A DESCRIPTIVE STUDY, EVALUATION AND ANALYSIS OF INSTRUCTIONAL SYSTEMS DEVELOPMENT ACTIVITIES IN SELECTED DEPARTMENTS AT MICHIGAN STATE UNIVERSITY DURING THE PERIOD 1960 TO 1963

Thesis for the Degree of Ed. D.

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This is to certify that the

thesis entitled

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of Instructional Systems Development Activities
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ABSTRACT

A DESCRIPTIVE STUDY, EVALUATION AND ANALYSIS OF INSTRUCTIONAL SYSTEMS DEVELOPMENT ACTIVITIES IN SELECTED DEPARTMENTS AT MICHIGAN STATE UNIVERSITY DURING THE PERIOD 1960 TO 1963

by Elwood Eugene Miller

In the past decade, educators have evidenced increasing interest in the use of general systems theory in the instructional process. Both the systems approach and instructional systems analysis are being studied by the education profession.

The purposes of the study were to develop a description and operational definition of the term instructional system; to study selected departments at Michigan State University and their uses of innovative teaching techniques; to observe similarities or dissimilarities of those departments in terms of

the defined instructional system; and to develop hypotheses needing further investigation.

Two departments of Michigan State University were studied. These departments have introduced innovations into their curricular patterns within the time specified in the study. These innovations were analyzed in terms of their tendency to fit the instructional system paradigm developed in the study.

Information was gathered by interviewing administrators and professors in the departments, by reading research studies published by the departments, and by interviewing students.

Closed circuit television as used in the Department of Health, Physical Education and Recreation for instructing freshman foundations courses in Physical Education was one of the major studies. Programed Learning as used in the freshman course in the Department of Natural Science was the other innovation reported in the study.

Elwood Eugene Miller

PRIMARY RECOMMENDATIONS

1. Experiments should be designed to compare different approaches to similar problems of instruction. Conditions under which one instructional technique seems to be superior to other instructional techniques should be investigated.

2. The concept of equifinality, differing systems using the same resources and reaching the same goal, should be studied insofar as its applicability to education is concerned.

3. The decision to rebuild an instructional pattern, or design a new instructional system, should be studied. Conditions under which one approach seems to be superior should be investigated.

4. It is recommended that instructional resources at Michigan State University be placed upon the same financial basis insofar as costs to the departments are concerned.

5. Teacher education and the role of the teacher in instructional systems building deserve further study.

6. It is suggested that instructional systems be designed with a built-in propensity for change. Instructional systems should exist to breed better systems, not to maintain themselves within a closed network.

7. It is suggested that a team approach to the design of instructional systems is the logical manner in which this task can be best accomplished.

SECONDARY RECOMMENDATIONS

Within the Department of Health, Physical Education and Recreation, several recommendations are made.

Women's Department

1. Studies of the cost of closed circuit television used by the department should be compared with

costs of other techniques of teaching classes.

2. Administrative patterns within the department should be examined for information concerning staff acceptance of a program that must be classed as a major innovation.

Men's Department

1. Evaluation of the entire television program is suggested. This has not been done and this major weakness to an otherwise acceptable program should be remedied.

2. A study of the assumption that both men and women learn equally effectively from the use of closed circuit television should be investigated.

Within the Department of Natural Science, only one recommendation of any major nature is suggested. The Department should experiment with classes using the programed materials without limitation in either direction as far as the time variable is concerned.

Elwood Eugene Miller

In general it was found that neither department studied fit the definition of an instructional system except in a very general sense. The programing experience would come the closest to an instructional system building effort. Both innovations are interesting and deserving of further study.

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INSTRUCTIONAL SYSTEMS DEVELOPMENT ACTIVITIES

IN SELECTED DEPARTMENTS AT MICHIGAN STATE

UNIVERSITY DURING THE PERIOD

1960 TO 1963

By

Elwood Eugene Miller

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF EDUCATION

College of Education

1965

Dedicated To

My Wife, Barbara...who had just enough push,

and My Children,

Steven
Andrew
Kendall
and
Cheryl

who had the patience.

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TABLE OF CONTENTS

Table of Contents - continued. Page

LIST OF APPENDICES

CHAPTER I

THE PROBLEM AND THE DEFINITION OF TERMS

The London Times Educational Supplement of April, 1964, carried an article by Austwick on the immediate needs of education and the change and innovation phenomenon.

> Change will be the dominant theme of the future, in schools--change in buildings, in curriculum, change in aims, methods, and teaching equipment. Continual change will involve expense and consequently a demand for efficient and economic use of resources.[1]

If the assumption is that acceptable change and innovation are a necessary part of the development of education, then it follows that a system is required to understand, manage, and analyze the changing educational patterns. Change becomes inherently a part of instruction, as it is of all sociological development, and change then should be structured and planned to insure that it will improve the educational pattern. It is within this framework that thinking in terms of "systems of instruction" is

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[1]Dr. K. Austwick, "Education Mechanized," The Times Educational Supplement (April 17, 1964), p. 960.

legitimate. Systems exist, whether they are amenable to analysis and understanding or not, and it is the function of the educator interested in this field to search for an understanding of the systems concept.

BACKGROUND OF THE PROBLEM AT MICHIGAN STATE

President Hannah's Prediction Michigan State University President John Hannah, speaking to the University faculty on March 27, 1960, pointed out that the university was facing problems of swelling enrollments without comparable increases in appropriations. In a series of recommendations he suggested that new and fresh looks must be taken at the instructional patterns of the University, and that the newer media of instruction would need to be employed wherever they could successfully be applied.

As he predicted, enrollments have steadily increased since that time, and the available supply of talented faculty has not kept up with the demands of this university. Each year the problem becomes more critical with a greater need for some systematic method of approaching a solution.

The same problem exists in all institutions of higher education, differing only in the degree of severity. The large state-supported universities, in particular, are feeling the pressure since they are committed to offer a higher educational opportunity to all qualified residents of the state.

Innovations at Michigan State Within the university, several departments and colleges have experimented with instructional innovations since the President's message in 1960. Many have been routine innovations brought on by the pressure of high registration and no increase in faculty assistance. This has caused "large group instruction," of the classic lecture variety, to become an innovation by necessity.

Other departments have experimented with new teaching techniques such as programed learning and instructional television.

From these departments three case studies have been selected to analyze and study in terms of systems ideas in the educative process. Rationale for the selection of these particular cases will be found later in the dissertation.

THE AUDIOVISUAL-MEDIA SPECIALIST AND INSTRUCTIONAL SYSTEMS

For nearly ten years, educators interested in the effective use of audiovisual materials and the machine-material media have heard references made to the effect that soon, if the field is to really reach its hypothetical potential, scholars will have to grope with the terms and basic philosophies of systems thinking. Hoban, as early as the National Audiovisual Leadership Conference meeting at Lake Okoboji, Iowa, in 1955, referred to instructional systems in his keynote address.[2] Using a paradigm based primarily upon the Communications Model of Shannon and Weaver,[3] Hoban built a plan around the source and producer of materials, the distributor and the user of materials.[4]

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[2] Audio-Visual Leadership, A Summary of the Lake Okoboji Audio-Visual Leadership Conferences, 1955-1959 (State University of Iowa; Iowa City, Iowa; August, 1960), p. 9.

[3] Claude E. Shannon and Warren Weaver, The Mathematical Theory of Communication (Urbana: University of Illinois Press, 1949).

[4] Audio-Visual Leadership, A Summary . . ., op. cit., p. 12.

Only in the last few years has anyone attempted to sharpen the definition of what is really meant by an instructional system. In this time period, the United States Office of Education has evidenced interest in this area by financing studies with the hope that some advances in thinking will result from intensive study and research.

Media Specialists and Instructional Systems

Audiovisual materials have been in use for generations. Illustrations have been a part of the culture from the time of Commenius. At the turn of the century when Superintendent Harris of St. Louis arranged for many of the international artifacts from the St. Louis Exposition of 1906 to be placed in a museum for the study and future use of the children of St. Louis, the first organized efforts were really brought to bear on the provision of real objects for learning. This innovation harmonized nicely with the new educational philosophies of Dewey and others in the realm of the child and experience-centered curricula.

Development of devices to record and hold messages (the record playback, the motion picture, and the lantern slide technique) were not long in coming. In the early thirties when the sound motion picture machine was technically developed to the point that it was economically feasible for public school use, a major breakthrough was made. The 16mm motion picture became of major importance in both military and industrial training programs during World War II. Propaganda and training were in large part responsible for rapid acceptance of sound films in instruction.

Subsequent to the Second World War, additional technological developments came upon the educational scene very rapidly. Few educators were ready or prepared for the wave of "sound" possibilities made with the breakthrough in audio technology by the audio-tape recorder--playback. Commercial television, followed by a promising idea, educational television broadcasting, soon confronted the educator (educational radio had been a part of the instructional scene for many years). Both broadcast and closed circuit television held promise for a major role in the educational process. Computer technology promised a new future for treatment and classification of information.

The growth of information, in an exponential manner, had caused much of the traditional library card catalog system of classification to become increasingly unwieldy and inefficient. Computer information-handling loomed in the future.

The last decade saw the introduction of the programed learning and teaching machine idea. Implied were many new and different approaches to the problems of instruction.

Potentially, the many methods of communication and message transmission that have developed since the turn of the century hold much promise. Yet much of the promise is dimmed by the lack of a systematic relationship between them. Many examples can be cited of individual schools and colleges using individual techniques with varying degrees of success. Such examples might include departments of colleges using closed-circuit television; high schools using language laboratories in their foreign language program; science departments using the newer multi-media approach (films, laboratory experiences, and printed material) to teach the new physics or chemistry.

Little evidence can be found that many educational institutions have taken a careful and analytical look at <u>all</u> of the potential learning resources, selected the strengths of those uniquely adapted to their own situations and <u>systematically</u> knitted them into a rational, functional pattern for the improvement of their instructional programs.

Recent injections of Federal funds may institute improved approaches to the problem, but additional financial assistance alone is not sufficient to insure that a more rational approach will result.

IMPORTANCE OF THE STUDY

The promise of such educational media as films, television and programed learning lie not only in their capacity for accommodating large numbers of students. Appropriate and effective use of media can also result in improving the quality and amount of learning which takes place. It is the combined benefits of a better education than was heretofore possible plus a means of accommodating vastly increased numbers of students which are of primary interest to university faculties and adminstrators.

In consequence, in recent years numerous institutions of higher learning have undertaken studies and experimental programs aimed at testing possible solutions to the above programs, particularly in large enrollment undergraduate offerings. Curricula, credit requirements, course organization and content, staff utilization, teaching methods, teaching materials, and modes of presentation have been scrutinized and often modified.

There is considerable evidence that the media used played an important part in many of these investigations.

Representative of many studies undertaken in institutions of higher learning were the Pennsylvania State University studies of Closed Circuit Television.[5] Undertaken in 1955 and continued for over three years, they were indicative of the interest of university administrators in the "newer media" in education.

