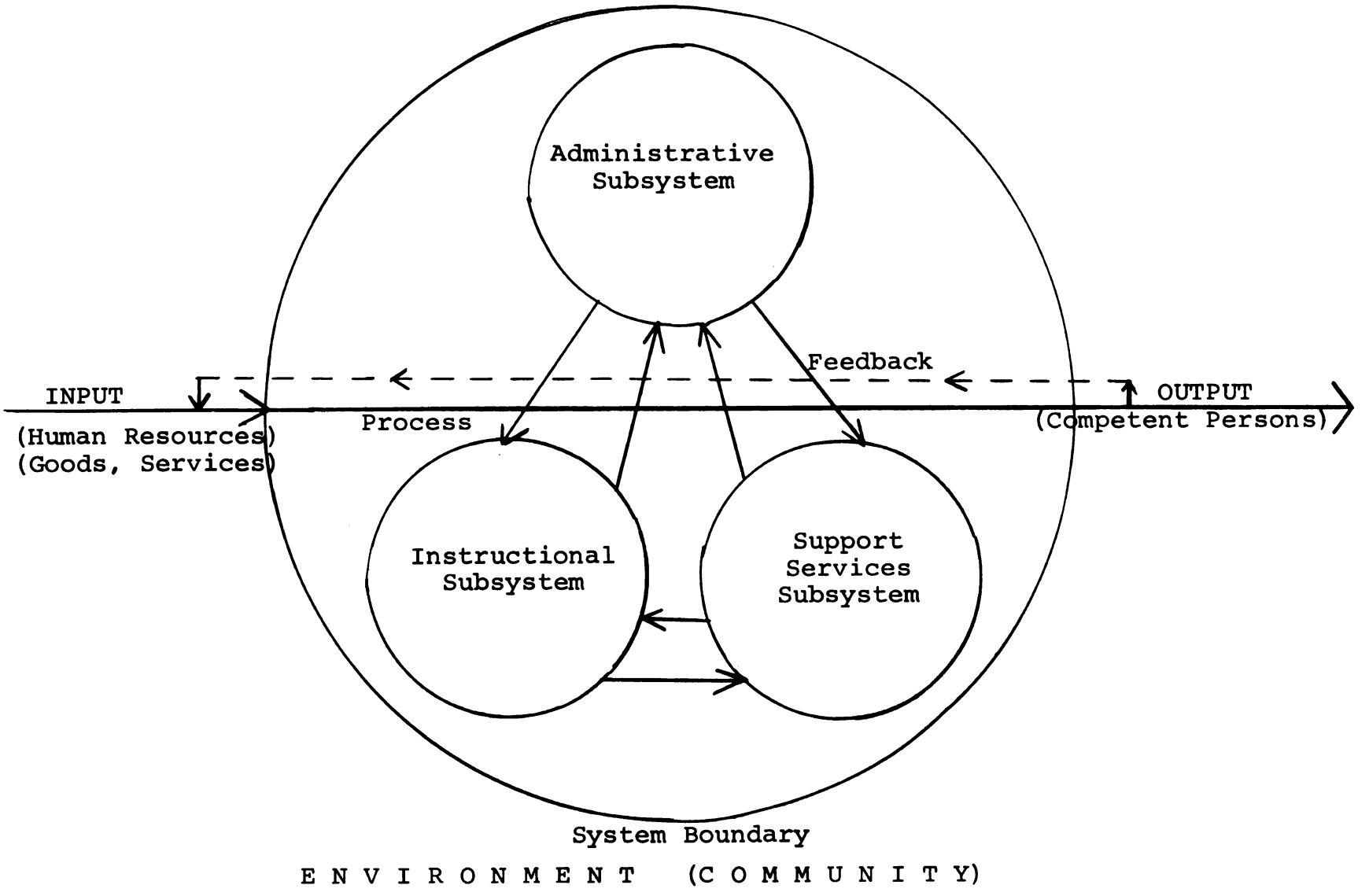

Figure 3.--Typical Open System in its Environment

A totally independent system would actually be a closed system. There is no communication across its boundaries or between its parts and thus is destined to a state of equilibrium or total loss of energy. In other words, the system will be heading toward a state of de-organization or maximum independence.

Independence in a system in characterized by a high degree of the process of progressive segregation. The system has lost contact with its environment and the subsystems are operating as independent autonomous units. It is a rigid and unchanging unit and as a result does not meet the demands of its environment. Communication has broken down and goals and purposes have become muddled or lost. An example of this, if carried to extremes, would be a nation that crumbles and ends up as a group of separate independent states, each of which perceives itself as a new system.

Robert Keuscher studied openness and closedness in two-year community colleges in California. He defines eight principal characteristics which he feels make up a precise definition of independence:

1. Communication is poor or nonexistent, both within the system and between the system and its environment.

2. The system is rigid and inflexible--unwilling to change.

3. Because the system does not have clearly defined goals, functions of the various subsystems have not been clearly delineated.

4. Procedures for making decisions within the system are not precise and consistent.

5. Any minor modification of procedures is likely to upset the system's operation.

6. The system vacillates between resisting change and being overly impulsive. Changes are frequently made without proper planning and preparation.

7. Change can occur in any one subsystem without any noticeable effect on other subsystems or on the system as a whole.

8. The system functions as a series of independent entities rather than as an integrated unit.[44]

II--Wholeness

At the opposite end of the continuum from independence is the state of wholeness. Some theorists would say that independence and wholeness are simply extremes of the same property. For purposes of assessing openness in systems, however, we will distinguish between the two concepts.

Hall and Fagen describe wholeness as follows:

> If every part of the system is so related to every other part that a change in a particular part causes a change in all the other parts and in the total system, the system is said to behave as a whole or coherently.[45]

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[44]Keuscher, op. cit., p. 59.

[45]Hall and Fagen, op. cit., p. 21.

Waetjen and Weisbrod state:

> Wholeness implies a maximum of effectiveness at the other end of the scale from independence and a functioning of a system completely competent to cope with all environmental demands.[46]

A system characterized by wholeness would be quite capable of meeting the demands of the environment. It would be steady, adaptive and organized to operate at maximum effectiveness.

The more open a system is, the more "whole" it will be. It can handle changes and all parts of the system are affected by them. There will be a high degree of adaptiveness, stability, hierarchial order, and progressive systemization. This would be the state of a perfectly functioning system which is constantly getting feedback and willingly making changes suggested by the information received. The goals and objectives are clearly defined and, in addition, priorities have been established for procedures and structure to facilitate those goals.

Careful planning and preparation are involved in any changes, with the system not being too over-anxious or resistant to change. Channels of communication are open within the system and also with the environment. Systems

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[46]Waetjen and Weisbrod, op. cit., p. 156.

with a high degree of wholeness function more as integrated wholes than as independent subsystems.

Keuscher defines the eight principal characteristics of wholeness as follows:

1. Communication channels, both within the system and between the system and its environment, are open and functioning.

2. The system demonstrates a willingness to make the changes suggested by the information and feedback it receives.

3. The system has a clearly defined mission and has established priorities and procedures aimed at attainment of its goals.

4. Procedures for decision-making have been established and are known at all levels.

5. The institution is able to maintain a smooth, steady operation despite constant modification of procedures.

6. Changes are made only after rational planning and preparation, the system being neither resistant to change nor too impulsive.

7. Change does not occur in isolation. Change in any one subsystem may affect all other subsystems and the system as a whole.

8. The system functions as an integrated unit rather than as a group of independent entities.[47]

III--Adaptiveness

Adaptiveness, one of three qualities which exist in a system, is the quality or characteristic of being willing and able to change in response to fluctuations in the environment.

Waetjen and Weisbrod cite an adaptive system as one that "changes in response to environmental change. In general adaptiveness contributes to growth and productivity."[48]

Hall and Fagen state:

> Many natural systems, especially living ones, show a quality usually called adaptation. . . .they possess the ability to react to their environment in a way that is favorable, in some sense, to the continued operation of that system.[49]

If a system is to be adaptive, it must keep in close touch with its environment. A less adaptive system shows little awareness or response to its environment. Communication is broken down both into and from within the system.

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[47]Keuscher, op. cit., p. 57.

[48]Waetjen and Weisbrod, op. cit., p. 154.

[49]Hall and Fagen, op. cit., p. 23.

Thus, the more open system keeps close contact with its environment and is constantly sensitive and adjusting to the changing needs and demands of the environment. The closed system shows little concern for the condition of the environment, and the result is less adaptive behavior and a tendency toward rigidity.

The principal characteristics of adaptiveness defined by Keuscher are:

1. The more open system maintains close contact with its environment and is aware of its changing needs and demands.

2. The more open system demonstrates a willingness to make changes.

1.1 The more closed system has little contact with its environment and is not sensitive to its changing needs and demands.[50]

2.1 The more closed system is rigid and unwilling to change.

IV--Stability

Closely related to the concept of adaptation, is the second of the qualities of an open system: stability. We have previously noted that both open and closed systems

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[50]Keuscher, op. cit., p. 50.

are subject to the effects of the second law of thermodynamics and tend to move toward stationary states of equilibrium. Von Bertalanffy concludes:

> Open systems may, provided certain conditions are given, attain a stationary state. Then the system appears also to be constant, though this constancy is maintained in continuous change, inflow and outflow of materials. This is called steady state.[51]

Hall and Fagen note:

> A system is stable with respect to certain of its variables if these variables tend to remain within defined limits. . . .a system may be stable in some respects and unstable in others.[52]

Thus, in an open system, stability is a result of continuous modification of the systems procedures.

Waetjen and Weisbrod describe a stable system as:

> . . .One which keeps its internal functions in a steady state. The stable system is free to give up or to modify entities as new one are added. . . .This implies a state of openness to change which requires the breaking down of new information into manageable amounts and admitting it to reality. It suggests as well the capacity to discharge stress induced by having to modify some previously held facts to accommodate new information which may be contrary to old information.[53]

A system must have the flexibility, along with the capacity, to manage varying amounts of information input

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[51]Von Bertalanffy, op. cit., pp. 156-57.

[52]Hall and Fagen, op. cit., p. 23.

[53]Waetjen and Weisbrod, op. cit., p. 154.

without overloading the system function either in terms of quality or quantity.

Another important factor that can affect the stability of a system is "feedback". Hall and Fagen state:

> Certain systems have the property that a portion of their outputs or behavior is fed back to the input to affect succeeding outputs. . . .It is a well known fact that the nature, polarity, and degree of feedback in a system have a decisive effect on the stability or instability.[54]

Norbert Wiener also discusses feedback:

> Feedback is the property of being able to adjust future conduct by past performance. It may be simple as the common reflex, or it may be a higher order feedback, in which past experience is used not only to regulate specific movements, but also whole policies of behavior. Such a policy-feedback may, and often does, appear to be what we know under one aspect as a conditioned reflex, and under another as learning.[55]

The closed system tends to resist change. It can, however, be too impulsive and change drastically without careful planning. The open system neither resists change nor is apt to make changes without adequate preparation.

Keuscher notes the principal characteristics of a stable system:

1. The more open system appears to be constant and steady although continuously modifying its procedures.

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[54]Hall and Fagen, loc. cit.

[55]Norbert Wiener, The Human Use of Human Beings, (New York: Doubleday Anchor Books, 1954), p. 33.

2. The more open system is neither resistant to change nor overly impulsive. Changes are made only after careful planning and preparation.

3. The more open system readily adjusts to a major change and re-establishes its steady state.

1.1 The system which tends to be closed becomes unstable and unsteady each time there is a slight modification in its procedures.

2.1 The system which tends to be closed can either be resistant to change or overly impulsive and make too many changes too fast. There frequently is inadequate planning and preparation before change is undertaken.

3.1 The system which tends to be closed finds it difficult to adjust to a major change and takes a long time after a change to return to normalcy.[56]

V--Hierarchial Order

The third quality which is vital to a system is hierarchial order. It is the quality where proper balance is highly important among the system components. Waetjen and Weisbrod describe a system as having hierarchial order if:

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[56]Keuscher, op. cit., pp. 52-53.

> it continues a gradation of entities and relationships between entities. Under hierarchial order a system is in the process of expansion from lower to higher levels of integration. . . .The important ingredient here is a state of interdependence among subsystems or entities requiring a continuous flow of information to all entities and permitting the inclusion of new concepts and generalizations into the hierarch of valued concepts.[57]

Von Bertalanffy says that, "In many systems the components themselves are systems of a next lower order."[58] Hall and Fagen relate in other terms:

> . . .any given system can be further subdivided into subsystems. Objects belonging to one subsystem may well be considered as part of the environment of another subsystem. Consideration of a subsystem, of course, entails a new set of relationships in general. The behavior of the subsystem might not be analogous with that of the original system.[59]

In other words, hierarchial order refers to an ordering of goals or purposes of any given system. It also refers to the development of priorities and the clear delineation of responsibilities and functions. The decision-making process is very carefully described and explained.

In an open system there will be clearly delineated roles for subsystems in moving toward its goals. The more closed system will be confused in its goals and the subsystems will often be in conflict or operating independently.

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[57] Waetjen and Weisbrod, op. cit., p. 155.

[58] Von Bertalanffy, op. cit., p. 151.

[59] Hall and Fagen, op. cit., p. 20.

The decision-making process will not be clearly defined in a closed system, whereas in an open system the process will have been carefully defined and explained.

In his study of openness, Keuscher sets out the principal characteristics of the quality, hierarchial order:

1. In systems which are open, a hierarchy of valued concepts exists constituting a system "point of view" or set of goals.

2. In systems which are open, priorities have been established at high levels for system functions and procedures aimed at attaining the goals.

3. In systems which are open, procedures for making decisions have been established and are known at all levels.

1.1 In systems which tend to be closed, goals and purposes are general and vague and are not likely to be understood by all segments of the system.

2.1 In systems which tend to be closed, procedures and priorities aimed at attaining system goals have either not been established or are not understood by all segments of the system.

3.1 In systems which tend to be closed, procedures for decision-making, if they exist at all, are unclear and not understood by all segments of the system.[60]

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[60]Keuscher, op. cit., pp. 51-52.

VI--Progressive Systemization

Progressive systemization in a system is a process; the antithesis of the progressive segregation process in a system. Hall and Fagen quite succinctly describe progressive systemization as:

> a process in which there is a change toward wholeness. It may consist of strengthening of pre-existing relations among parts previously unrelated, the gradual addition of parts and relations to a system, or some combination of these changes.[61]

According to Waetjen and Weisbrod:

> a system has progressive systemization if in time independence tends toward wholeness. Such systems become progressively open to accommodate change in both the internal and external environments. The duration of the change is toward higher levels of abstraction and interrelatedness together with increasing capacities to receive, incorporate and implement information into the system. The resultant output (behavior) would be more and more consistent with environmental demands for competence. Feedback to the system would become progressively supportive and reassuring of the systems action.[62]

A system which is characterized by the process of progressive systemization would tend to be more open. Not only would it become increasingly adaptive and show increasing hierarchial order, but it would also be able to maintain a relatively smooth operational level regardless of change and hence be able to attain a steady state.

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[61] Hall and Fagen, op. cit., p. 22.

[62] Waetjen and Weisbrod, op. cit., p. 155.

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The principal characteristics of the process of progressive systemization according to Robert Keuscher are:

1. The system is increasingly sensitive to and receptive to information from both its external and internal environments.

2. The system is increasingly willing to change in response to environmental demands.

3. The goals or "mission" of the system are increasingly clear.

4. Priorities and procedures for functions aimed at attaining system goals are increasingly clear.

5. Procedures for making decisions are constantly being clarified and becoming better known at all levels.

6. The system is increasingly able to pace itself in the matter of making change--avoiding both resistance and impulsiveness.

7. The system is increasingly able to maintain smoothness in operation despite change.[63]

VII--Progressive Segregation

The converse of progressive systemization is the process of progressive segregation. In his description of progressive segregation, von Bertalanffy states:

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[63]Keuscher, op. cit., p. 54.

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> the system passes from a state of wholeness to a state of independence of the elements. The primary state is that of a unitary system which splits up gradually into independent causal chains.[64]

Hearn analyzes the concept in different terms:

> the system divides into a hierarchial order of subordinate subsystems which gain a certain independence of each other. . .this process of progressive segregation is related to. . .the products of negative entropy.[65]

Another aspect of progressive segregation that must be explained is discussed by von Bertalanffy. He concludes:

> Progressive segregation also means progressive mechanization. Progressive mechanization. . .implies loss of ability to be regulated. As long as a system is a unitary whole, a disturbance will be followed by the attainment of a new stationary state, due to the interaction within the system. The system will regulate itself. If, however, the system is split up into independent causal chains, regularity disappears. The partial processes will go on irrespective of each other.[66]

Hearn cites dual consequences of the two processes:

> one is the entropic forces, the forces toward differentiation and homogeniety, are held in check, that is progressive mechanization and segregation are life-maintaining. The other is that they impose constraints upon the free interplay of the functional sub-systems of the system in which case they would seem to impose a limit upon the degree to which the system may achieve its potentiality.[67]

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[64] Von Bertalanffy, op. cit., p. 148.

[65] Hearn, op. cit., p. 49.

[66] Von Bertalanffy, op. cit., p. 149.

[67] Hearn, loc. cit.

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Hall and Fagen note that it is possible for progressive segregation and systemization to occur in the same system. It is their contention that:

> These two processes can occur simultaneously, and go on indefinitely so that the system can exist in some kind of steady state. . ."[68]

Thus, we can conclude that progressive segregation is the movement of a system toward the condition of closedness. The system is less adaptive and more rigid; subsystems are more autonomous; communication is breaking down; contact with the environment is being reduced; and less hierarchial order is demonstrated. The system would have increasing difficulty in adjusting to change and maintaining an efficient operational level.

Robert Keuscher summarizes the principal characteristics of the process of progressive segregation:

1. The system is decreasingly sensitive to and receptive to information from both its external and internal environments.

2. The system is decreasingly willing to change in response to environmental demands.

3. The goals or "mission" of the system are decreasingly clear.

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[68]Hall and Fagen, loc. cit.

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4. Priorities and procedures for functions aimed at attaining system goals are decreasingly clear.

5. Procedures for making decisions are decreasingly clear and are not understood at all levels.

6. The system is decreasingly able to pace itself in the matter of change, being either overly resistant or overly impulsive.

7. The system is decreasingly able to maintain smoothness in its operation when change occurs.[69]

Summary

We must be concerned today, in the study of human systems, with more than the study of abstract part-functions. It is more the whole truth, and particularly the truth about wholes, that is needed in practice. The kind of theory which is needed for the understanding of human problems is different from that which guides most laboratory research or is generated from it. We need theory that is not formal or mechanistic, but dynamic, not elementaristic, but holistic, not narrow and specialized but comprehensive, not concrete and tangible, but on a level of abstraction that is most appropriate to the problem at hand.

The problem at hand, openness in systems, is of vital importance. Thus, in order to carefully study the

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[69]Keuscher, op. cit., pp. 55-56.

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degree of openness in systems, we have identified from the writings of systems theorists certain properties which describe them.

Seven fundamental properties have been delineated as characteristic of open and closed systems. Three of those properties are qualities which exist within a system to varying degrees: adaptiveness; hierarchial order; and stability. If those qualities exist in a system to any great degree, they initiate the process defined as progressive systemization, which is the movement of a system toward total integration and the ideal state of wholeness. If, however, the three qualities are lacking to any great degree in a system, they set in motion the process defined as progressive segregation. This is the destructive movement toward the state or condition of independence or degeneracy within a system.

This study will hopefully add some empirical evidence to the development of systems theory. Through the testing of one of its most vital concepts, openness, some clarification can be made regarding its generalizability to social organizations; in particular, high schools.

The emphasis in the present Chapter has been on the properties and characteristics of open and closed systems. In Chapter IV the design and procedures used in the study are explained.

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CHAPTER IV

DESIGN OF THE STUDY

This study attempts to test the hypothesis, "high schools classified as innovative will show a significantly higher degree of openness as defined by systems theory than will schools which are classified as non-innovative."

Selection of the Schools

The schools in which the study was conducted were identified from all public high schools in Oakland County, Michigan, with enrollments exceeding one thousand students. The intent was to identify four high schools which could be classified as innovative and four high schools which could be classified as non-innovative. This task proved to be a difficult one. There can not be found a real consensus in the literature or from practitioners as to the definition of an innovative school.

For the purposes of this study, a series of "innovative" practices were identified from the literature and from interviews with practitioners. The scale was formulated from the practices identified and submitted to a college professor, a practicing school assistant superintendent in charge of instruction, and a director of testing and

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measurement in a county intermediate school district. From their criticisms and recommendations, certain changes and revisions were made. The scale used here was approved by these raters as encompassing the necessary criteria for measuring innovative indicators in high schools. The resulting "Scale of Innovativeness," as shown in Appendix I, attempts to show the "degree to which a high school can be classified as innovative."

The scale is divided into six basic categories:

1. Individualized Instruction;
2. Developments in Curriculum;
3. Developments in Technology;
4. Staff Involvement in the Decision-Making Process;
5. Student Involvement in the Decision-Making Process;
6. Developments in Ancillary Services.

A specific list of criteria was developed which was considered important in assessing each particular category. After considering each of the criteria for a given category, a score from one to five could be given that category.

The Oakland County Intermediate School District was approached to assist in the selection of the innovative and non-innovative schools from Oakland County. The contention of the researcher was that this office was more

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knowledgeable about the high schools in Oakland than any other group. A panel of four judges was chosen to select the four innovative and four non-innovative high schools. They used as their instrumentation, the "Scale of Innovativeness" developed by the researcher.

The four innovative and four non-innovative high schools were selected by the judges and submitted to the researcher as a block of eight schools. No innovative or non-innovative connotations were reported, thus preventing the researcher from biasing the results in the administration of the "Openness Scale."