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[5]C. R. Carpenter and L. P. Greenhill, An Investigation of Closed Circuit Television for Teaching University Courses. Instructional Television Research Project Number One (University Park, Penn.: The Instructional Film Research Program, Pennsylvania State University, July 31, 1955); and An Investigation of Closed Circuit Television for Teaching University Courses. Report Number Two: The Academic Years 1955-1956 and 1956-1957 (University Park, Penn.: Division of Academic Research and Services, Pennsylvania State University, 1958).

Dreher and Beatty continued a broadcast television study at San Francisco State College in 1958,[6] with results indicating "no significant difference," paralleling the Pennsylvania State Studies. The no significant difference reflects studies comparing outcomes of instruction of television as compared with instruction by conventional methods.

Positive results in favor of open circuit instructional television are found in the Chicago TV College report of 1960.[7] In perusing the large body of studies in newer media at the college level, most findings indicate that the newer method is as good as or better than traditional methods of instruction reported in the studies.

A two year experimental study of the use of programed instruction in the Natural Science Department of the University College at Michigan State University (the subject of Chapter IV of this report) is another

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[6] R. E. Dreher and W. H. Beatty, Project Number One: An Experimental Study of College Instruction Using Broadcast Television (San Francisco: San Francisco State College, April, 1958).

[7] C. G. Erickson and H. M. Chausow, Chicago's TV College. Final Report of a Three Year Experiment (Chicago: Chicago City Junior College, August, 1960).

indication of the interest of college administrators and faculties in the problems of instruction as they relate to the newer media.

The experimental programs cited were for the most part limited to a few departments or to only a few aspects of the overall problem, such as the media, the materials, or the restricted roll of staffs.

No institution, to the writer's knowledge, has taken a systematic view of the entire problem of instructional improvement or attempted to analyze it as a whole before undertaking experimental and isolated efforts at solution. It is suggested that this method is of a "first aid" nature.

Those parts of the system in most need of emergency attention tend to receive some sort of innovative treatment without concern for the overall consequences on the entire system of instruction.

The real importance of this study lies in the suggestion that this piecemeal approach is both unwise from the instructional point of view and expensive from the economic point of view.

This study will point in the direction of a logical and rational approach for the media field. Careful research, plus systematic planning are essential to the systems approach in education.

Leadership in systems development in education seems likely to be assumed by the audiovisual or media specialist who is ready for it since he is the educator most directly concerned with technological developments, innovation, and newer systems of instruction. Other professional educators should interest themselves in the instructional systems idea. Curriculum authorities especially are needed in the developmental process with respect to this idea.

PURPOSES OF THE STUDY

The purposes of this dissertation are concerned with three general areas.

Systems Models An operational definition of an instructional system, along with such descriptions of this model as seem necessary, will be developed.

Case Studies Several case studies of instructional innovations at Michigan State University will be described. These will be compared with the above described model, and analyzed for their similarity to or disparity with the instructional system definition.

Hypothesis Generation A set of hypotheses will be proposed at the conclusion of the study incorporating suggestions for major areas of the study needing further research at the university level. These will be classed as major areas in need of extensive study, and additional areas within certain departments that are in need of more specific evaluation and research.

METHODOLOGY FOR THE STUDY

Most descriptive dissertations follow the pattern used in this study. The five steps used by the writer may be briefly described as follows:

1. The Problem. The major problem leading to the development of this study is identified and discussed. A rationale is developed for approaching the problem through a set of studies. The

strategy used for securing and treating the data is also described.

2. The Literature. A search of educational literature on instructional systems was conducted and reported. Since instructional systems are somewhat analagous to engineering and commercial operations analysis, literature in these fields, was included in the search.

3. The Model. Descriptive characteristics of an instructional system are then developed. From these characteristics, a working definition of the instructional system has been constructed. A paradigm of the system has also been designed.

4. The Case Studies. Several departments of Michigan State University which evidence new patterns of instruction within their structure are identified. These are then studied through interviews and analyzed in light of the system model developed for the study.

5. Conclusions and Hypotheses. As a result of the above steps, certain hypotheses and research studies will be suggested. Implications are proposed for Michigan State University which may be of possible interest to other institutions of higher education with similar problems.

DEFINITIONS OF TERMS IN THE SYSTEMS FIELD

A number of important terms should be described as they relate to this study. Some otherwise familiar terms have different interpretations from general non-system usage, and are included in this section for that reason.

System. A set of components arranged in an orderly fashion with the purpose of accomplishing a specified goal or goals.

Instructional System. In a general sense, any group of methods employed to reach defined and operationally describable goals. Chapter Two will treat this term at some length.

Media. The in-between or intermediate part or parts in a communications network that transmit the message from the source to the receiver. These parts may be the voice of the lecturer, the print of the textbook, the electronic impulses of the television, radio, or public address system or a combination of several of these. In instructional system thinking, the term media is usually interpreted to represent the system used to connect the teacher and the students.

Media Specialist. An educator primarily concerned with the efficient use of pertinent and available media in the instructional process.

Instructional Systems Analyst. A professional educator concerned with instructional improvement who has a sufficient background of experience and training to assist in making major decisions in the revision of instructional practices.

Model. An optimum conception of an instructional process.

Paradigm. A graphic illustration of a model.

Instructional Materials. Any material used in the process of instruction by the teacher or by the student. Included are such materials as textbooks, library materials, filmed materials, pictures, programed materials, and graphic aids.

Instructional Paramaters. Those limits within which the description of an instructional pattern fall. Implications leading outside this set of boundaries may exist, but must be accounted for in the system model.

Inputs. The economic and human energies placed into a system at its inception.

Outputs. The state within the instructional system when the students have met or accomplished the operationally defined goals or objectives. This is usually defined in system thinking as being accomplished or not accomplished. No scaled or graded product is acceptable.

Component. A part or element of a system. Instructional systems contain many components, such as students, teachers, instructional materials, and media.

<u>Feedback</u>. The communications control mechanism reflected from the output (or interaction) of a system which affects the inputs in order to secure the reaching of the goal of the system. Feedback is a major factor in the structure of organizational maintenance.

<u>Equifinality</u>. The ability to reach a final state in a system from different inputs, and with different interactions within the system.

<u>Entropy</u>. From the physicists second law of thermodynamics, the tendency to disorganize. It is not important to instructional systems analysis excepting as it relates to its opposite term.

<u>Negative Entropy</u>. In an open system, the tendency to organize toward a goal or objective. Social systems of all types evidence this phenomenon, and it is with the analysis and control of this phenomenon that systems thinkers concern themselves.

<u>Efficiency</u>. A ratio relationship between the inputs to a system and the outputs from that system.

SUMMARY

To maintain a high quality of education, to do so with funds that are in increasingly short supply, and with personnel that are more and more difficult to obtain, is the problem of higher education in the mid-1960's.

Instructional patterns must come under careful and intensive study if the instructional problems of higher education are to be met. To cope with these problems, it appears highly probable that better means must be found than the traditional lecture-recitation methodology of instruction.

If innovations are necessary, it becomes the responsibility of educators to design new patterns of instruction which can meet the problems discussed in this chapter. Instructional systems analysis is seen as a promising method of approaching those problems.

It is the function of this study to explore certain problems of higher education at Michigan State University and to make suggestions with respect to those problems. While generalizations cannot be made with respect to these problems and their possible solution on other campuses from the three cases studied, certain implications can be derived which may be of interest to other institutions of higher learning in which comparable conditions are present.

CHAPTER II

A REVIEW OF THE LITERATURE IN GENERAL SYSTEMS THEORY

INTRODUCTION

In one sense, everything that the human does can be broadly described as a system. The human organism is itself a system. It lives, in turn, in a social and economic system within a world of other social and economic systems. Encompassing all of these are various systems of trade, protection, health, and industrial development on a loosely-drawn world basis.

These are not "systems" in the controlled sense of the engineer or the physical scientist. These are open systems, containing the phenomenon of negative entropy or tendency to organize themselves for some function.

As open systems, they are of interest to the instructional system designer, for many interesting parallels can be drawn. Both the sociologist interested in the general systems of world culture, and the educator interested in systems thinking in instruction are concerned with such factors as efficiency, innovation, and improvement of conditions. The educator is typically interested in improving the educational environment or in causing some increase in educational efficiency or effectiveness within the educational system. It is accordingly necessary for the instructional system to be tighter and more operationally defensible than the general "life" systems described in the opening paragraph of this chapter.

<u>Communications and Systems Thinking</u> To understand and to be understood are basic problems of education. The concerns of the communications researcher and of the scholar are much the same. Therefore, it follows that at the heart of the instructional process and underlying any system of instruction must come some recognition and understanding of the communications process. Educational media specialists are coming to realize more and more that the communications problem lies at the heart of their field of interest. Gerbner describes

this concept succinctly in a recent publication.

> The basic cultural transformation of our time is in the media and the systems which cultivate ways of looking at life, society, and the world. It is in the processes and institutions which produce, organize, and distribute messages bearing man's notions of what is, what is important, what is right.
>
> This recent transformation has brought the "communication approach" into existence. This is what brought about our concern with the production, nature, and uses of messages in the acculturation process, and, in its more formal aspects, in the educational process. The field of the educational media specialist is rooted not so much in the pictures of Comenius (devotional texts have been richly illustrated many centuries before him), but in the really revolutionary practice of putting pictures as well as texts into books "programmed" for wide distribution in popular education. It is rooted not in sights and sounds as such, but in the communications revolution which gave us technological means to produce and mass-produce and project and broadcast sights and sounds and images for all. And it is now coming full circle to ways of programming and linking message systems in integrated sequences of production, perception and response.[8]

The educational media specialist is the individual to whom the task of system thinking, and later, of system analysis will probably fall. The complexity

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[8] George Gerbner, University of Illinois (Excerpts from an unpublished paper, 1960), p. 2.

of "coming full circle into methods of linking messages into integrated sequences of production, perception, and response" brings to the educational scene a clear need for thinking in the field of systems analysis and systems design. Who is the logical educator to design the communication instruction system?

<u>The Media Generalist</u> The term "generalist" as applied to system analysis requirements is appropriate to consider at this point since it is particularly germane to breadth of perspective necessary in effective educational planning. Reference is made frequently in the literature on systems to the need for a generalist's viewpoint along with the specialized skills required.

> Any research group needs a generalist, whether it is an institutional group in a university, foundation, or an industrial group . . . . In an engineering group, the generalist would naturally be concerned with system problems. These problems arise whenever parts are made into a balanced whole.[9]

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[9] H. Bode, F. Mosteller, J. Tukey, and C. Winsor, "The Education of a Scientific Generalist," <u>Science</u>, CIX (1949), p. 553.

It would appear that if the systems approach is to be legitimately applied to the process of instruction, a new type of educator must be developed. He will be the educational "generalist." Education, like other sociological disciplines, has proliferated itself into groups that specialize in a vast number of areas. Thus we see the training, preparation, and education of a multitude of specialists, such as subject-matter experts, curriculum experts, adult education specialists, industrial educators, home economists, communication experts, and audiovisual specialists.

The educational generalist who is to be the planner and the system designer must have competence in most of the basic areas of education in order to see the system as a whole if he is also to function effectively in improving its instructional processes. He must also have expert knowledge of educational technology if he is to bring the potential of educational media to bear on teaching and learning.

The educational generalist, as described in this section of the study, operates in parallel with, but at a different order of, concern from the traditional school administrator. Administrators must make final decisions on the appropriateness of the use of instructional systems. In the planning stages, the educational generalist must work as an informational resource person to the administrator. He will then work actively to design and implement the instructional system after the basic decision has been made by the administrator. It is conceivable that in certain instances the administrator operates as the systems planner.

In general practice the administrator spends the major portion of his effort and energy on decisions and planning procedures that are outside the general areas of instructional concern reflected by the systems generalist. Concern with problems of a curricular nature and of instructional improvement are common to both, but the systems generalist will spend his entire effort in this area.

<u>Audiovisual Tools</u> Since the sixteen millimeter motion picture medium began to affect educational patterns in a small way in the 1930's, many new devices for storing and reproducing information and ideas have become available. Many of these might be termed highly

efficient filing cabinets, with instant audio and visual as well as verbal recall capabilities.

The sheer amount of existing information, along with the rapid and unprecedented expansion of new knowledge in most fields, applies new storage and retrieval systems to the instructional system. It is also essential for the system that those instruments, materials and methods of value to teaching and learning be organized and applied, insofar as possible, for optimum results.

Volumes of research on the use of individual instructional media tend to conclude that, used in reasonable conjunction with established patterns of instruction, they do "as well as" instructional methods employed before inclusion of the new device or material. Perhaps this reflects the basic ability of some of these materials to hold and present certain bodies of information as efficiently as can the human teacher or the printed page.

A readily observable phenomenon in nature demonstrates that no two things are ever really equal. No two leaves from the oak, no two snowflakes, and certainly no two human organisms can be described as being <u>exactly</u> the same. From this common observation, it is deducible that systems or patterns of instruction are never exactly the same (unless repeated by mechanical or electronic means). Yet research in the comparative methods in instructional processes tend to show the "no significant difference" or "as well as" phenomenon. Inability to measure with precision may account for some of these observations, but could it be that a new frame of reference, a new position from which to view the whole instructional condition is needed? Instructional systems thinking is an attempt to reach the position from which the educator might take this new "view of the world."

Consequently the media oriented educator interested in scientific methodology, in bettering the educational establishment, and in the efficient use of all the human and machine based resources of instruction must turn toward a new direction to find this needed position or frame of reference. What are some of the applicable thoughts of systems writers in the field of general systems theory, and how might they be applied to education?

GENERAL SYSTEMS

In discussing the need for interaction of ideas between the various scientific disciplines, or the difficulty of getting words from "one cocoon to the other" --the need for more generalized information transfer is evident along with the need for better methods of understanding this information. Von Bertalanffy states:

> . . . there exist models, principles, and laws that apply to generalized systems or their sub-classes, irrespective of their particular kind, the nature of common elements, and the relation 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.[10]

Von Bertalanffy then lists some of the principles which he feels are valid for systems in general:

1. Properties that exhibit structural similarities or isomorphies indicate the presence of a general system conceptualization.
2. Today's problem is one of organized complexity. Concepts like organization, wholeness, directiveness, teleology, control, self regulation, differentiation, etc., all exist. These, unlike

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[10] Ludvig von Bertalanffy, "General System Theory," General Systems Yearbook, I (1956), p. 1.

the problems of the natural sciences, tend to identify with the biological, social, and behavioral sciences. "Thus a basic problem posed to modern science is a general theory of organization." General systems theory can conceivably do this.

3. System Theory is <u>not</u>: Pure mathematics, or identical with the triviality that mathematics of some sort can be applied to every problem. It is not a search for vague and general analogies between physical, biological, and social systems. Analogies are of little value, in that addition to similarities, dissimilarities can always be found.[11]

In terms of educational systems, a question might well be raised with respect to von Bertalanffy's third principle, since much teaching and instruction are done through analogy. The development of an analagous system theory could well indicate a step in the right direction to a more precise system theory in education. Although this suggests another study, it is conceivable, on the other hand, that instructional analogies are of a different order of abstraction from instructional systems and that their use might cause limitations to a system model that could be artificial and unnecessary.

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[11] *Ibid.*, pp. 2, 3.

Von Bertalanffy continues with some of the aims of a General System Theory:

a. There is a general tendency towards 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 universe of the individual sciences, this theory brings us nearer to the goal of the unity of science.

e. This can lead to a much needed integration in scientific education.[12]

Operations Analysis A logical turn at this point is in the direction of the operations analyst, already used for many years in industry and in some areas of sociology, and to a study of his criteria and his paradigms to see if any can be applied to the problems of the modern educator.

Operations research is an area of specialization which has had significant effect on the economic system in this and other countries. Applying this type

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[12] Ibid.

of analysis to education will not be an easy task, for there are two fundamental criteria which must be met before serious planning can take place in the field of operations research.

The first criterion is the specification of objectives. No system can be scientifically analyzed unless clearly stated operational goals and objectives are established. Precision in objectives is a difficult achievement in education beyond the skills and content levels and is seldom found in curriculum guides or lesson plans.

Second, each system must be amenable to some sort of quantitative measurement. Again in education the problem is so often discussed in terms of values, or qualities, and not so often in quantification terms. Test and measurement specialists are making serious efforts to cope with the measurement question.

Bennett discussed the measurement problem as follows at a recent systems conference in Syracuse:

> It is perhaps worthwhile to indicate that it is almost universally accepted that the operations research approach involves the application of the scientific method. To the extent that this is true, it is therefore implied that operations research methods

> and techniques are only applicable in those situations where we are dealing with rational processes for which tests and measures can be designed. Almost all of the successful applications of operations research to date have been concerned with what has been defined as "well structured problems," i.e. problems which can be described in terms of numerical variables (scalar and vector quantities) and in which goals to be obtained can be specified in terms of a well defined objective function.[13]

The twin questions of objectives and measurement are serious and worthy of considerable research effort. It is understood that they are receiving much attention in research.

Development of precise instructional systems goes along with the development of new information and principles concerned with objectives and measurement.

A DIFFERENTIATION OF TERMS

Systems Analysis. At this point some elaboration should be given to a set of interchangeable and

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[13] Carl A. Bennett, "The Conduct of Operations Research," Hanford Atomic Products Operation, General Electric Co., Richland, Washington (Unpublished paper, prepared for Conference on "New Dimensions in Research in Educational Media Implied by the 'Systems' Approach to Instruction," conducted by Center for Instructional Communications of Syracuse University, April 2-4, 1964). pp. 1-2.

non-interchangeable terms. Operations analysis, system analysis, operations research, and systems research are often used interchangeably, and for purposes of this paper they will be interpreted as having the same definition. They will be defined as a specific analytical technique constructing an empirical model of some educational phenomenon, defining its objectives, organizing patterns of quantitative evaluation, and optimizing some function of the variables involved in the model. For purposes of this thesis, the term "systems analysis" may be taken to cover the same definition for all of the above terms.

Systems Approach On the other hand, the term "systems approach" has a meaning that is entirely different to the educator interested in a scientific analysis of an instructional pattern. It is a "view of the world" observation of the ramifications and complexities of an instructional problem. It is a less definitive term, one that almost anyone can favor. Mood writes, "Almost everyone is in favor of the systems approach in the same sense that almost everyone is in favor of God, country, and motherhood."[14]

Most teachers and school administrators operate at a level that is barely conducive to an interest in the systems approach to instruction, and certainly not to a systems analysis of instruction. No serious efforts or developments in system analysis in education can occur until a philosophy, or view of the world, that includes a commitment to the systems approach is accepted by the educator.

Closed and Open Systems Another general terminology differentiation must be injected into the orientation of the systems thinker at this point. Systems fall into two general categories.

The first, or closed system, is usually defined as that type of system to which no energy can be admitted, or removed. This type of system while applicable to the physical sciences has little application to education.

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[14]Alexander M. Mood, "Problems Inherent in The Systems Approach to Education" (Unpublished paper prepared for Conference on "New Dimensions for Research in Educational Media Implied by the 'Systems' Approach to Instruction," conducted by Center for Instructional Communications of Syracuse University, April 2-4, 1964), p.1.

The second general category of systems is that of the open system. Into this kind of system the experimenter can introduce, under careful accounting, various kinds of energies (both human and financial), and study the outcomes of the system as a result of the introduction or the delegation of certain energies. These are usually termed as "variables" in the research field.

In discussing the adaptability of the open system to education, Bertalanffy continues:

> Characteristics of organization, that of a living organism or a society, are notions like those of wholeness, growth, differentiation, hierarchical order, dominance, control, competition, etc. Such notions do not appear in conventional physics. Systems theory is well capable of dealing with these matters.[15]

The "open endedness" which is necessary in con-conceiving of any sort of instructional system makes it obvious that only the open system will fit into the mold of instruction as defined in scientific literature.

The closed system of the physical sciences, with their tendency to follow the second law of

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[15] Bertalanffy, op. cit., p. 7.

thermodynamics, are perhaps diametrically opposed to the open system of the social or even the biological sciences. It is evident in the latter that conditions of negative entropy are operational, and there is a system in operation that tends to cluster itself around some sort of goal or objective, regardless of the nature or value of that goal.

Equifinality The meaning of equifinality is quoted from the definition of terms: "The ability to reach a final state in a system, from different inputs, and with different interactions within the system."

One of the chief problems of the educator attempting to familiarize himself with the philosophy of the systems approach is concerned with the narrowness of the paramater within which a system could confine itself. The instructional system must remain an open and dynamic operation, and it is usually argued that in a process as complex as an instructional pattern, desired ends can conceivably be reached by different routes. The concept of equifinality raises a major question in instructional systems thinking.

Bertalanffy introduced the "equifinality" term in his system writing a generation ago, and it has enjoyed popular support in the instructional field. This is an interesting paradox, however, for if it is conceivable that any one of a number of systems can be employed to reach desired goals and objectives, then it might be suggested that there is really very little need for financial energy and human thinking to go into the systems approach. Would it not be better to spend the time developing instructional patterns that are harmonious with the personality and idiosyncracies of the human in charge of a given operation or system?

This concept of equifinality, or the ability to reach goals through many and diverse methods, is an idea that must be scrutinized. There are many routes to Chicago, but can it be argued that there is no best route, given a set of conditions and a starting place? If it is up to the individual to choose, the "system" of transportation without any sort of operational definitions or any sort of economic factors, then perhaps system thinking is not necessary.

On the other hand, if there are economic problems, problems of difference in starting point, problems of difference in the vehicle available, and problems in the type of driver available, then some scientific analysis of the best method under a stated set of circumstances is in order.

The old aphorism that you get what you pay for is not news to the elected representatives of the people who make basic decisions in the operation of our schools. They know that if twice the financial energy were available for their schools, some increase in effectiveness of the instructional patterns would result. What they do not know is how much. And what is much more important, they need to know how they might change their resource allocations in order to gain a more optimum learning opportunity for the students they represent. It is at this point that the concept of equifinality ceases to hold much validity for the person sincerely interested in improving the instructional situation in the schools.

Equifinality and the Media Specialist The concept of equifinality is one that is especially difficult for the media specialist. The point has been reached when intelligent, rational decisions must be made in the use of the various systems of media in the instructional pattern. Sufficient evidence, from Hoban and Van Ormer[16] on the use of motion pictures in instruction to volumes of research produced since 1960 in television and programing, can be found to prove that many types of media can do "as well as" or "better than" traditional lecture-recitation patterns or systems of instruction. Are all of them equally good?