Selection of the Subjects from each School

Upon selection of the schools, a contact was made with each school by the Oakland County Office. They indicated their support for the study and asked each high school to cooperate with the researcher in conducting the study. Individual appointments were then made with each of the high school principals to explain the purpose of the study and the procedures to be utilized.

It was very important to get an accurate picture for each sample school of the people's beliefs about the openness of the school. In order to obtain a representative group across levels within the school, to whom the "Openness Scale" could be administered, the researcher chose the following subjects from each high school:

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1. The principal and assistant principals;
2. The counseling staff;
3. The department chairmen;
4. A sample of teachers;
5. A sample of students.

Systematic random sampling techniques were used to select the teachers and students in each school. The attempt was made to select between ten and fifteen teachers and approximately twenty to thirty students.

Utilization of the Instrument

The instrument utilized in this study is modeled after an "Openness Scale" developed by Robert Keuscher at the University of California, Los Angeles. The Scale was revised so that it could be administered to students as well as adults. Several items were reworded to simplify the meaning of the concept. Some items were added to refer to students and their role in the school. The instrument and the revisions were developed directly from the body of concepts, reviewed in Chapter Three, titled "general systems theory."

Keuscher validated the instrument by submitting it to a panel of experts in the field of education. He pretested the scale on two groups of subjects. The final scale developed by Keuscher for use in community colleges contained forty items. The scale is divided into five subscales: nine items apply to "adaptiveness," seven

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items apply to "hierarchial order," six items apply to "stability," eight items apply to "progressive systemization-progressive segregation," and ten items apply to "wholeness-independence."

The scale developed for the present study is revised to contain fifty-two items: eleven items apply to "adaptiveness," nine items apply to "hierarchial order," six items apply to "stability," twelve items apply to "progressive systemization-progressive segregation," and fourteen items apply to "wholeness-independence." It also was pretested and revised.

The scale was administered to subjects in each school in small groups depending upon when the individuals were available during the day. Each group was given a careful explanation of the five possible responses for each item on the scale. The concept assessed in each subscale was also reviewed with the subjects to insure a high degree of comprehension. The subjects were instructed to complete each of the fifty-two items. Any subjects that were in need of additional time to complete the scale were granted that opportunity. The explanation and administration of the instrument took approximately forty minutes.

Every effort was made to establish a positive attitude on the part of the subjects toward completing the scale to the best of their ability. Each respondent was asked to indicate only his position on the form and no

name. It was carefully explained that there would be no way that an individual's responses could be connected to him other than as part of a group.

The respondents were informed about the use of the results by the researcher. It was made clear that the name of the school would not appear in the study. Each principal would receive the results of the study for his particular school. It would be his concern as to how the results would be used in the school. The confidentiality of the results was felt to be highly important by the researcher.

In some cases, all subjects were not present on the day when the instrument was administered. In those cases, the researcher returned to the school and administered the scale to those subjects who had been absent.

Testable Hypotheses

For purposes of this study the central hypothesis is stated here in Null Form:

Null Hypothesis: No significant difference will be found in openness between innovative and non-innovative high schools when measured by mean scores on the "Characteristics of Openness Scale."

Symbolically: $H_o : M_1 = M_2$

Legend: M_1 = mean of innovative schools group

M_2 = mean of non-innovative schools group

The present study will also attempt to test the following sub-hypotheses:

H_{o2} There will be no significant difference on the mean scores of openness between administrators in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale."

H_{o3} There will be no significant difference on the mean scores of openness between counselors in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale."

H_{o4} There will be no significant difference on the mean scores of openness between department chairmen in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale."

H_{o5} There will be no significant difference on the mean scores of openness between teachers in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale."

H_{o6} There will be no significant difference on the mean scores of openness between students in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale."

Analysis of the Data

The instrument used in this study is the "Characteristics of Openness Scale", which is composed of five subscales; adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, and wholeness-independence.

The subjects in each of the schools were composed of five groups; administrators, counselors, department chairmen, teachers, and students.

For purposes of analyzing the data obtained on the openness scale, the analysis of variance method was used to find what differences existed. When the preliminary analysis and F-test indicated significance, an appropriate post-hoc technique was used to test the significance of post-hoc comparisons. All significance testing was done at the p .05 level.

The following information was desired:

1. The differences between innovative and non-innovative schools when measured by the mean scores on the total openness scale;
2. The differences between groups (administrators, counselors, department chairmen, teachers, students) in innovative and non-innovative schools;
3. The differences on the five-sub-scales between innovative and non-innovative schools;

4. The differences between groups in innovative and non-innovative schools on the five sub-scales (adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, wholeness-independence) and on the total openness scale;
5. The differences between groups within innovative schools.
6. The differences between groups in all schools.

The data was also analyzed in such a manner to provide each individual school a profile of the responses of the different groups in that school. Mean scores by item were provided for the school, for each group in the school, and for the school as a whole.

Additional Data to be Analyzed

The main effect tested by hypothesis in this study deals with the differences between innovative and non-innovative schools and within-school groups in innovative and non-innovative schools. The differences were sought on the scores of "Characteristics of Openness Scale."

There were, however, certain other main effects about which no hypotheses had been formulated. These main effects are important and provide pertinent data both about the testing instrument (Characteristics of Openness Scale) and the characteristics of openness in innovative and non-innovative schools.

The other main effects specifically analyzed were as follows:

1. An analysis of the "type-by-measures" interaction; Is there a significant difference between measures (adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, wholeness-independence) when innovative and non-innovative schools are compared?

2. An analysis of the "groups-by-measures" interaction; Is there a significant difference between the five within-school groups on each of the sub-scale measures?

Validity

The instrument used for assessing openness in this study has been validated by submitting it to three experts. Three college professors of education judged the instrument to be a valid measure of system openness in a high school.

Reliability

The method used in testing for reliability was the Hoyt Estimate of Reliability. This method allows the researcher to obtain an estimate of the internal consistency of the instrument. This process was carried out for the items in each of the sub-scales. The reliability of the instrument was considered important to the analysis of

of the data. No previous reliability estimates had been made for the instrument.

Summary

In Chapter IV we have described the design of the study, the methodology, and the procedures used. The selection of the schools and subjects was described as well as the rationale used in selection process.

In each school the Scale of Openness was administered to groups of administrators, counselors, department chairmen, teachers, and students. The scores of those groups and also those of the innovative and non-innovative groups of schools were analyzed, using an analysis of variance. The hypothesis to be tested was stated: No significant difference between innovative and non-innovative schools will be found in openness when measured by average scores on the openness scale. In Chapter V the data collected is presented and analyzed.

CHAPTER V

ANALYSIS OF THE DATA

Presentation of the Data

The primary purpose of this study was to determine whether schools which were classified as innovative would show evidence of being more open than schools which were classified as non-innovative. The test instrument used to assess the degree of openness in high schools was the "Characteristics of Openness Scale" developed for the study. The scale is found in Appendix II.

The basic design of the study was an analysis of variance for repeated measures involving four factors. "School-Type had two levels: "innovative" and "non-innovative." Within school type there were four replications of "school building," the unit of analysis. "Within-school-groups" was crossed with "school-type" and contained five levels: (1) administrators; (2) Counselors; (3) Department Chairmen; (4) Teachers; and (5) Students. The final factor, "repeated measures," was crossed with both "school-type" and "within-school-groups." Measures contained five levels: (1) adaptiveness; (2) hierarchial order; (3) stability; (4) progressive systemization-progressive segregation; and (5) wholeness-independence.

Thus, the design produced is a 2 x 4 x 5 x 5 structure for which the last factor is repeated measures.

The unit of analysis was school-building. In order to eliminate the difficulty of unequal cell sizes for the different groups, each school building was assigned a mean score representative of that building. Thus, each building had a mean score for total openness and a mean score for each of the within-school groups.

Each item on the scale was assigned a numerical value of one, three, five, seven, or nine. (See Figure 4) The values for all items in a sub-scale were summed to obtain a sub-scale score. The five sub-scale scores were then summed to obtain a total openness score. The value obtained by summing across sub-scale scores was divided by five to obtain a mean score for each school on the total scale. The sub-scale mean scores were summed across groups and by measures for all subjects in the school. A mean score for each group and for each sub-scale was then calculated. The same process was followed for total openness scores. (See Figure 5)

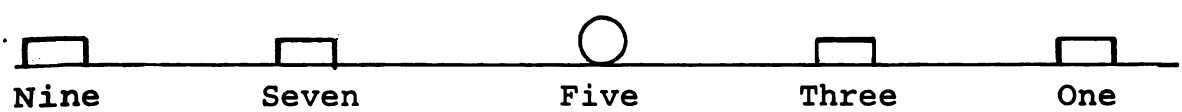

Figure 4.--Method of Scoring Individual Scale Items.

Adaptiveness	79
Hierarchial Order	63
Stability	36
Progressive Systemization-Progressive Segregation	84
Wholeness-Independence	60
Total	322 /5 = 64.4

Figure 5.--Method of Scoring One Total Openness Scale.

The raw mean scores can be found in Appendix III. From the raw mean scores an "analysis of variance table" was generated. Table 5.1 is the "analysis of variance. The analysis of variance table indicates the following differences in main effects when tested at the $p<.05$ level:

1. No significant difference between types: innovative and non-innovative;
2. A significant difference between groups; administrators, counselors, department chairmen, teachers, and students;
3. No significant difference between types by groups interaction;
4. A significant difference between measures: sub-scale scores;

5. A significant difference between types by measures interaction;
6. A significant difference between groups by measures interaction;
7. No significant difference between types by groups by measures interaction.

The analysis of variance table gives a key to where significant differences exist in the data obtained. After locating overall differences among the various levels, it becomes necessary to evaluate certain of the comparisons among means where significant differences occur.

Testing of Hypotheses

Careful examination of the analysis of variance table provides immediate data which indicates acceptance of the major and sub-hypotheses when tested at the $p<.05$ level. This can be ascertained by noting the F-value, which must be exceeded to have significance, and comparing that to the calculated F-ratio for each level. The F-ratio obtained for "Type" (innovative and non-innovative) was not significant at the $p<.05$ level. Thus, we accept the major hypothesis: H_o = There is no significant difference in openness between innovative and non-innovative schools when measured by mean scores on the "Characteristics of Openness Scale."

TABLE 5.1.--Analysis of Variance Table.

Levels	Sum Squares	D.F.	Mean Squares	F-Ratio	P	F^1
Type	270.369	1	270.369	.954	N.S.D.	5.99
Building (Type)	1699.698	6	283.283			
Group	6772.170	4	1693.042	11.235	p<.05	
Type by Group	1213.001	4	303.250	2.012	N.S.D.	2.78
Group-Building (Type)	3616.731	24	150.697			
Measures	39784.484	4	9946.121	290.518	p<.05	
Type (Measures)	1460.530	4	365.133	10.665	p<.05	4.26
Measures-Building (Type)	821.695	24	34.236			
Group-Measures	1253.435	16	78.340	3.193	p<.05	
Type-Group-Measures	122.191	16	7.637	.311	N.S.D.	2.78
Measures-Group-Building (Type)	2355.481	96	24.536			
Total	59369.747	199	298.340			

T = type (innovative or non-innovative), G = Group (Administrators, Counselors, Department Chairmen, Teachers, Students), B = Buildings, M = Measures (adaptiveness, hierarchial order, Stability, Progressive Systemization-Progressive Segregation, Wholeness-Independence. N.S.D. = no significant difference.

TABLE 5.2--Mean Scores for Main Effect: Type by Measures and Differences between Mean Scores.

Type	Measures				
	Adaptive-ness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence
Non-Innovative $\bar{X}_1$	54.017	51.864	43.469	74.677	75.129
Innovative $\bar{X}_2$	63.712	54.224	36.479	76.709	79.659
$\bar{X}_1 - \bar{X}_2$	9.695	2.360	-6.990	2.032	4.530

TABLE 5.3--Analysis of Type by Measures Interaction (Innovative vs. Non-Innovative High Schools by Sub-Scale Mean Scores).

Type	Measures				
	Adaptive-ness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence
$\bar{X}_{Innovative} - \bar{X}_{Non-Innovative}$	9.695	2.360	-6.990	2.032	4.530
Est. σ diff. $\sqrt{S_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}$	2.792	2.727	1.817	3.050	4.376
t	3.472*	.865	-3.847*	.666	1.035
p	p<.05	No significant difference	p<.05	No significant difference	No significant difference

p<.01 level, df = 38, t > 2.75 or t < -2.75

* = significant difference

Study of the analysis of variance table will also show no significant difference between Types of Groups interaction. The F-ratio at the $p<.05$ level was not significant and thus we must accept the sub-hypotheses formulated for that main effect:

H_{o2} = There is no significant difference in the mean scores of openness between administrators in innovative and non-innovative schools;

H_{o3} = There is no significant difference in the mean scores of openness between counselors in innovative and non-innovative schools;

H_{o4} = There is no significant difference in the mean scores of openness between department chairmen in innovative and non-innovative schools;

H_{o5} = There is no significant difference in the mean scores of openness between teachers in innovative and non-innovative schools;

H_{o6} = There is no significant difference in the mean scores of openness between students in innovative and non-innovative schools.

Analysis of Other "Main Effects"

The first main effect considered here is the "type by measures" interaction. The objective is to determine

whether there is a significant difference in each of the measures (sub-scales: adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, wholeness-independence) when innovative and non-innovative schools are compared. To test for this main effect, the T-test for significant difference between means was utilized. The formula is noted below:

$$t = \frac{x_1 - x_2}{\sqrt{s_p^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

In order to report at the $p<.05$ level using repeated measures, t for each measure was calculated at the $p<.01$ level with 38 degrees of freedom. For a significant difference to exist, we must have values for $\underline{t}$ of $t>2.75$ or $t<-2.75$. The data is reported in Table 5.3.

A significant difference exists between innovative and non-innovative schools for the sub-scale measures of adaptiveness and stability. Innovative schools score significantly higher on the "adaptiveness" sub-scale than do non-innovative schools. However, an inverse relationship exists in comparisons on the stability scale. Innovative schools score significantly lower on the "stability" sub-scale than do non-innovative schools.

The second main effect to be treated here is the difference between "groups by measures" interaction. The object is to determine where significant differences exist

TABLE 5.4.--Mean Scores for Main Effect: Group by Measures Interaction.

Groups	Measures				
	Adaptive-ness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence
Administration	66.792	61.410	44.475	85.717	90.112
Counselors	60.781	57.354	42.271	81.281	86.823
Department Chairmen	55.544	51.398	40.867	73.498	74.048
Teachers	56.029	48.405	37.629	72.158	66.462
Students	55.176	46.652	34.627	65.812	69.525

between the within-school groups (administrators, counselors, department chairmen, teachers, students) when compared on the five sub-scale measures (adaptiveness, hierarchial order, stability, progress systemization-progressive segregation). In order to carry out this post-hoc analysis, Tukey's Honestly Significant Difference (HSD) test was applied. The Tukey HSD test is a multiple comparison test designed for making all pairwise comparisons among means. The formula is noted below:

$$HSD = q_{\alpha,v} \sqrt{\frac{MS_{error}}{n}}$$

In this case we must use conservative degrees of freedom (v) because of the repeated measures. Alpha is set at .01 and degrees of freedom at 24. HSD = 9.053.

The data is presented in Table 5.5. An analysis of the data presented indicates significant differences in the way within-school groups score on the sub-scales of the "Characteristics of Openness Scale."

Administrator scores differ significantly with more other groups on more sub-scale measures than any other within-school group. Administrators differ significantly from teachers on the sub-scales of adaptiveness, hierarchial order, progressive systemization-progressive segregation, and wholeness-independence. Administrators differ significantly from department chairmen on the same four sub-scale

TABLE 5.5.--Mean Score Differences between Within-School Groups on Sub-Scale Measures.

Paired Group Differences	Measures				
	Adaptive-ness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independ-ence
Administrators Minus Counselors	6.011	4.056	2.204	4.436	3.289
Administrators Minus Teachers	10.76*	13.005*	6.846	13.559*	23.650*
Administrators Minus Dept. Chairmen	11.248*	10.021*	3.608	12.269*	16.064*
Administrators Minus Students	11.616*	14.758*	9.848*	19.905*	20.583*
Counselors Minus Dept. Chairmen	5.237	5.965	1.404	7.783	12.415*
Counselors Minus Teachers	4.752	8.949	4.642	9.123*	20.361*
Counselors Minus Students	5.605	10.702*	7.644	15.469*	17.294*
Teachers Minus Dept. Chairmen	.485	-2.984	-3.238	-1.340	-7.586
Teachers Minus Students	.853	1.753	3.002	6.346	-3.063
Dept. Chairmen Minus Students	.368	4.737	6.240	7.686	4.523

$p<.01$ level, $df = 24$, $HSD>9.053$ or $HSD<-9.053$

* = significant difference.

measures noted for teachers. Administrators and students show significant differences on all five sub-scale measures. Administrators and counselors,on the other hand, do not differ significantly on any of the sub-scale measures.

Counselors and department chairmen score significantly different only on the wholeness-independence measure. Counselors and teachers score significantly different on the sub-scale measures of progressive systemization-progressive segregation and wholeness-independence. Counselors and students show significantly different scores on the sub-scale measures of hierarchial order, progressive systemization-progressive segregation and wholeness-independence.

There is no significant difference on any sub-scale measure between students and teachers or between students and department chairmen. Teachers and department chairmen also do not differ significantly on any of the sub-scale measures.

Reliability Estimates

It was desired to obtain data regarding the degree to which the five sub-scale measures (adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, wholeness-independence) were reliable. The Hoyt Estimate of Reliability was used to

measure the extent to which each sub-scale measured a unitary construct. In this case the Hoyt Estimate of Reliability gives an index of the dependability of the sub-scale. The Hoyt Estimate of Reliability is arrived at by using an analysis of variance formula:

$$\text{Hoyt Estimate of Reliability} = \frac{MS_{\text{subjects}} - MS_{\text{items by subjects interaction}}}{MS_{\text{subjects}}}.$$

TABLE 5.6.--Hoyt Estimate of Reliability for Five Sub-Scales

Sub-Scales	Number of Items	Hoyt Estimate of Reliability
Adaptiveness	11	.739
Hierarchial Order	9	.801
Stability	6	.625
Progressive Systemization-Progressive Segregation	12	.827
Wholeness-Independence	14	.872

The results are presented in Table 5.6. Examination of this table indicates a high level of reliability for three of the five sub-scale measures. Hierarchial order, progressive systemization-progressive segregation and

wholeness-independence were all estimated at higher than .800. Stability showed the lowest estimate of reliability, measuring at .625. Adaptiveness was estimated at .739.

It was also important to correlate the sub-scale measures with the total openness scale score. That data is presented in Table 5.7. There is a fairly high correlation between the sub-scale scores and the total openness score with the exception of stability, which correlates at the .541 level.

Summary

The major hypothesis tested in this study was accepted at the p .05 level. There is no significant difference between mean scores of openness in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale". There is also no significant difference on scores of openness between within-school groups when innovative and non-innovative schools are compared.

Findings regarding other main effects did show significance at the p .05 level. The main effect for "type by measures" interaction showed a significant difference in mean scores. Innovative schools scored significantly higher on the "adaptiveness" sub-scale measure than did non-innovative schools. However, innovative schools scored significantly lower on the

TABLE 5.7.--Simple Correlations of Sub-Scale Scores and Total Openness Scale Scores.

Measures	Measures					
	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Adaptiveness	1.000					
Hierarchial Order	.586	1.000				
Stability	.199	.398	1.000			
Progressive-Systemization-Progressive Segregation	.513	.655	.451	1.000		
Wholeness-Independence	.598	.759	.378	.721	1.000	
Total	.741	.862	.541	.856	.911	1.000

"stability" sub-scale measure than did non-innovative schools.

The main effect for "groups by measures" interaction also showed a significant difference. Numerous significant differences were found between administrators, students, teachers, counselors, and department chairmen when post-hoc comparisons were made.

The Hoyt Estimate of Reliability showed the sub-scale measures of hierarchial order, progressive systemization-progressive segregation, and wholeness-independence, to be very reliable. The stability sub-scale measure showed a reliability of .625. Adaptiveness measured at .739. A high correlation existed between all sub-scale measures and the total openness scale score, with the exception of the stability sub-scale measure and the adaptiveness sub-scale measure. The stability sub-scale measure showed a correlation of .541 and adaptiveness showed a correlation of .739.

In Chapter VI the study is summarized briefly, conclusions drawn, and recommendations made for further research.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

Public high schools today are coming under increased pressure to provide equal education for all youth. Quality education based on the individual needs of students is being demanded at all levels. Although the demands are increasing in intensity, resources seem to be increasingly more limited. Administrators must plan and evaluate to deal effectively with the dilemma. Schools must improve.

Few high schools have made significant strides toward improving high school educational programs. Real change and innovation are not common. One of the concerns of this study was to attempt to identify characteristics which could be associated with innovative high schools. The basic concept studied was the degree to which a school could be described as an "open system".

Systems theorists have identified seven fundamental properties of open systems: adaptiveness, hierarchial order, stability, progressive segregation, progressive systemization, wholeness, and independence. In this study those properties were studied carefully, analyzed, and used to develop an instrument for assessing high schools as "open or closed systems". The instrument was titled the "Characteristics of Openness Scale".

It is obvious from the literature that "systems approaches" are only in their infancy. Systems approaches in education have been developed to an even lesser degree. This study attempts to add more empirical data to the growing body of knowledge about the systems approach in education.

The study was designed to look at the degree of openness in innovative and non-innovative high schools. It was hypothesized that: H_o = There is no significant difference in openness between innovative and non-innovative schools when measured by mean scores on the "Characteristics of Openness Scale". It was also hypothesized that there would be no significant difference in mean scores of openness between paired within-school groups when each group was compared across innovative and non-innovative schools.