If the equifinality concept is valid, perhaps other factors than the nature of the media in use determined the results. Here lies an area that should produce fruitful findings if research can be designed to cope with the complexities of the problem. Some suggested hypotheses will appear later in this dissertation with that possibility in mind.

Efficiency Educators have traditionally been inclined to disassociate themselves from the term

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[16] Charles F. Hoban, Jr., and Edward B. Van Ormer, Instructional Film Research, 1918-1950 (Rapid Mass Learning), U. S. Department of Commerce, Special Devices Center, 1951.

"efficiency" and its ratio implications in education, either in terms of financial energy spent, or in terms of learning or cognition gains on the part of the students.

It is not consistent to deal with a paper discussing the term "system" as it relates to instruction without also attempting to deal with the term "efficiency." Inherent in any system design is an efficiency factor. System infers that inputs in the form of human or financial energy is a part of the paradigm. If we admit that this is an important factor, then the natural problem follows that there can be many kinds and degrees of energy injection. Energy can be injected in unlimited or in controlled amounts. The systems thinker will want only to inject the amount of energy necessary to reach the defined goal, and no more. If additional energy injections must be included to be certain that a goal is reached, that extra injection must be calculated in mathematical terms to evaluate the degree of efficiency attained.

Increased efficiency levels can be accomplished only by manipulating the parts of the system. Manipulation infers change and change involves the problems of innovation. Educational innovation is an area in which much work has been done, and many treatises are available to the educator interested in the innovation process. Outside of education, people like Rogers[17] have discussed and written widely in the area. Theories, studies, and case histories of educational innovation exist in quantity.

Austwick's quotation from the London Times Educational Supplement, used in the opening paragraph of this thesis relates efficiency to the change and innovation factor. Herein is found another point in the case for the use of efficiency ratios that education can use to advantage through the development of instructional systems analysis.

THE BASIC APPROACH--COMPONENT OR WHOLE?

Background Von Bertalanffy, the German biologist, inferred as long ago as 1933 that the general

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[17] Everett M. Rogers, Diffusion of Innovation (New York: The Free Press of Glencoe, 1962).

systems concept was a legitimate part of the scientific movement and should be considered as such by those interested in a systematic development of the entire science of human history. In a series of papers, Von Bertalanffy discusses the movement toward general system theory which has been developing for many years.

Von Bertalanffy was instrumental in developing the base that systems engineers in industry and government have used to build a discipline of systems. Various papers discuss general systems analysis and its usefulness in scientific research, especially in educational situations concerned with the "whole" vs. the "component" approach. Bertalanffy introduced the whole-component concept in biology.

> When, some 40 years ago, I started by life as a scientist, biology was involved in the mechanism-vitalism controversy . . . . In this situation, I was led to advocate the so-called organismic [vitalism] viewpoint . . . . It appeared, however, that I could not stop on the way once taken and so I was led to a still futher generalization which I called "General System Theory" . . . . However, at this time theory was in bad reputation in biology, and I was afraid of what Gauss, the mathemetician, called the "clamor of the Boeotians." So I left my drafts in the drawer, and it was only after the war that my first publications in this respect appeared.

> Then, however, something interesting and surprising happened. It turned out that a change in intellectual climate had taken place, making model building and abstract generalizations fashionable. Even more: quite a number of scientists had followed similar lines of thought. So General System Theory, after all, was not isolated or a personal idiosyncrasy as I have believed, but rather was one within a group of parallel developments.[18]

In dealing with the problems of instruction within the frame of reference of the "systems approach" thinker, one must consider the thought that it might be the overall system which needs serious study and not simply its isolated components. Traditionally, in educational research we take the bits and pieces of instructional methodology and build tight experiments around them, manage sophisticated statistical treatment of the data, and eventually arrive at conclusions with respect to the individual study. Conclusions may or may not prove adequate when the part of the system to which they relate becomes a working part of the system as a whole. Too often we choose not to look at the overall problem in all of its ramifications simply because it is so complex. This makes

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[18]Bertalanffy, op. cit., VII, p. 1.

the generation of scientific papers easier, but is probably inadequate for today's educators.

On the other hand, the "whole look" has its inadequacies as well. As Churchman recently pointed out:

> Even as far back as the Greek philosophers men constructed two ways of thinking about the whole that makes up a system. One is to insist that the thinker begin with the simple parts, understand them thoroughly, perfect them if he can and then begin building the parts together into an edifice that eventually becomes the entire structure. Modesty and diligence characterize this philosophy; one must work very hard on what one clearly understands and can feasibly change before he goes off onto more complicated and less tried pathways; one only earns the right to talk about wholes when one has been sufficiently trained in the parts.
>
> The opposite philosophy says that we must begin with a concept of the whole because otherwise we shall never know even how to identify the parts, much less to improve them. Daring and creativity are the hallmarks here, as well as hours of contemplation and debate. Again, one must earn a right, but in this case, the right to act.[19]

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[19] C. West Churchman, Design for Systems Research in Instruction (Prepared for a Conference in "New Dimensions for Research in Educational Media Implied by the Systems Approach to Instruction," conducted by Center for Instructional Communications of Syracuse University, April 2-4, 1964), p. 31.

Inductive, or scientific methodology is almost matched with deductive, or systematic methodology in this argument. Systems thinking, starting with an argument on an inductive, scientific method has now been almost identified with its antithesis.

The two positions are not as opposed as one might suspect from the above quotation, however, for most reasonable men will agree that any whole is made from components or parts. Furthermore, most will agree that the reasonable, rational approach toward their study would be to consider and deal with both factors, not one at the expense of the other.

Churchman[20] describes an interesting illustration of an operations analysis team, employed to study an accounting system for a railroad company. After careful study was made, it was clear that what needed changing was simply certain paperwork. Informational content was to be as good as under the previous system. No one in the company would take the step to remedy the problem, for reducing paperwork meant cutting back jobs as well as managerial responsibility. The operations analysis team had carefully and scientifically

[20] *Ibid.*, p. 5.

studied the parts, made logical rational recommendations, but did not consider the whole system or the effects upon it. Their work had no effect in the final analysis, because the whole had not been considered.

Many gains have been made in education by the "component" approach, and they cannot be discounted. But in the final analysis, more could have been done, or perhaps can be done, by taking the "whole" look as well. This, in essence, is the systems approach.

It is evident in education that problems or systems cannot be defined in the same precise terms possible in the sciences. Engineering can operate at a sophisticated level of measurement and can therefore render decisions which are precise and accurate. An engineer for education would enjoy no such advantage. As one writer has said, "It is better to obtain an approximate solution to an exact problem than an exact solution to an approximate problem."[21]

The above statement would suggest that an important application of the systems approach to education might lie in the identification of problems that

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[21] Bennett, op. cit., p. 4.

are amenable to systems thinking, and then to careful analysis of these in order to delimit the degree of approximation.

Another aspect of the problem of treating the system as a whole vs. the system as a collection of parts or components, is suggested by Beer:

> "The part is greater than the whole: is an aphorism everyone has heard, and there are occasions when people think they discern a meaning in the paradox. When something is labelled "a system," the whole intention would seem to be to assert that a collection of separate things is in an important sense a whole. But no one imagines that this debars him from dividing the system into parts for the sake of description; indeed, any arbitrary division is logically admissible, and the criterion of suitability is that of convenience alone. The would-be divider of systems must, however, be careful: He may succeed in making a division which destroys the sense in which the system is a whole. A surgeon who treated migraine by amputating the patient's head (cephalectomy?) would be doing this. And the patient, on discharge from hospital, might posthumously reflect on the sense in which this part of him had proved greater than the whole.[22]

Interaction The above question suggests a factor which must be a part of any serious discussion

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[22]Stafford Beer, "Below the Twilight Arch, A Mythology of Systems," General Systems Journal, V (1960), p. 15.

of systems theory as it relates to education. Consideration must be given to interaction of components within an operating system. Interaction is recognized as important by some definers of systems, but not by others. In instructional system theory, interaction is of fundamental importance.

As an example, one might view a seventh grade class in arithmetic as a "system" and match child for child, with the purpose of building two nearly identical classes in terms of ability, cultural background, economic factors, ages, etc. Even though the same teaching methods were used in both classrooms with the same resource materials, the two classes would soon diverge from equivalence. There would be interaction factors within each section which would become apparent as soon as the classes got underway. Teachers sometimes refer to this phenomenon with the statement "classes, like individuals, have personalities and, as such, are never quite the same."

This line of reasoning might conceivably cause one to abandon systems theory as being inapplicable to education. Yet an instructional system which does incorporate interaction in its descriptive design can offset to a degree much of the obvious difficulty and perhaps achieve significant benefits to education. There is a parallel here to the problems of the scientific movement in education of a generation ago.

DEFINITION OF THE TERM "INSTRUCTIONAL SYSTEM"

The effective use of the instructional system concept is not possible until clear definitions of the individual terms are available to the educator. As these concepts and ideas become more meaningful, the educator approaches the point of talking of descriptions, characteristics, and eventually definitions of the term "instructional system." An important step in developing this terminology is a review of definitions of both instruction and instructional systems as they appear in the literature in education, in general systems theory, and in instructional systems.

The basic term _instruction_ has operational meaning to most educators. It is important that it be fully understood for part of the instructional systems concept must be built upon a real meaning of the basic term instruction. Churchman's description appears adequate for this study.

> I take the term "instruction" to mean the activity centering in the classroom, usually consisting of an interface of teacher and a group of students, together with the peripheral support activities the classroom requires.[23]

The basic term <u>system</u> can assume many meanings, depending upon the discipline from which it is retreived. Von Bertalanffy in his early basic work in system theory stated that: "A system is a set or sets of elements standing in interaction."[24]

Broad, general definitions similar to the one quoted above are often found, and can be appropriately applied to instruction in context with the systems definitions under study.

Commonly found in literature on systems is the term <u>operations research</u>. For purposes of this study, the term operations research will be interpreted to mean the same thing as systems analysis. Ackoff defines

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[23] Churchman, <u>op. cit.</u>, p. 10.

[24] Von Bertalanffy, <u>op. cit.</u>, I, p. 3.

operations research in the following manner:

> "Operations Research" is research on problems involving the control of organized (Man-machine) systems to provide solutions which best serve the purposes of the organization as a whole, by interdisciplinary teams, through the application of the scientific method.[25]

Boulding suggests the reintroduction of the negative entropy concept from the sciences: "Whatever is not chaos is system."[26] Fundamental structure in systems thinking must be built upon this organization concept. Boulding continues with the suggestion that system breeds knowledge, and that knowledge leads to a striation phenomenon. He chooses to identify some four levels of systematic knowledge forming a continuum ranging from the empirical to the theoretical. This notion is important for the present status of

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[25] Russell L. Ackoff, "The Development and Nature of Operations Research and Its Relevance to Educational-Media Research" (Prepared for a Conference in "New Dimensions for Research in Educational Media Implied by the Systems Approach to Instruction," conducted by Center for Instructional Communications of Syracuse University, April 2-4, 1964), p. 8.

[26] Kenneth E. Boulding, "Political Implications of General Systems Research," *General Systems*, VI (1961), p. 1.

instructional patterns should be located somewhere within this range. A movement in the direction of true instructional systems would be in the direction of more theoretical concepts. A movement of education in this direction should be encouraged, for it should lead to a more scientific basis for instruction. Boulding suggests this continuum:

> The first level is that of the purely empirical system, based upon frequently observed connections. These involve the kind of knowledge on which bodily skills are based. At the second level we have what might be called mechanical construction systems. These involve the kind of knowledge which would enable us to build a house or a machine from a blueprint. We can go on to distinguish a third level, which might be called engineering systems. These involve the kind of knowledge which would enable us to design a machine. We should therefore distinguish a fourth level of systematic knowledge which forms the basis for designs of the third level. This might be called the theoretical level. Pure science is concerned mainly with this level.[27]

There is little question that education ranges from the second to the third level of this scale. The fourth or truly theoretical level is not available to

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[27] Kenneth E. Boulding, "Political Implications of General Systems Research," General Systems, VI (1961), pp. 1-2.

the educator until measuring tools adequate to the job are available to the instructional specialist. In education, measuring tools are reasonably good in some areas, but notable by their absence in others. Until research provides the educator with better measuring tools, level three is difficult and level four is nearly impossible.

The efforts of educators to build a "science of education" can be helped by the concept of system thinking. Boulding suggests that:

> There is little doubt that the most important fruit of the improvement of general theoretical systems would be the development of more adequate theoretical structures in the sciences of man and society.[25]

Education would qualify as one of the "sciences of man and society," and as such should benefit from the fruits of instructional systems thinking.

Ryans, of the Systems Development Corporation of California, has defined system in the following manner.

> Simply stated, a system is any identifiable assemblage of elements (objects, persons, activities, information, records, etc.)

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[28] *Ibid.*, p. 2.

> which are interrelated by process or structure and which are presumed to function as an organizational entity in generating an observable (or, sometimes merely inferable) product.[29]

The three essential parts of systems diagrams can be seen in Ryan's definition. The first, or input, phase includes the "assemblage of elements" statement; the second or operations phase is seen in the terms "interrelated" and "process"; the third, or output phase is the identified "product." Most system definitions, unless they are too generalized in scope, can be fitted to this three phase plan.

A contrast to Ryans' definition is a very general definition of system suggested by Ackoff:

> Initially we can define a system broadly and crudely as an entity, conceptual or physical, which consists of interdependent parts.[30]

In constructing an operational definition for the term "instructional system," the following two

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[29]David G. Ryans, Systems Analysis in Educational Planning, TM 1968 (Unpublished paper of the System Development Corp., Santa Monica, Calif., July 9, 1964), p. 5.

[30]Russell L. Ackoff, "Systems, Organizations, and Interdisciplinary Research," General Systems Journal, V (1960), p. 1.

points stand out. The term instruction is well understood and can be defined operationally. On the other hand the term system carries many meanings, rising from its use in many different disciplines. The multitude of shadings of the meaning are not difficult to understand but are difficult to operationalize. To use these two terms to build an operationally valid definition for educators is not an easy task. Nevertheless this difficult definition must be constructed. One of the challenges of this study is in the attempt to operationally define the term "instructional system."

<u>The Instructional System--Description</u> System definitions in the preceding section of the study are seen to be somewhat general. The major differences are often in their semantic interpretation. This is not surprising as the terminology is drawn from many intellectual fields. Sub-system levels or descriptions often differ among the various descriptions and definitions. From all of these quotations, as well as from readings of the works of system theorists, the following effort is made to develop an operational definition of the term instructional system. Groundwork must be

laid for the understanding of the definition of the term by discussing a series of characteristics that are unique to the term and the ideas it generates. These characteristics are developed to relate the systems idea to the process of instruction.

1. An instructional system is open-ended. No instructional system can be designed that does not include in its set of principles or ground rules a built in opportunity for changing itself upon presentation of demonstrated need. An obvious framework within which the educator could trap himself might result from a description so definitive that innovation is not a possible alternative. To innovate oneself into an unchangeable system should not be possible.

2. An instructional system must include a collection of components, including the human instructors and students, any machines used in the process, all materials of any nature introduced into the system, the learning environment provided to the system to contain

the instructional pattern, and a stated time interval over which the instructional pattern is to be spread.

3. An instructional system may provide for groupings of students or potential learners, arranged in any prescribed fashion (large group, small group, individual, or any combination of these).

4. An instructional system must be composed in such a manner that interaction within the system can be observed and accounted for. This includes interaction between individual students, the interaction between instructors and students, and the interaction between any human elements in the system and any machines or materials introduced into the system.

5. An instructional system must be designed in such a manner that evaluation, according to the best research and practice, can be an integral part of the operation of the system. Such evaluation must be in conjunction with stated objectives of the instructional system.

The above characteristics incorporate traditional system paradigm of input-operation-output, but also include the interaction factor which is an essential element whenever humans become major factors in a system as they must be in an instructional system.

The Instructional System--Definition An Instructional System is the development of a specific instructional model resulting from instructional analysis and evaluation. It includes a design within a given context of a teaching-learning process into which are introduced inputs of learners, teachers, and resources. The process must include descriptions of instructional content, methods, and resource utilization. Interaction (including feedback) should be observable. Outputs of the Instructional System should include learners who emerge demonstrating observable behavioral changes in the direction of predetermined instructional objectives. Evaluation must be an integral part of the system from conception to completion.

The Instructional System--Paradigm A generalized conception of this definition is illustrated in the paradigm in Figure I (Appendix E).

THE ORGANIZATION CONCEPT

Ackoff pursues in depth the idea of systems theory as one of organizational patterns. Based upon the thesis that the only type of system which is appropriate to sociology is one which displays activity, the system then might be described as a behavioral system. The next logical step is one in which he states, "The behavior displayed by a system consists of a set of interdependent acts which constitute an operation."[31]

Content Functions Within the boundaries of system thinking Ackoff describes four separate functions, including content, structure, communications patterns, and decision-making procedures. These concepts introduce another dimension into the process of developing systems models for instructional use.

A total understanding of the instructional problem includes the necessity for decisions on what is to be included and on what is to be excluded from

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[31] Ackoff, *op. cit.*, p. 2.

the teaching-learning unit. Manipulation of content materials is, therefore, one aspect in which research can be undertaken within the systems concept.

Structure within the system is a second essential element to the system analyst and one which can be isolated for the purposes of systems analysis. Normally it is up to certain members of a systems analysis team to select a suitable structure for those materials or methods under scrutiny.

Communications, a part of the organizational pattern, must be optimized if effective work is to be done in the system. Although it is a variable factor, it must be effective for an optimum system to be operational.

The decision-making apparatus is one that must also come under study by the systems analyst. Here are found the major decisions or "go-no-go" points within the system, and at these points of major decisions, rationale for selection or rejection should come under close scrutiny. Certainly a serious study of decision-making is nothing new in education, but within the context of a broad study of an entire instructional system, decision studies take on new importance. Effective administrative decision-making does not necessarily guarantee success in an organization, but ineffective administrative decisions tend to assure failure of the organization.

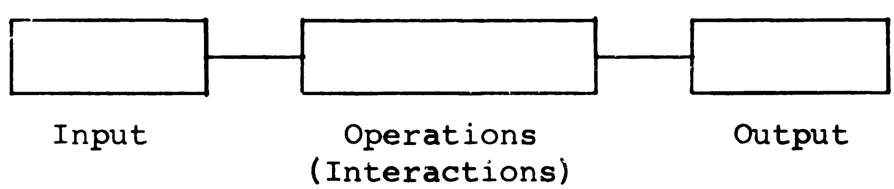
MODELS AND INSTRUCTIONAL SYSTEMS

A stated goal of this study is the discussion and development of a conceptual model for the term <u>instructional system</u>. The term <u>model</u> is defined in Chapter I as "An optimum conception of an instructional process." This definition is too general to be of use to the instructional systems analyst. In order to make the definition more functional, instructional models must be discussed further.

<u>The Model</u> The major tool of the systems analyst is the model. Models in this context are visual impressions of ideas, or, more accurately, of processes incorporating ideas. Such models enable the systems thinker to diagram sets of ideas, processes, and blocks of information. From this point,

the systems analyst can begin to manipulate and change basic patterns in the model construction. With this visual advantage, changes are easier for others to understand as innovations are suggested within the context of the model.

Models normally consist of a number of little "boxes." Many meanings can be attached to the boxes by variations in their shape, size, color, or position. Models tend to follow one general flow pattern consisting of input, operations, and output factors. Diagrammed in its simplest forms, a model would look something like this:



Models take on increased complexity as the situation under study becomes complicated. Analysis of a complex situation requires breakdown of each phase of the above model into a number of sub-units in order to identify and locate all possible components of the system. A systems model for an instructional process must accordingly identify and classify all of the components that can be identified as affecting the operation.

Inputs and Outputs The input and output phases of a systems model are defined by Ryans as follows:

> Inputs (whether endogenous or exogenous) are the conditions which are sensed by a system and which the system analyzes, synthesizes, and transforms; and outputs are the responses of a system, or the phenomenon representing the end-activity of the system.[32]

Educators have long been concerned with identifying and working with inputs in order to bring about improved outputs or results. The systems designer, however, takes the next step of analyzing the interaction between components within the system as they relate and inter-relate with one another. He is also concerned with output energies, as he cannot use the concept of efficiency without this knowledge.

As the systems model is constructed, a generalist who understands the whole must be a member of the team. Component specialists have their place in

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[32] David G. Ryans, System Analysis in Educational Planning (Unpublished TM-1968, Systems Development Corp., Santa Monica, California), p. 8.

the design team but the major decisions must be reviewed by the instructional generalist who understands the model as something more than a set of individual components fitted together into a unit.

Feedback In any systems approach to education, the concept of feedback is an essential element. Feedback, or the influence of inputs in a system reflected from the output, is a central problem in instructional systems building. Instructional systems contain the most complex of all components, the human instructor and the learner. Interactions within instructional patterns among various instructors are a most important part of the paradigm. Some limitations must be agreed upon, for the human interaction pattern could be endless, and part of the problem of the systems designer is to establish such limitations.

A feedback phenomenon always present is influence of feedback loops that tend to maintain the organization. Whenever humans are part of a system, this organizational maintenance-feedback interaction can be identified. The systems designer must take this into account, for by definition the instructional system must not close itself and fail to permit change as a part of the system. In effect, a function of a good instructional system is to create better instructional systems, and not to maintain itself. This feedback conception must be included in the instructional systems design.

Objectives and Measurement As the systems analyst studies the inflections of systems thinking as it relates to instructional model building, two major areas of concern must be described, namely, objectives and measurements of results. These are the same requirements placed upon the scholar within any discipline.

Anyone with a real interest in instruction recognizes the need for improved means of measuring educational outcomes. While current systems of measuring human learning are imprecise, for purposes of systems thinking in education the scholar must assume that educational results can somehow be measured and that precision will increase. As it does, system designers can become increasingly sophisticated in their ability to analyze and resolve problems of more effective learning and teaching.