To test those hypotheses, an analysis of variance design for repeated measures was developed and utilized. The design involved four factors. "School type" had two levels: "innovative and non-innovative". Within "school type" there were four replications of "school building", the unit of analysis. Within-school groups was crossed with "school type" and contained five levels: (1) administrators; (2) counselors; (3) department chairmen; (4) teachers; and (5) students. The final factor, "repeated measures", was crossed with both "school type" and "within-school groups". Measures contained five levels: (1) adaptiveness; (2) hierarchial order; (3) stability; (4) progressive systemization-progressive segregation; and (5) wholeness-independence.

Thus, the design produced a 2 x 4 x 5 x 5 structure for which the last factor is repeated measures.

Findings

Based on the data collected and analyzed in this study the major and sub-hypotheses were accepted in null form. They are stated as follows:

H_o = No significant difference will be found in openness between innovative and non-innovative high schools when measured by mean scores on the "Characteristics of Openness Scale".

H_{o2} = There will be no significant difference on the mean scores of openness between administrators in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale".

H_{o3} = There will be no significant difference on the mean scores of openness between counselors in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale".

H_{o4} = There will be no significant difference on the mean scores of openness between department chairmen in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale".

H_{o5} = There will be no significant difference on the mean scores of openness between teachers in

innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale".

H_{o6} = There will be no significant difference on the mean scores of openness between teachers in innovative and non-innovative high schools when measured by the "Characteristics of Openness Scale".

There were, however, two other main effects of the study which produced significant results. The first dealt with differences between innovative and non-innovative schools on the sub-scale measures of the "Characteristics of Openness Scale". It was discovered that innovative high schools scored significantly higher than non-innovative high schools on the sub-scale measure "adaptiveness".

An inverse relationship was discovered between scores on "stability" in innovative and non-innovative schools. Innovative schools scored significantly lower than non-innovative schools on the sub-scale measure "stability".

The second main effect studied, but not dealt with under hypothesis, was the differences between "groups by measures" interaction. It was discovered that significant differences exist between scores of administrators, counselors, department chairmen, teachers, and students when analyzed on the sub-scale measures: adaptiveness, hierarchial order, stability, progressive systemization-progressive segregation, and wholeness-independence.

Administrator scores differ significantly from those of teachers on the sub-scales of adaptiveness, hierarchial order, progressive systemization-progressive segregation, and wholness-independence. Administrators differ significantly from department chairmen on the same four sub-scale measures as noted for teachers. The administrators and students differ significantly on all five sub-scale measures. On the other hand, administrators and counselors do not differ significantly on any of the sub-scale measures.

Counselors and department chairmen score significantly different only on the wholness-independence sub-scale measure. Counselors and teachers score significantly different on the sub-scale measures of progressive systemization-progressive segregation and wholeness-independence.

There is no significant difference on any sub-scale measure between students and teachers or between students and department chairmen. Teachers and department chairmen also do not differ significantly on any of the sub-scale measures.

Conclusions

Administrators would do well to study the basic precepts of open systems and their value for more effectively assessing the health or climate of the school organization. The use of the "Characteristics of Openness Scale" can provide valuable data very pertinent to administrators and others concerned with effective and efficient school organization. The perceptions of groups within the school toward

the functioning of the school can be readily obtained in a simple and practical manner. The results of the scale take very little time to tabulate and analyze.

It is worth extensive consideration from administrators to note that innovative schools are perceived as much more adaptive than non-innovative schools. Hopefully this is one of the major concerns of a school; adjusting and adapting to the varied individual and organizational needs of the school.

It is also important to observe that innovative schools tend to be considerably more unstable than non-innovative schools. The high school administrator must be ready to face the possibility that if he strives toward change and innovation, there may be periods of significant instability.

One important conclusion relates to the manner in which innovative and non-innovative schools are identified. The method and technique used in this study were consistent and thoroughly developed. However, after visiting the eight schools involved in the study and administering the "Characteristics of Openness Scale", there is some doubt about the validity of any method of identifying innovative schools. We need a great deal more evidence about the description of an innovative school.

The work of this study has reaffirmed my belief in the importance of process in organizations. In light of

systems theory, process becomes even more crucial to the development of healthy school organizations.

The process becomes more than a subjective concern when the data obtained from this study is examined. Significant differences exist between within-school groups on several of the sub-scale measures. Administrators and students, for example, are discrepant on all five of the sub-scale measures of openness. The two groups would experience considerable difficulty trying to work effectively toward the goals of the school if no attempt were made to develop some compatibility of perceptions about the school. The same holds true for administrators and teachers, and any other groups within the school, when there is significant difference on the sub-scale measures.

In all schools which I visited, there was a high degree of excitement generated from students toward the research project because for many it was the first opportunity they had been given to give feedback about the school and its openness.

All groups within the school were very cooperative and enthusiastic about the study. The fact that the school would receive significant feedback about the school organization created a great deal of interest.

The cooperation of the staff members at the Oakland County Intermediate School District was very gratifying. Their interest and attention to the essence of the study was highly positive. Their efforts in obtaining cooperation

from the individual high schools were crucial in making the study a success.

Recommendations for Further Study

The present study should be replicated in other high schools to determine whether there is similarity in findings. There is need for much more evidence about openness in schools and the relationship of open systems to change and innovation.

More definition is required concerning the characteristics of innovative schools in light of the fact that they have been shown to be significantly more "adaptive" than non-innovative high schools. Further research is needed to define more clearly what there is about innovative schools that makes them more adaptive.

There is need for more study about the "stability" of a high school. The fact that innovative schools are less stable may be a desired quality. It may, however, be a quality that destroys characteristics of innovativeness in high schools. Those factors that cause instability need to be delineated carefully for the use of administrators in effecting change.

The significant differences on sub-scale measures between within-school groups needs to be studied more extensively. These different perceptions of the school as an open system could cause serious difficulties in reaching the goals of the school. The reasons for different perceptions between within-school groups need to be identified. Valuable

data would be obtained for use of administrators in assessing the organizational health of the high school.

The study should be replicated at different educational levels. Middle schools, junior high schools, and elementary schools would be critical areas in which to conduct further study. Central administration offices could also be carefully studied to determine the degree to which they operate as an open system.

Lastly, it would be profitable to take any one of the properties of systems theory and study it thoroughly, in isolation from the other properties. The refinement of each individual basic property of open systems would assist in defining more specifically the total "open system" construct.

The potential for further study of the open systems concept is great. There needs to be continued evaluation of the concepts discussed and tested in the present study. University schools of education and local boards of education should encourage on-going research about the school as an open system.

Personal Feelings

The findings of this study reinforce three basic ideas which the researcher has previously felt to be highly important in high school administration.

The first is concerned with the present intensity of student unrest in our schools. Administrators definitely view high schools as more open than do students. Schools need to become more open in a manner that involves students

in an active rather than passive way. The learning environment of a high school can only be realistic when students are involved in the learning process and making decisions about it. The conflict between students and high schools today is evidence of that fact.

Secondly, the same holds true for a great deal of the dissatisfaction that teachers feel toward administrators. Teachers see high schools as significantly less open than do administrators. If teachers are to become more positive factors in the learning environment of high schools, they too must become part of the learning process and become involved in making decisions about it. Only then can the school become an open system.

Thirdly, it is apparent that if a school is to tend toward innovativeness, administrators will have to risk the possibility of instability. If high schools are to become more "adaptive" to the needs of students and teachers, administrators will have to take the risk of "making waves". To be an effective administrator and move toward providing innovation in learning, is not a "safe" role to play. It takes intestinal fortitude to be a real educational leader in modern American high schools.

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APPENDIX I

APPENDIX I

SCALE OF INNOVATIVENESS

The purpose of this scale is to obtain an estimation of the degree to which certain Oakland County Schools can be classified as innovative.

For the purpose of this scale we will accept the following definitions of Innovation:

1. A specific, planned change for the purpose of more effectively achieving the goals and objectives of the organization;

2. Any practice fitting the above definition, which is not in common practice or use in the Oakland County Area.

Listed in the scale are six objective categories which describe possible innovative practices in high schools. The categories are as noted below:

1. Individualized Instruction.

2. Developments in Curriculum.

3. Developments in Technology.

4. Staff Involvement in the Decision-Making Process.

5. Student Involvement in the Decision-Making Process.

6. Developments in Ancillary Services.

Beneath each objective category in the scale is a specific list of important criteria to be considered in assessing each category. Each of the criteria is to be carefully considered so that an accurate judgement can be made regarding the objective category.

There are five responses which may be used to assess each of the categories. The responses are placed on a continuum which describes the "Degree of Awareness and Implementation of Innovations". The continuum ranges from an "extensive degree" of awareness and implementation to "little or no degree" of awareness and implementation of the innovative practice.

The diagram below shows the continuum and the appropriate responses for the different degrees of awareness and implementation. Also shown on the continuum are numbers which represent the different degrees on the continuum.

DEGREES OF AWARENESS AND IMPLEMENTATION

OF INNOVATIVENESS

(1)	(2)	(3)	(4)	(5)
Extensive		Moderate		Little or None

INSTRUCTIONS FOR USE OF THE SCALE:

1. Complete one scale for each of the high schools considered.
2. Read each objective category and the important criteria for innovative practice.

3. Circle the number of the response which best describes the Degree of Awareness and Implementation of Innovativeness for each objective category.