The second area of basic concern for the systems thinker is the specification of educational objectives. Curriculum builders have long emphasized the objectives of instruction but only in recent times have educators shown serious interest in a measurable degree of specification of objectives. The work of Skinner, Pressey, Crowder, and others in programed instruction has increased interest in the specification of objectives since effective programing is impossible without such specification. For this reason it is most helpful to the instructional system designer to understand the principles of programed learning.

Mager[33] has been particularly helpful in illustrating how educational objectives can be made more specific and measurable. Such specification of educational objectives is essential for systems analysis because the success of a system developed to attain those objectives can be determined only by measurement of the results achieved in terms of the objectives established.

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[33] Robert F. Mager, Preparing Objectives for Programmed Instruction (San Francisco: Fearon Publishers, 1962).

For example, a spelling lesson that states for its objective that the students should learn to spell and understand all words appropriate to the fourth grade would not be sufficient for the system designer to proceed with a pattern of instruction. Someone must define what words are appropriate for that grade, or at least what readings the students will be held responsible for at that level. It is essential that the goals and/or the objectives of a course and of each segment of a course be stated in operational terms.

Simulators Another model development which is beginning to show promise in recent years is the systems simulator. Developed both by industry and the military, simulation techniques coupled with high speed computers have added a new dimension to the potential of systems development for readily understandable reasons:

> System simulation has the most useful property of permitting experimentation with and testing of certain policy, procedure and organizational changes in much the same way as the aeronautical engineer tests his design ideas in the laboratory or wind tunnel . . . .

> Simulation has the advantage of being easily understood, of being relatively free of mathematic and of often being quite superior to mathematical methods which may be too complex to apply or not even available.[34]

The techniques and procedures of applying systems simulation to the problems of instruction are just beginning to come under serious analysis and study, but appear to have promise.

The Electronic Computer and Simulation. There is little question that until the advent of the electronic computer, the techniques of simulation were not practicable for the scientist interested in sociological research because the many involved variables were not manageable without computer assistance. The digital computer which can accept thousands of bits of information, retrieve them on command, and perform calculations on any combination desired, opens a whole new area for both research and development. Under the guidance of educators who can ask the right questions and programers who can code them in the proper manner

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[34]Donald G. Malcolm, "System Simulation, A Fundamental Tool for Industrial Engineering," The Journal of Industrial Engineering, IX (May-June, 1958), p. 177.

many new possibilities appear for instructional improvement.

Sturlow[35] points out that computers, used for some time to program materials in the manner of teaching machines, are capable of much more than this simple mechanical use. Their real value lies in their contribution to the technology of research on instruction. He states that "the automation of instruction by means of a computer-based system provides education with a genuine laboratory facility." Furthermore, he suggests that the data collection and reduction capability of the computer adds enormously both to the rate at which research on instruction can be accomplished, and also to the accuracy of the results produced.

Models for research purposes are often developed by using one or more of the media of instruction as teaching instruments. This procedure facilitates one type of control since the experience can be more readily

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[35] Lawrence M. Sturlow, "Some Educational Problems and Prospects of a Systems Approach to Instruction" (Unpublished paper read to the Conference on "New Dimensions for Research in Educational Media Implied by the Systems Approach to Instruction," conducted by Center for Instructional Communications of Syracuse University, April 2-4, 1964), p. 3.

repeated in the same manner any desired number of times. A live instructor is unlikely to be able to repeat an instructional pattern exactly, regardless of the imposition of a formal model upon him.

Typical of some of the simulation studies in education, is the work of Kersh[36] at Oregon with his classroom simulator for teacher candidates.

Sixteen millimeter filmed classroom experiences are the basis of this classroom simulation experiment. Each potential teacher, faced with a filmed problem situation must make a decision to which the simulator then reacts with one of several possible responses which is dictated. Replication studies in this project are currently under way at the Audiovisual Center at Michigan State University.

Systems Definitions and Models Definitions of instructional systems and the resulting paradigms or models are now in early development stages. These developments hold promise for better and more efficient

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[36]B. Kersh, Classroom Simulation: A New Dimension in Teacher Education; Monmouth, Oregon: Oregon State Systems of Higher Education (NDEA 7-47-0000-164 Proj. No. 887 Final Report, June 30, 1964).

instructional patterns. As indicated by Sturlow:

> Both the development of models of instruction and the techniques of simulation are important research frontiers. The models of instruction are the theoretical matrix from which testable hypotheses can be derived, and significant research generated.[37]

Models represent best guesses at the time they are designed. As data accumulates and as new evidence is generated, the initial models are frequently modified or replaced with better ones.

Instructional Systems--To Remodel or Build Anew? An interesting question facing the instructional systems analyst is that of whether to remodel old structures or to build entirely new ones. The human organism, with all of its psychological characteristics which tend to make one stay with that with which he is comfortable, is a fundamental factor in most instructional systems. Humans can be induced to change, but the innovator must consider all political, social, and psychological factors involved in the needed change and attempt to bring it about in as painless and yet in as effective manner as possible.

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[37] Sturlow, op. cit., p. 12.

If the situation is subject to treatment through remodeling, this is generally a superior way to bring about more efficient patterns of instruction.

On the other hand, just as some houses are too antiquated to remodel, some instructional patterns may be too ingrained and too "rutted" to be amenable to remodeling. Then the systems analyst might decide that the superior way is to "cut clean," and design a new system to replace the old. Inherent dangers lie in this decision in that the total replacement of any part of a sociological system can bring the wrath of those who believe in the "old traditions." One must not risk losing the war by making a poor decision in one battle.

Which of these approaches is superior? A general principle would be hard to devise for this question. The analyst charged with facing an individual pattern must keep his thinking open on the question and make the decision based on as much information as can be secured. The nature of the problem, or the system under consideration, the nature of the community, the nature of the teaching staff involved, and the nature of that which is to be taught are some of the factors necessary to consider in making the decision.

IMPLICATIONS

In essence, the major problem of the educator desiring to apply systems thinking to educational problems consists of taking a long and definitive look at the problems themselves. Steeped in tradition and the usual research method of studying the parts to infer the whole (the inductive approach), his greatest difficulty may well be in attempting to take an overall, systematic look at the totality of the instructional problem.

> We must stop acting as though nature were organized into disciplines in the same way that universities are.[38]

Division of labor along academic lines is not efficient enough for today's world.

As educators move in the direction of instructional systems thinking and model building, one logical

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[38] Russell L. Ackoff, "Systems, Organizations and Interdisciplinary Research," General Systems Journal, V (1960), p. 6.

consultant to use for the task is the educational media specialist. Few educators have been consciously trained for this task; however a number of institutions of higher education are involved in the preparation of personnel to take leadership in this challenging effort. Cooperation is the keynote to success, but leadership is necessary for its completion.

SUMMARY

The construction of a model for an instructional system is the aim of educators who would build a better pattern of instruction. In order to construct such a model the systems analyst must understand some of the implications of general systems theory.

At the same time the system builder must learn to operationalize his terminology. Any technological approach to a problem means that terms must be firm and easily understood. Hazy definitions and conceptions cannot be a part of system building.

The instructional system builder then must face several key decision points in his efforts to construct a usable system of instruction. The problem of building from a ground or base point must be faced compared with the alternative approach of improving the components of the existing instructional system. These are decision problems and must be approached as such. Decisions infer that an organization is a part of the plan and the educator must involve his thinking with the problems of the organization.

By following this line of reasoning, and by putting sufficient effort into the thinking and planning process in instructional system building, the model system can then be generated for use in the instructional situation under study.

The next two chapters of this study analyze recent innovations which have taken place in two departments of Michigan State University. An attempt is made to apply a systems model to the instructional innovations reported, to note similarities and differences among the departmental changes, and the effectiveness of the results obtained.

CHAPTER III

THE USE OF CLOSED CIRCUIT TELEVISION IN THE DEPARTMENT OF HEALTH, PHYSICAL EDUCATION, AND RECREATION

Section One--The Women's Program

In 1960, the Women's Department of Health, Physical Education, and Recreation arrived at a decision to utilize the new closed circuit television facilities which only recently had been made available to most departments of the University.

Closed circuit television for instructional purposes was not an innovation so far as the University was concerned, for the Veterinary College and the Accounting Department had been using some form of closed circuit instructional television since 1956 and 1958 respectively. But on completion of the campus coaxial network contracted between Michigan State University and the Michigan Bell Telephone Company, other departments of the University were invited to make use of the facility.

THE NATURE OF THE INNOVATION

The instructional change was of a major nature in comparison with the systems used in the department through the school year 1960-61. The freshman physical education course, required for all freshman girls and identified as HPR 105, "Foundations of Physical Education for Women," was the course chosen for the innovation.

This course had recently been studied and revised in terms of the physical education curriculum and course content by Dr. Janet A. Wessel, of the Women's Health, Physical Education, and Recreation teaching staff. There is little doubt that this revision played a large part in the decision to select closed circuit television for teaching major portions of this course. Her teaching guide, with its definite goals and objectives, and its precise content suggestions made this course a natural one for experimentation with new media and related methods.

The major factor in the decision to change to teaching methodology appears to have been the familiar one of excess numbers of students and not enough instructors. Starting with the school year 1961-1962, the department could see mushrooming enrollments, insufficient funds to enlarge the department staff, and were aware that even if funds were made available, suitable staff of the quality desired by the department would not be available.

If the department were to cope with the problem, it would need to make one of several obvious adjustments. The freshman course, required in the past, might be made an elective. This would reduce numbers significantly. The philosophy of the Health, Physical Education, and Recreation Department was not amenable to such a shift in basic policy.

Larger sections were the most obvious solution. Lack of space in teaching laboratories and gymnasium facilities ruled out this alternative.

More sections per instructor were not considered, as this solution had been used unsuccessfully in the past. Instructors during the school year

1960-61 were already meeting up to eight sections per week, or double the load common to university instructors. This faculty load was central to the problem and it was partly to relieve this pressure that the innovations were readily considered. Thus the decision to go to closed circuit television met with no discernable resistance from the Women's Physical Education staff.

Jean McIntyre, teaching member of the department, was selected by the department administration to take the leadership role in the innovation. Miss McIntyre reported that some five to six weeks of full time work were spent in the summer of 1961 organizing and planning for the presentations for the fall quarter. She was not an experienced television teacher, but seems to have been selected on the basis, first of all, that she was willing; and second, she was familiar with the content and objectives of the course, having taught it a number of times.

Three other instructors were assigned to work with Miss McIntyre during the fall quarter on the course presentation. No video-tape recording facilities were available at the time, and the demonstrations were repeated every hour, some eight times daily. Each instructor was required to take two sections daily and present the basic instruction as well as perform the physical demonstrations involved in the presentations.

The studio facility was new, many of the staff members at the television station were new, and Miss McIntyre and her three instructors were new. In retrospect, she reports a certain adventuresome spirit that accompanied this new venture. In any case, she recognizes that many of the lessons were poorly done, and that it was a good thing for the department and the studio that no tape facilities were available. In a sense, the first year constituted a pilot study, and many changes were made in the patterns of presentation before the lessons were repeated in the fall of 1962.

In the question of the medium structuring the content, Miss McIntyre reports in her interview that "It didn't change the content, but it did straighten out the organization." Interpretation of this comment indicates that she was referring to the problem of the previous year, that of keeping a uniform schedule and time sequence for all sections, when 17 different instructors were teaching the course.

Selection of the closed circuit television system of instruction by this department was not done on the basis of a systematic analysis, so far as can be determined. Perhaps the only other medium that could have met the problems faced was the 16mm motion picture medium and no consideration was apparently given this possibility by the department.

Instead it appears that the simultaneous arrival of the problem and an expanded closed circuit television facility with a need for customers was the major factor in the selection of the medium. In view of the exigencies of the situation it was quite natural that the ready solution of closed circuit television should be warmly embraced.

Materials for use with the course were considered by the planning committee. It was recognized early in the planning that written workbook materials for students would add materially to the effectiveness of the course, and a text was selected.[39]

Certain filmed sequences were also selected for use in the studio presentation to the classes. A minimum of time was involved in the selection of these items. Rather, materials already familiar to the instructors were selected and used. Minimum graphic materials were produced by the studio technical staff and made available to the teachers. No systematic effort seems to have been involved in the graphics aspect of the system.

INPUT STAGE

The principle factors in development of the new teaching system for the course in Foundations of Physical Education for women appear to have been as follows:

A. Planning--One full time staff member was released for five to six weeks to plan the class sessions. Four television studio teachers

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[39] Janet A. Wessell, Movement Fundamentals, Figure, Form and Fun (Englewood Cliffs, New Jersey: Prentice-Hall, 1961).

shared the hourly demonstrations in the studio. After the advent of the video tape recorder, one instructor, Miss McIntyre, was selected as the only television instructor.

B. Viewing Room instructors were included in the pattern. The function of these instructors, many times graduate assistants, was to meet with the class as it viewed the presentation, manage the housekeeping details of class work, work with the students on an individual basis, and carry on for some time-interval with the class after the televised lesson-demonstration was completed. The advantage that these instructors had over previous years was the fact that they did not have to demonstrate every movement and exercise for the students. This was done for them by the television instructor. Thus a viewing room instructor could meet with as many classes daily as her schedule would permit, without fatigue being a significant factor.

C. Sympathetic Administrative Support While this factor cannot be measured, the support and encouragement always evident on the part of the administrative staff of the Women's Physical Education Department seemed to make success in the experiment more possible. No administrative blocks of resistances to the innovation could be detected.

D. Freshmen Women Students, except for those with physical disabilities, were required to take the course. The freshman girls represent the major human input as far as numbers are concerned. Some 1700 took the class in the fall of 1961; this had grown to over 3,000 taking the course during the fall of 1964.

E. Materials of Instruction were primarily the workbook text which was written for the course by Dr. Wessel. The strong part of the material, as observed in the system, was the daily integrated use of the book, with responses to make during each class section. Uniformity in use of the text was greater than would have been possible under traditional methods of instruction. Films and graphic materials used in the course came to the group via the television circuit. Their effectiveness would be difficult to measure in the system. They have some importance to certain facets of the presentation, and have been used more and with increasing time allotments as the course has been improved and refined over a two year interval.

F. The Medium The strong technical abilities of the television staff, their working relations with university instructors, and their access to funds for experimental purposes made the closed circuit possibility inherently attractive to hard-put deans of colleges with both enrollment and financial problems.

The major problem of evaluation in this system, so far as the economic picture is concerned, is the problem of budget and expenditures of the closed circuit television facility. Overall cost figures are available, but these are not apportioned according to departments. The input to the "system" of this facility is therefore difficult to assess. While this does not invalidate the use of the above illustration as a forerunner of later, more systematic approaches to solving instructional problems, it does suggest certain considerations for institutions embarking on similar ventures. These are incorporated in the concluding section of this study.

OPERATIONS STAGE

The course under study is a one term course. Most freshmen women take it during their first quarter on the campus and therefore it is heavily loaded in fall term, and less so during the winter, spring, and summer terms.

Thus, it is necessary to organize and present it over a period of only ten weeks; and since it is offered twice weekly to the women, some twenty actual sessions are involved in the planning.

During the winter and spring terms of 1962, Miss McIntyre again repeated the course by closed circuit television. This was done in order to gain experience with the medium and not because of enrollment pressures.

By summer of 1962, videotape recording equipment was available and the department elected to have Miss McIntyre tape record all of the major presentations for the course. When the course was offered in the fall term of 1962, it was all on tape. The major change in the organization of the course was from live instruction over television in the fall of 1961 to the use of taped lessons in the fall of 1962. The lessons were recorded after the primary instructor had had three quarters of experience in televising the course, and the results were substantially better than had they been recorded during the first attempt at teaching the course via closed circuit television.

Between 1962 and 1963, except for some minor editing on a small number of tapes (and because of budget limitations), no changes were made in the taped lessons. The course was offered in 1963 with the same recorded lectures and demonstrations that had been used in 1962. At this writing, during the fall term of 1964, essentially the same tapes are being used for instruction in the course.

The analyst would have to conclude that no major changes have taken place in the curriculum for the course and that changes in the presentations of the lessons have been of a minor nature.

Staff opinions concerning the course have not shown any marked change over the period from 1961 through 1964. In general, the instructional staff favored the original proposal, and were at least willing to give it an honest chance. Recently one of the staff members of the department was asked by this investigator what her reaction would be if the entire system were scrapped, additional teachers hired, and the initial system of instruction re-instituted. Her reaction was one of real concern because she recognized instructional gains above and beyond those of accomodating larger enrollments.

Student opinions in general are favorable to the closed circuit television system for women's physical education as noted in a survey to be discussed in the next portion of this report. It might be observed that in the eyes of the students, any system in its fourth season is an old system, and thus one that would not be regarded by them as an innovation.

The operational stage of this instructional system has exhibited less change than most instructional situations might tend to exhibit. There are probably two reasons for this phenomenon.

First, the nature and content of the course were such that transition to a television mode of teaching was not a traumatic experience for the instructors and students. Goals were clear cut, operational, and generally agreed upon within the department.

Secondly, the people involved in the innovation were skilled teachers with a keen interest in their work, and apparently without marked bias so far as the proposed innovations was concerned. Whatever methods were used by the Women's Health, Physical Education and Recreation Department to bring about acceptance of the new system of instruction are worthy of emulation by other departments. Suffice it to say that at this point the innovative process employed was highly successful in this instance. It might be useful to ascertain whether innovations in more advanced courses could be introduced with equal ease.

OUTPUT STAGE

Defining the goals and objectives for a course in physical education is perhaps somewhat easier than might be true in more academic subjects. However, one of the findings of this study is that the people involved in this particular innovation knew where they were going. The desired student skills were discreet, observable, and readily measurable.

The major findings from the television experience are reported in a study done by the primary instructor and three senior members of the Women's Physical Education Department.[40] Most of the observations in analysis of this department are influenced by the research document cited.

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[40] Janet A. Wessel, Jean McIntyre, Anna Ganung, and Dorothy Kerth, Teaching University Physical Education by Closed Circuit Television (East Lansing, Michigan: Office of Research and Publications, Michigan State University, 1963).

FINDINGS IN THE APRIL 1963 REPORT

In general, the findings of the study on the television project are summed up in the following statements by the department evaluators.

> Televised instruction for Foundations of Physical Education is most effective when used in the presentation of lectures (fitness, nutrition, exercise physiology, preventive medicine). Television offers visual aids such as movies, slides, posters, and supplementary instruction and demonstration; sufficient time, however, is alloted for the viewing room instructor to discuss, answer questions, and personally apply the subject matter presented each class hour. Guidance procedures, self-evaluation, individual movement prescription, introduction to course, and summary and review, are all aspects of the course content which are most effectively presented by the viewing room instructors. The plans for the forthcoming school year (1962-63) are for one-hour classes with 20-30 minutes on television and 30 minutes presented by viewing room instructors.[41]

The suggested procedures at the end of this quotation were followed during the following year. The report suggests that this television approach is a possible instructional tool that could be used in other courses in the department. Recommendation three of the 1963

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[41] *Ibid*., pp. 1-2.

report suggests that:

> Serious consideration should be given to the use of televised presentation as supplementary instruction for the complete program of planned learning for other courses in the instructional program (Swedish gymnastics, dance, bowling, archery, fencing). The use of television should also be considered for courses in the professional major program (lecture courses and methodology of sports activity).[42]

The report indicates that some of the evidence used in reaching conclusions is of an "observation and experience" nature. The manner in which the conclusions were drawn caused the statistical data to be influenced to a degree by individual observation. Conclusions must be made in light of this factor, although the situation as reported in the 1963 research report, and as seen in the interviews with staff members, is markedly similar.

Major findings were reported under three general headings. These were student attitudes, student achievement, and faculty reactions.

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[42] Ibid., p. 2.

Student Attitudes Toward Television as a Means of Instruction in Foundations of Physical Education

1. Students, in general, tended to rate the effectiveness of the television presentation favorably. The interaction between assignment of television instructor and viewing room instructor (regular faculty members, graduate students, and undergraduate students) was investigated in a widespread sampling. The evidence obtained did not support a differential pattern of attitudes. Regardless of their assignment, students tended to rate the television presentation favorably. They gave less favorable ratings in all instances to items concerned with the amount of student-instructor time for interaction (conference and/or question and answers). Students with undergraduate major students as viewing room instructors tended to rate the television presentation more favorably than those with graduate assistants as instructors. Probably this reflects the fact that undergraduate students were enrolled in a special seminar course during this term while the graduate assistants were "new" instructors in this course. Special assistance (one meeting a week with television instructor) was given to graduate assistants along with the regular faculty members.

2. There is no indication that television instruction was more acceptable to low ability (College Qualification Test or course grades) than to high ability students. As a general rule, high and low ability students held essentially the same attitudes toward television instruction in comparison to total students sampled. Low level ability as compared

with high ability students seem to feel that they had more opportunity to apply what they learned than they would have had if in a non-television class.

3. Specific problems involving the mechanical aspects of presentation, e.g. sound, lighting, ventilation, and seeing clearly, were found in several of the viewing room stations. In general, students felt that the camera should have focused longer on certain visual materials presented. The greater handicap possibly is the lack of rooms designed for television reception.

4. The instructor is, herself, a major determinant of student attitudes. The majority of students (52.8 percent) indicated that they would enroll in a television class if they had a choice. Students (85.5 percent) also indicated they would prefer enrolling in a television class if ensured of an excellent instructor rather than taking their chances in non-television classes.

5. The students, in general, tended to rate their television instructors very favorably.[43]

Part one of the quotation reflects the need for careful preparation of the viewing room instructors. It is noted that the students liked their undergraduate assistants, but this differential is attributed to the planning that was done in an in-service program with the undergraduate leaders. This suggests

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[43] Ibid., pp. 3-4.

that in-service training of secondary instructors is highly important in the type of program described.

There appears to be no difference in the attitudes of the students with respect to their ability levels. No findings supporting this type of hypothesis were reported in the study. This conclusion is not supported in television research in other areas and one reason may be the skill type of subject matter involved. More research in this area is suggested.

A lack is indicated of suitable teaching facilities designed for television reception and instruction. This is a factor that the university administrators should take into consideration in their long range planning efforts. Not very much can be done about existing facilities, but there will be little excuse for new university buildings not containing adequate viewing room facilities.