4. Add the five numbers (obtain one for each category) to get a numerical description for each school.

SCALE OF INNOVATIVENESS

DATA

NAME OF HIGH SCHOOL_____

NAME OF SCHOOL DISTRICT_____

ENROLLMENT OF HIGH SCHOOL_____

ENROLLMENT OF SCHOOL DISTRICT_____

ADDRESS OF HIGH SCHOOL_____

_____

PRINCIPAL OF HIGH SCHOOL_____

SUPERINTENDENT OF SCHOOL DISTRICT_____

OBJECTIVE CATEGORIES OF INNOVATION

1 2 3 4 5 I. INDIVIDUALIZED INSTRUCTION

CRITERIA TO BE CONSIDERED:

A. Continuous Progress

B. Flexible Scheduling

C. Differentiated Staffing

D. Multiple-Level Instructional Materials

E. Team Teaching

F. Independent Study

---

1 2 3 4 5 II. DEVELOPMENTS IN CURRICULUM

CRITERIA TO BE CONSIDERED:

A. Science-Inquiry Approach, i.e., PSSC Physics, CBA Chem.

B. Social Studies-Conceptual Approach

C. Math-Modern Math, i.e., SMSG Math

D. English, i.e., linguistics, transformational grammar

E. Vocational Training for Saleable Skills, i.e., computer courses, electronics

F. Interdisciplinary Studies, i.e., Humanities

G. Foreign Language---Audio-lingual

H. Programs for Slow Learners and Under-achievers

1 2 3 4 5 III. DEVELOPMENTS IN TECHNOLOGY

CRITERIA TO BE CONSIDERED:

A. Computer-Assisted Instruction

B. Wet Carrels--Retrieval System

C. Closed Circuit T. V.

D. Teaching Machines--Programmed Learning

E. Language Labs--Listening Posts

F. Other Audio-Visuals---Overheads, film loops, tapes, photography equipment, etc.

---

1 2 3 4 5 IV. STAFF INVOLVEMENT IN THE DECISION-MAKING PROCESS

CRITERIA TO BE CONSIDERED:

A. Involvement in Curricular Decisions, i.e., course offerings and planning, selection of materials, evaluation

B. Involvement in Decisions regarding school rules and regulations

C. Involvement in the Evaluation of Curriculum and School Rules and Regulations

---

1 2 3 4 5 V. STUDENT INVOLVEMENT IN THE DECISION-MAKING PROCESS

CRITERIA TO BE CONSIDERED:

A. Involvement in Curricular Decisions, i.e., course offerings and planning, selection of materials, evaluation

B. Involvement in Decisions regarding School Rules and Regulations

C. Involvement in the Evaluation of Curriculum and School Rules and Regulations

1 2 3 4 5 VI. DEVELOPMENTS IN ANCILLARY SERVICES

CRITERIA TO BE CONSIDERED:

A. Counseling

B. Psychological Services

C. Psychiatric Services

D. Social Work Assistance

E. Health Services

F. Reading Services

SCORES

_____	I.	INDIVIDUALIZED INSTRUCTION
_____	II.	DEVELOPMENTS IN CURRICULUM
_____	III.	DEVELOPMENTS IN TECHNOLOGY
_____	IV.	STAFF INVOLVEMENT IN THE DECISION-MAKING PROCESS
_____	V.	STUDENT INVOLVEMENT IN THE DECISION-MAKING PROCESS
_____	VI.	DEVELOPMENTS IN ANCILLARY SERVICES
_____		TOTAL NUMERICAL SCORE

APPENDIX II

APPENDIX II

CHARACTERISTICS OF
OPENNESS SCALE

DIRECTIONS:

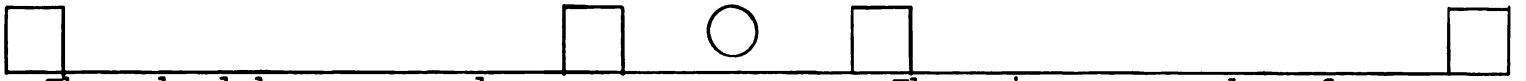
1. If you feel the statement on the left is most representative of the school, place a check in the box at the left end of the line.
2. If you feel the statement on the right is most representative of the school, place a check in the box at the right end of the line.
3. If you feel that neither statement accurately describes conditions at the school but is more representative than the statement at the opposite end of the line, place a check in the appropriate box at the immediate left or right of the center circle.
4. If you feel neither statement is applicable to the school, place a zero in the circle at the mid-point of the line.
5. If you feel there is insufficient evidence to make a valid judgement about the school, place the letter "I" in the circle at the mid-point of the line.

POSITION_____

SCHOOL_____

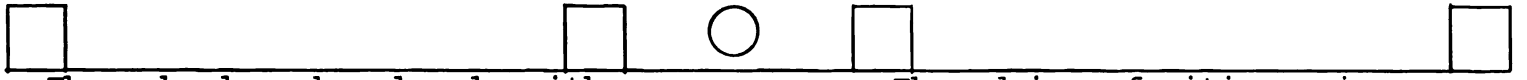
DATE_____

ADAPTIVENESS RATING SCALE

1. 

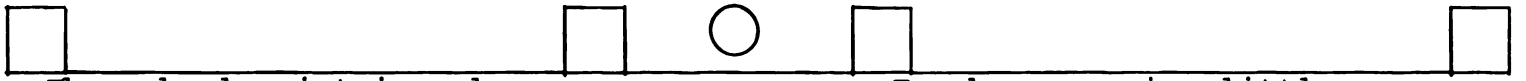
The school has a procedure for gathering information on changes in the community which might have implications for the instructional program.

There is no procedure for gathering information on changes in the community. Thus, little information about the community gets to classroom instructors.

2. 

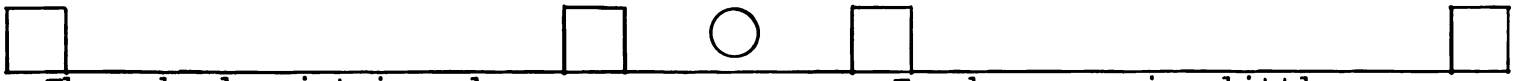
The school works closely with citizens when considering new courses and new instructional procedures.

The advice of citizens is rarely sought in helping to plan new courses or to institute new instructional procedures.

3. 

The school maintains close contact with colleges, universities, and other training schools for the purpose of evaluating its instructional offerings.

Teachers receive little or no feedback on students who continue their education after graduation.

4. 

The school maintains close contact with employers for the purpose of evaluating course offerings.

Teachers receive little or no feedback on students who go to work after attending high school.

5. 

A department of school research has been established which gathers information on the effectiveness of the instructional program.

There is no department of school research to gather information on the effectiveness of the instructional program.

6. 

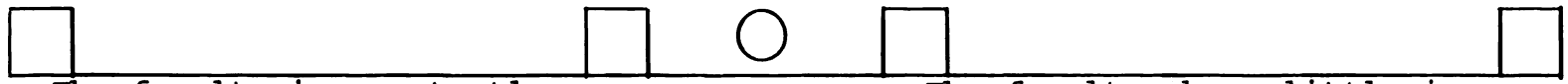
The administration encourages faculty members to experiment and innovate.

The administration does not encourage faculty members to experiment and innovate.

7. 

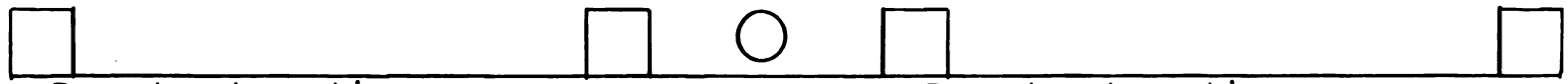
Students and student groups are encouraged to experiment and innovate.

Students and student groups are not encouraged to experiment and innovate.

8. 

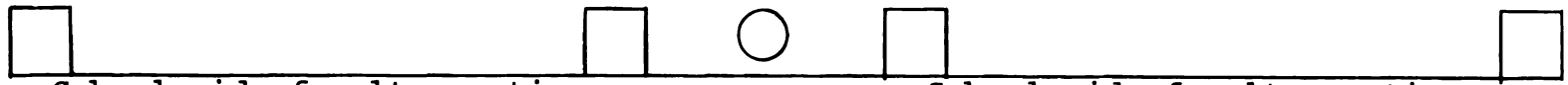
The faculty is constantly looking for ways to improve instruction.

The faculty shows little interest in change or ways to improve instruction.

9. 

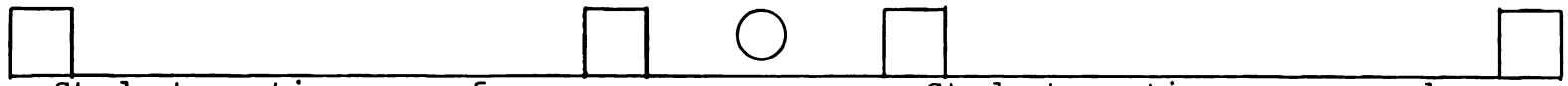
Department meetings are frequently devoted to discussion of curriculum and/or instruction.

Department meetings are rarely, if ever, devoted to discussion of curriculum and/or instruction.

10. 

School-wide faculty meetings are frequently devoted to discussion of curriculum and/or instruction.

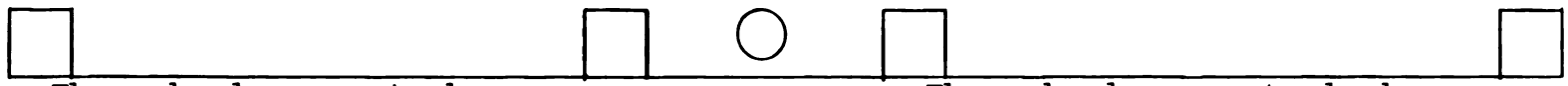
School-wide faculty meetings are rarely, if ever, devoted to discussion of curriculum and/or instruction.

11. 

Student meetings are frequently held and devoted to discussion of curriculum and/or instruction.

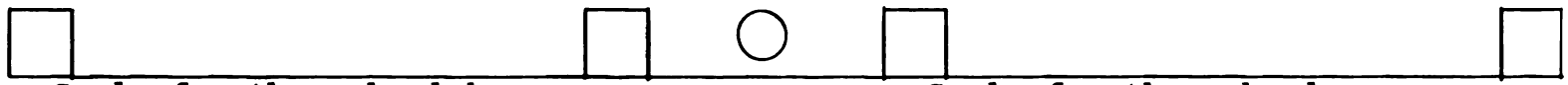
Student meetings are rarely, if ever, held and devoted to discussion of curriculum and/or instruction.

HIERARCHIAL ORDER SCALE

1. 

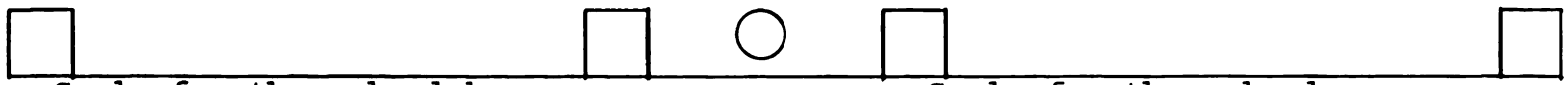
The school seems to have a purpose--knows what its mission is.

The school seems to lack purpose--does not know what its mission is.

2. 

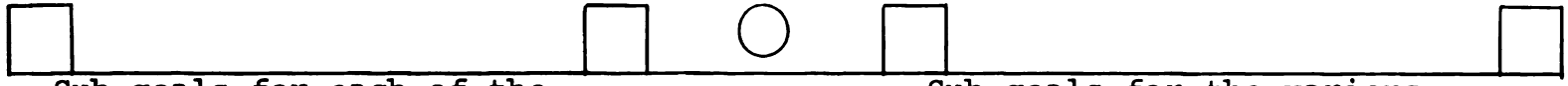
Goals for the school have been clearly defined and are understood by the staff.

Goals for the school are broad and vague and are not clearly understood by the staff.

3. 

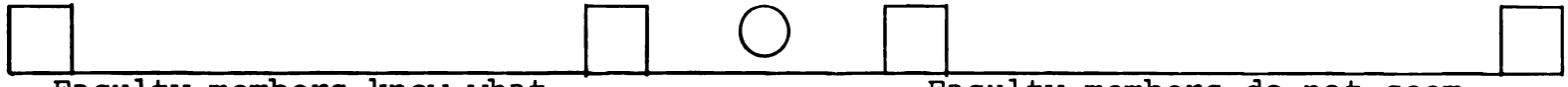
Goals for the school have been clearly defined and are understood by the students.

Goals for the school are broad and vague and are not clearly understood by the students.

4. 

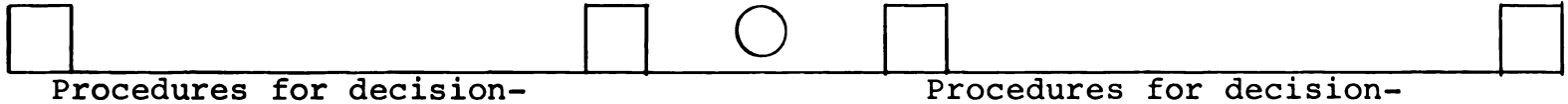
Sub-goals for each of the various departments have been clearly defined.

Sub-goals for the various departments have not been clearly defined.

5. 

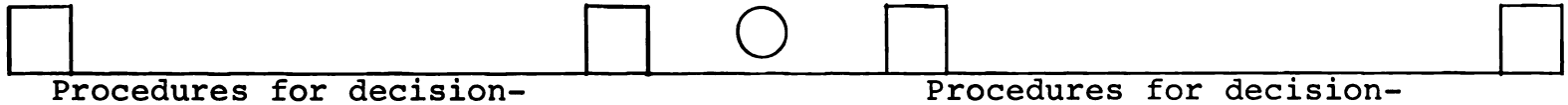
Faculty members know what their functions are in helping the school attain its goals.

Faculty members do not seem to know what their functions are in helping the school attain its goals.

6. 

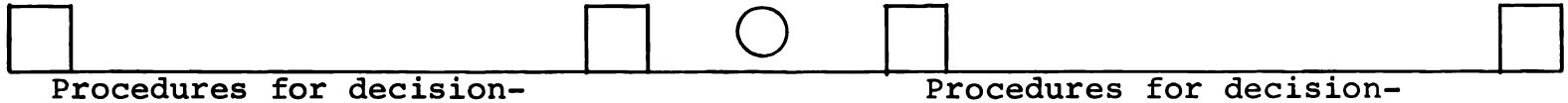
Procedures for decision-making have been clearly defined.

Procedures for decision-making have not been clearly defined.

7. 

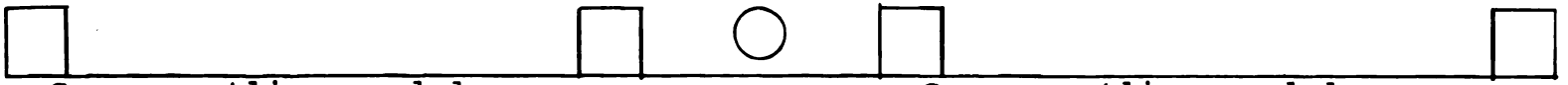
Procedures for decision-making are understood by the staff.

Procedures for decision-making are not understood by the staff.

8. 

Procedures for decision-making are understood by the students.

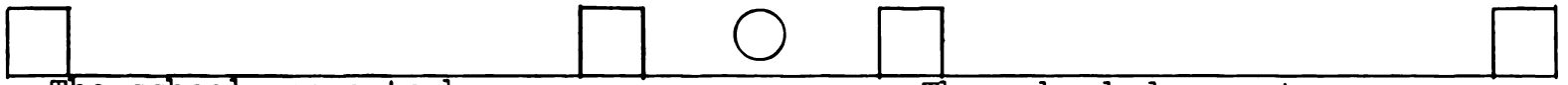
Procedures for decision-making are not understood by the students.

9. 

Course outlines and descriptions are available which accurately reflect the goals of the school.

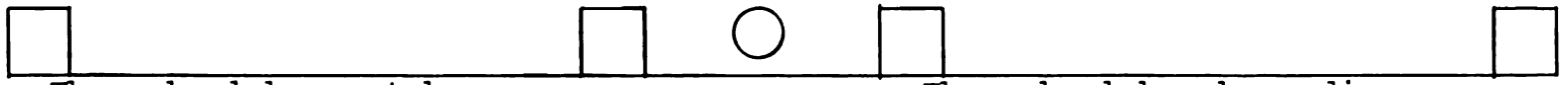
Course outlines and descriptions are not available which accurately reflect the goals of the school.

STABILITY SCALE

1. 

The school seems to be running smoothly.

The school does not seem to be running smoothly.

2. 

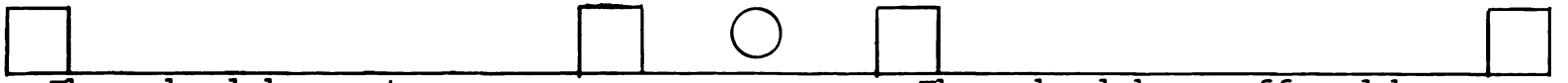
The school has not been discouraged from making changes by community pressure groups.

The school has been discouraged from making changes by community pressure groups.

3. 

The school has not been stampeded into change by community pressure groups.

The school has occasionally been stampeded into change by community pressure groups.

4. 

The school has not over-indulged in making changes or tried to change too much too soon.

The school has suffered because it has overindulged in change and tried to change too much too soon.

5. 

All changes in curriculum and instructional procedures are carefully planned and prepared for, prior to implementing them.

Changes in curriculum and instructional procedures are frequently made without proper planning and preparation.

6. 

Major changes in curriculum do not cause major upsets to the school equilibrium.

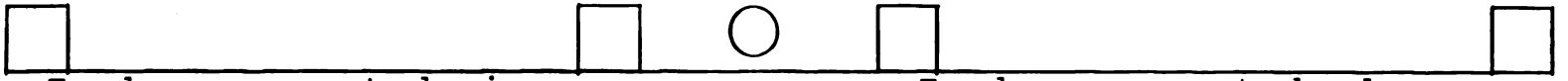
Major curriculum changes have caused upsets in the school equilibrium which took some time to overcome.

PROGRESSIVE SYSTEMIZATION--PROGRESSIVE SEGREGATION SCALE

1. 

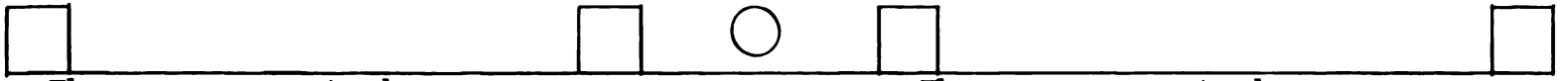
There appears to be increasing sensitivity on the part of the staff to the needs and interests of the community.

The staff appears to be decreasingly sensitive to the needs and interests of the community.

2. 

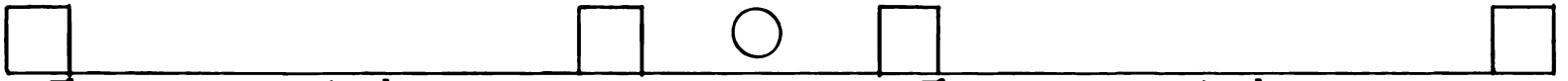
Teachers appear to be increasingly receptive to information and feedback on the effectiveness of the instructional program.

Teachers appear to be decreasingly interested in information and feedback on the effectiveness of the instructional program.

3. 

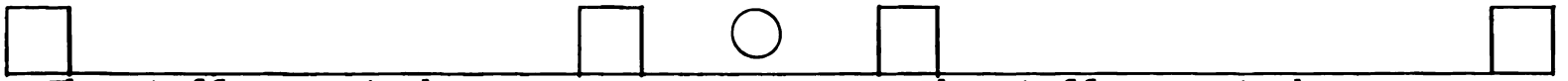
There appears to be an increasing willingness to change on the part of the staff.

There appears to be a decreasing willingness to change on the part of the staff.

4. 

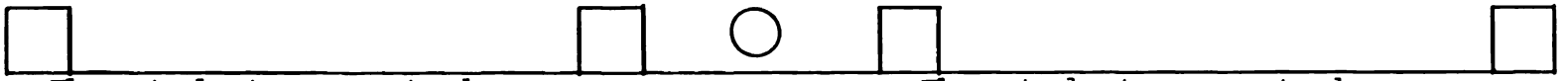
There appears to be an increasing willingness to change on the part of the students.

There appears to be a decreasing willingness to change on the part of the students.

5. 

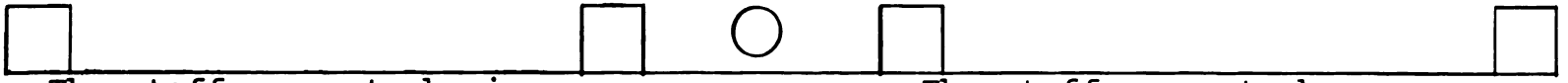
The staff seems to be increasingly aware of the goals and purposes of the school.

The staff seems to be decreasingly aware of the goals and purposes of the school.

6. 

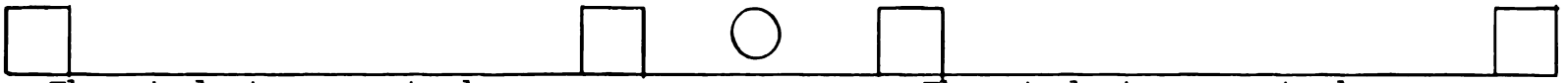
The students seem to be increasingly aware of the goals and purposes of the school.

The students seem to be decreasingly aware of the goals and purposes of the school.

7. 

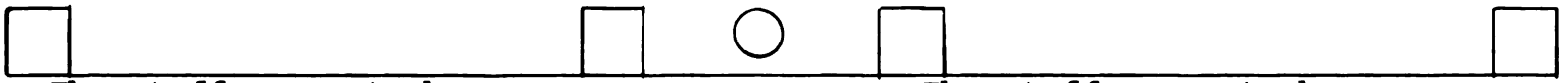
The staff seems to be increasingly aware of priorities and procedures aimed at attaining the goals of the school.

The staff seems to be decreasingly aware of priorities and procedures aimed at attaining the goals of the school.

8. 

The students seem to be increasingly aware of priorities and procedures aimed at attaining the goals of the school.

The students seem to be decreasingly aware of priorities and procedures aimed at attaining the goals of the school.

9. 

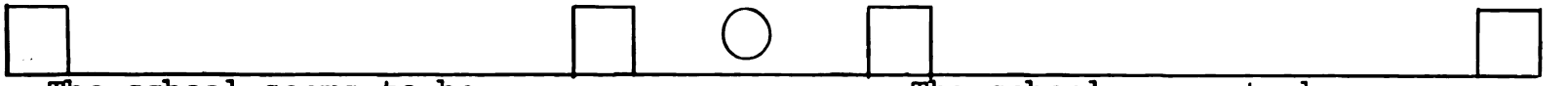
The staff seems to be increasingly clear as to how and where decisions are made within the school.

The staff seems to be decreasingly clear as to how and where decisions are made within the school.

10. 

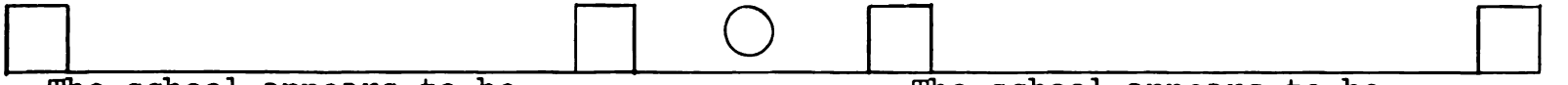
The students seem to be increasingly clear as to how and where decisions are made within the school.

The students seem to be decreasingly clear as to how and where decisions are made within the school.

11. 

The school seems to be increasingly able to pace itself. It is neither too resistant nor overly impulsive as far as change is concerned.

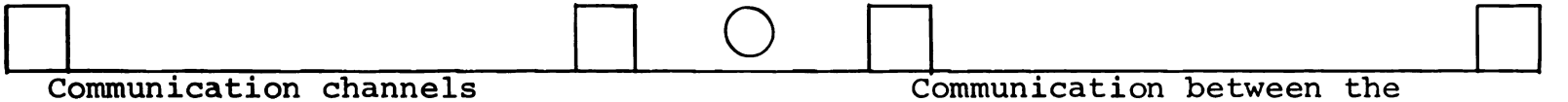
The school seems to be decreasingly able to pace itself. It is either overly impulsive or too resistant to change.

12. 

The school appears to be increasingly able to make changes without upsetting operational procedures.

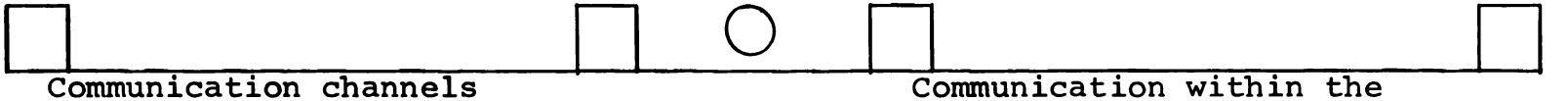
The school appears to be decreasingly able to maintain its smoothness of operation when change occurs.

WHOLENESS--INDEPENDENCE SCALE

1. 

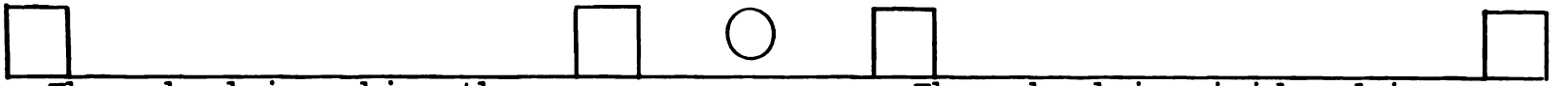
Communication channels between the school and the community are open and functioning.

Communication between the school and the community is almost non-existent.

2. 

Communication channels within the school are open and functioning.

Communication within the school is virtually non-existent.

3. 

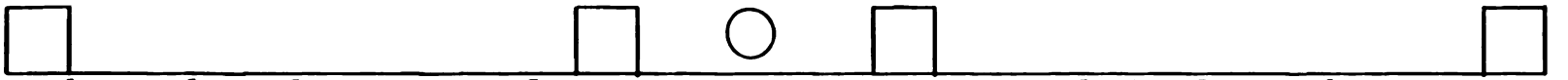
The school is making the changes suggested by the information and feedback it receives.

The school is rigid and inflexible and making few, if any, changes as a result of feedback.

4. 

The goals and purposes of the school are well-known by the faculty.

Most faculty members do not know the goals and purposes of the school.

5. 

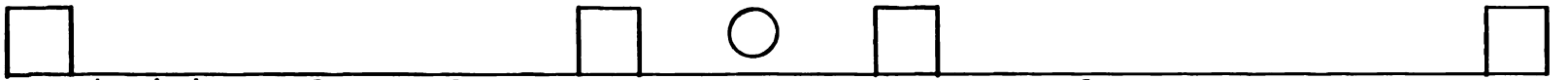
The goals and purposes of the school are well-known by the students.

Most students do not know the goals and purposes of the school.

6. 

Priorities and procedures for attaining the goals of the school are well-known by staff-members.

Most staff members are not aware of the role they are expected to play in the attainment of the goals of the school.

7. 

Priorities and procedures for attaining the goals of the school are well-known by the students.

Most students are not aware of the role they are expected to play in the attainment of the goals of the school.

8. 

Procedures for decision-making are well-known by the staff members.

Procedures for decision-making are not clear to most staff members.

9. 

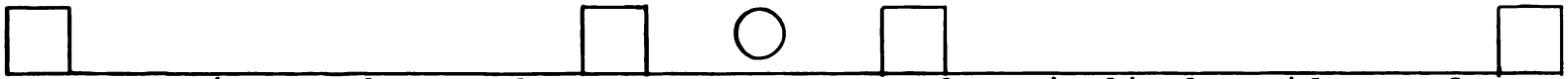
Procedures for decision-making are well-known by the students.

Procedures for decision-making are not clear to most students.

10. 

Changes made or contemplated in any one department are known throughout the school.

The remainder of the school is usually unaware of changes made or contemplated in any one department.

11. 

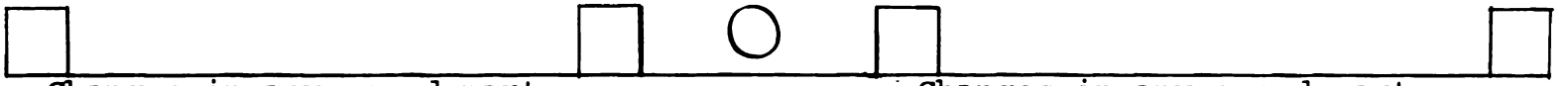
Cooperation, exchange of ideas, and joint planning are very evident between departments.

There is little evidence of cooperation, exchange of ideas, or joint planning between departments.

12. 

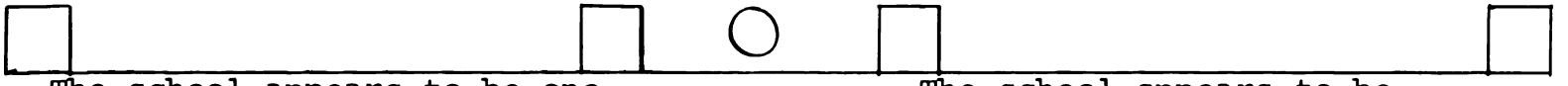
Cooperation, exchange of ideas, and joint planning are very evident between staff and students.

There is little evidence of cooperation, exchange of ideas, or joint planning between staff and students.

13. 

Changes in any one department are undertaken only after consideration has been given to their effect on other departments or on the school as a whole.

Changes in any one department are made without regard to their effect on other departments or on the school as a whole.

14. 

The school appears to be one smoothly functioning unit, working toward a common set of goals.

The school sppears to be a series of separate entities, each working toward its own goals.

APPENDIX III

TABLE A.1.--Raw Mean Scores: Non-Innovative School "A" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	75.00	65.00	50.67	93.67	90.67	378.33
Counselors	56.33	54.67	45.0	70.00	78.0	301.67
Department Chairmen	59.13	57.38	48.50	70.50	73.63	309.13
Teachers	49.80	43.00	39.00	70.60	60.70	263.10
Students	50.17	47.33	37.58	63.38	66.67	265.13
Total	53.52	49.67	41.00	68.38	68.79	281.40

TABLE A.2.--Raw Mean Score: Non-Innovative School "B" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	63.00	62.20	48.80	84.40	96.40	354.8
Counselors	68.50	65.67	44.00	87.67	103.67	369.5
Department Chairmen	46.71	34.43	40.86	54.43	45.86	222.29
Teachers	54.31	45.08	39.31	72.76	59.15	270.62
Students	48.54	39.50	39.50	64.14	67.93	260.04
Total	52.85	44.71	40.86	69.00	69.42	277.05

TABLE A.3.--Raw Mean Scores: Non-Innovative School "C" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	64.00	68.00	51.00	88.50	84.00	333.5
Counselors	39.00	41.50	48.00	74.00	61.00	263.5
Department Chairmen	49.40	54.60	47.20	83.00	85.20	319.4
Teachers	41.31	45.54	38.85	72.08	60.77	258.54
Students	45.57	43.57	31.52	64.67	61.71	247.05
Total	45.28	46.48	37.23	70.58	65.16	263.81

TABLE A.4.--Raw Mean Scores: Non-Innovative School "D" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	68.00	69.00	54.00	89.00	98.00	378.00
Counselors	43.67	53.00	38.67	85.33	88.67	309.33
Department Chairmen	49.71	53.57	48.00	80.29	83.14	314.71
Teachers	56.27	46.64	43.64	63.09	69.00	274.27
Students	51.92	47.63	35.29	62.04	68.42	265.29
Total	52.77	49.53	40.15	67.64	73.29	282.4

TABLE A.5.--Raw Mean Scores: Innovative School "W" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	66.33	54.33	42.67	84.67	79.33	327.33
Counselors	80.00	74.50	46.00	97.00	109.50	407.00
Department Chairmen	64.20	57.00	36.50	82.10	84.70	324.50
Teachers	68.00	50.55	35.82	78.09	75.82	308.27
Students	63.57	50.00	32.16	65.87	77.30	287.90
Total	65.79	53.22	35.10	74.10	80.62	308.33

TABLE A.6.--Raw Mean Scores: Innovative School "X" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	79.67	60.33	45.33	85.33	102.67	373.33
Counselors	74.00	59.25	46.00	80.00	86.50	345.75
Department Chairmen	69.67	59.44	41.11	77.00	84.88	331.77
Teachers	66.00	53.90	37.70	77.00	73.80	308.40
Students	63.00	47.75	33.04	67.54	70.67	283.25
Total	66.68	52.75	37.20	73.20	77.04	307.42

TABLE A.7.--Raw Mean Scores: Innovative School "Y" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	62.00	52.75	32.00	75.50	78.50	300.75
Counselors	64.75	61.25	42.00	78.75	82.00	328.75
Department Chairmen	53.33	50.17	31.17	76.67	72.17	283.33
Teachers	54.09	51.00	35.64	74.45	62.27	278.36
Students	57.04	51.96	35.38	69.38	69.77	282.27
Total	57.96	51.80	35.20	72.55	70.08	286.65

TABLE A.8.--Raw Mean Scores: Innovative School "Z" by Groups Across Measures.

	Adaptiveness	Hierarchial Order	Stability	Progressive Systemization-Progressive Segregation	Wholeness-Independence	Total
Administrators	56.33	59.67	31.33	84.67	91.33	323.33
Counselors	60.00	49.00	28.50	77.50	85.25	300.25
Department Chairmen	52.20	44.60	33.60	64.00	62.80	257.20
Teachers	58.45	51.55	31.09	69.18	70.18	280.45
Students	61.61	46.48	32.52	69.48	73.74	283.74
Total	59.35	48.56	31.87	70.50	73.85	284.09