The instructor is indicated to be a crucial factor in the attitude of students toward the televised instructional program. This finding is widely reported in other television research, and might be expected. The indication that students prefer a superior instructor even by television to an average one in the live classroom is probably significant.

Student Achievement Students were randomly assigned to control (non-television) groups and to experimental (television) groups for this portion of the report. The experiment was reported using the analysis of variance technique, with levels of confidence of 5 percent or less in each of ten different experimental situations. The statistical treatment of the data is sound and would support the conclusions of the report. These can be summarized as follows:

1. The study of subject matter achievement as a function of section assignment involved comparisons of scores earned on objective portions of the final examinations by groups of students attending the experimental (television) and the control (non-television) sections. It was apparent that television was as effective as non-television instruction.
2. Students in the television sections tended, in general, to rate the course content less favorably than did students in the non-television sections.
3. Student motivation and interest in the specific subject matter were not adversely affected by assignment to the experimental rather than to the control sections.

Objections to television instruction because conventional instruction (non-television) is believed superior in evoking student interest and motivation are not supported by the findings of this investigation.

4. The study of instructor effectiveness as a function of section assignment involved comparisons of instructor ratings given by students in the experimental and control sections. No significant difference was found between teacher ratings (effectiveness) assigned by students in the television and non-television sections.[44]

The third general portion of the report involves faculty attitudes toward the innovation in the basic course. The major flaw in this section of the report might be involved in the small size of the number reported. There were four television teachers reporting (those who taught at least part time on television). Nine viewing room faculty members reported, along with four graduate assistants who had served also as viewing room faculty. These numbers do not constitute a large number for purposes of statistical analysis, but they represent the entire staff used in the experiment. Accordingly, non-inferential statistical methods were used.

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[44] _Ibid._, pp. 5-6.

The summaries for the third part of the study follow: In general, the findings are definite, with reactions tending to be of a positive nature concerned with real problems of managing the course, or suggestions for additional areas that might be appropriate for television treatment.

Quoting from the study, the summary of faculty attitudes follows:

> 1. The overall reactions to televised instruction by viewing room instructors was enthusiastic with reservations (56 percent). All those who taught a television course reacted enthusiastically.
>
> 2. The greatest advantages of televised instruction as perceived by the television instructors (100 percent) and viewing room instructors were better organization of course content (100 percent), and more effective use of audio visual materials (66 percent television instructors and 100 percent viewing room instructors).
>
> 3. The greatest disadvantages of televised instruction as perceived by the television and viewing room instructors were loss of personal contact, inability of students to ask and to discuss questions (75-100 percent respectively), lack of time for personal application of subject matter presented by the viewing room instructor (75-100 percent respectively) and oversimplification of presented subject matter (66 percent viewing room instructors).

4. The reactions of viewing room instructors as to their own feelings of personal satisfaction and accomplishment for the television presentation of this course indicated that 77 percent of them felt frustrated, and received little personal satisfaction because of a lack of involvement with class and individual students. It is interesting to note that 50 percent of the television faculty felt no difference; also, 25 percent of the television faculty thought they could have done a better job if they had had more depth in the subject matter and 25 percent thought they had taught much better this term on television than they did last year by non-television.

5. Both the television and viewing room instructors suggested that in order to overcome these disadvantages or deficiencies that more experts in the fields of nutrition, medicine, exercise physiology, and sports should be presented on television (75-55 percent respectively). Also, ways should be found to improve the role of the classroom instructor--namely, time should be permitted to follow-through on subject matter presented on television. This could allow the teacher to meet the personal needs and interests of each student (75-100 percent respectively).

6. The study indicated that the aspects of this course which specially lent themselves to televised presentations as perceived by the television and viewing room instructors were lectures concerning fitness, tones, diet, nutrition, exercise physiology, and principles of movements (100-88 percent respectively); visual aids such as demonstrations (principles of motion and posture, exercise); and the use of music, slides, films, and posters (100-66 percent).

7. The evidence accumulated indicated that the aspects of this course which did not especially lend themselves to televised presentation as perceived by the television and viewing room instructors were guidance procedures (100-36 percent respectively), self evaluation and individual movement prescription (100-55 percent respectively) and introduction, summary, and review of material (50-22 percent respectively).[45]

GENERAL OBSERVATIONS

In the final analysis, innovations are usually studied for the success-failure patterns within them. In the success-failure pattern, this innovation in the Health, Physical Education and Recreation Department would have to be classed as a success. In fact, few innovations of the scope and nature of this one have succeeded so well in changing the patterns of instruction in a large university department. No one seriously considers returning to the original instructional system that was replaced by the closed circuit system. From this standpoint, one can infer the major strength of the innovation.

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[45] *Ibid.*, pp. 6-8.

Experienced instructors within the department feel, by and large, that the course as it is offered under today's system is superior to that offered four years ago. This is a key factor in the success of the innovation.

This course is basically a foundations course, and as such has parallels in nearly every department of a major university. The instructors tend to take the position that a system of this nature is more suited to a foundations course than to a more involved and sophisticated course in physical education. Suggestions have been made by members of the department that some other courses in the department could very well be treated in this same manner, but as yet, this has not been done to any great extent. The exception is a televised course in Social Dancing.

The analyst cannot study the closed circuit experience in physical education without reflecting some positive thinking of those who administer that department. As decision-makers analagous to middle management in business in many respects, almost any one of a number of officials within the department could have caused the prevention of this experiment, or caused it to fail. A study of the administrative patterns in this department might reflect some insights into the nature of the department. Nearly universal support for this innovation is seen throughout the department. In college departments, leadership of this sort is not the usual pattern.

The foresight of the university administration in making facilities of the nature found at the closed circuit operation must be maintained. As noted before, the problem and the solution arrived at the scene simultaneously, but not through an accident. Michigan State should be commended for making this facility available for experimental purposes to interested departments. The major flaw in this report is the lack of ability to compare the costs of the system as it exists (within the closed circuit operation), with projected costs of the programs if a traditional program of instruction had been followed.

Financial information is not available from the closed circuit operation; thus no cost analysis or comparison can be made at this writing.

IMPLICATIONS

The question remains, is it an instructional system? In the sense that a careful systems analysis of a problem was made, it is not a system. Systems analysis would have required additional factors beyond those discussed here. For example, to be a true systems approach, various plans and approaches would have had to be considered, and decisions made in light of this planning. Nothing of this nature was in evidence.

Rather, a vehicle was chosen in the media field, and the instructional pattern adapted to the vehicle. In a sense, we did not choose the best and the most economical way to get our hay crop to town, but we chose the sled with a flat bed because there was snow on the ground and it was there. We then proceeded to bale our hay to fit the wagon.

This decision to use the closed circuit television for our vehicle is not unusual in education. It is the practical way, and as educators tend to be pragmatists, they often take this method of solving their problems. Perhaps, in a way, this is the method that is best in the long run, but it leaves the nagging suspicion that it might have been done more effectively and efficiently. Still better, had the University chosen to provide, along with its excellent television facility, other instructional resources equally strong, along with suitably trained generalists in system thinking, it is conceivable that better and/or more economical alternatives might have been found.

In the sense, after the method of presenting the lessons was chosen and this decision was closed, the treatment of the problem described in this section does fit into systems thinking in many respects.

Certainly inputs, operations, and outputs can be identified within the described system. A paradigm can be generated (Section Two of this chapter concerns the men's phase of this system.) which operates using this system as a model.

Careful examination of the economic factors within the department, and within the closed circuit television operation, could make this system amenable to a rather precise economic analysis.

Within these thoughts, then, we have been analyzing a system, at least a system of sorts. Moving from this hazy description into increasingly precise definitions is the function of the system researcher.

SUMMARY

Within the Department of Health, Physical Education and Recreation, a model system of instruction using the facilities of the closed circuit television operation as an integral part can be identified. The department, recognizing the swelling enrollment and staff shortage problem, looked to other methods of managing it, other methods than simply increasing the class size and the ratio of students to teacher. The selection of the closed circuit television operation came rather early in the decision process, and the systems designer must suspect that true systems analysis is not possible, for the initial decision to use closed circuit television then influence all later decisions in the department.

The effectiveness of the chosen method of teaching the classes is discussed by the study of the research reports of the department. It is suggested that the Men's department evaluate its program as did the Women's group.

The study of the instructional system as it is used in the department leads to the observation that factors not identified by this writer are at work in the department and that such factors, factors that reflect the popularity of the program, should be identified. Success of a major innovation is enough of a rarity that such success should be analyzed.

Section Two--The Men's Program

The program of the Men's Department of Health, Physical Education and Recreation provides an excellent illustration of a department experiencing a problem or set of problems common in higher education today. Their solution to the dilemma was to borrow a method for solving those problems from an outside source.

Administrators in this department chose to borrow and implement the model teaching system developed by the Women's Department of Health, Physical Education and Recreation. This teaching system, using the closed circuit television facility of the university, was a logical choice for leaders in the department. Several factors could be identified that would make this seem to be a reasonable development.

First, the instructional pattern was available. It was already in successful use elsewhere in the department and evidence at this point was mostly in its favor.

Second, the situation seemed to be similar within the department. Problems of teaching HPR 105 for women did not seem to be much different than those problems encountered in the teaching of HPR 105 in the men's department.

Third, an assumption logically made from the second factor would cause the administrators to assume that the system would be transferable with a minimum of dissonance.

Fourth, the system had been tested carefully under a set of rather good controls within the women's department, and such testing would strengthen the case for the system at the men's building.

THE PROBLEM

Little real difference existed, in fact, between the problems of the men's and the women's sections. Essentially they were problems of swelling enrollments and limited financial resources to meet the growth patterns using the traditional systems of instruction.

A second problem, identified by the respondents in the study, was centered around the assignment of large numbers of instructors meeting large numbers of students. Many differences in their teaching patterns and their teaching outcomes were evident. Many did not reflect the philosophy of the department in its entirety, and many were not physically able to meet and lead the six to eight daily sections that were necessary to accommodate all of the students in the required course.

In 1955 a curriculum had been developed in the department. In many respects it was similar to that developed in the women's department. This curriculum was generally accepted by instructors in the department and like the women's course of study was rather concrete in its goals, requirements and course expectations. Better organization within the staff teaching this course seemed to be a necessity.

The department had been watching the women's course as it developed on the closed circuit facility for the year previous to this one. Seemingly, this was the logical direction to take in solving the problem of the freshman HPR 105.

In an attempt to alleviate the two basic problems, the department chose to begin teaching their course of study in 1962. Their plans were systematically coupled with the closed circuit television facility for the major lectures and demonstrations. The basic system of instruction, as used in the women's department, was copied, with some changes in content, and adjustment of certain points of emphasis in the course. Basically, the paradigm that would describe the women's system would equally well define the men's program.

Mr. Herbert Olson of the Men's department was assigned the task of developing the scripts and programs. He was given released time for one quarter (winter 1962) to complete the planning phase of the operation. As in the case of the women's department, he had no previous television experience, and apparently was chosen because he was willing to give it an honest tryout.

EVALUATION

No systematic written evaluation procedure has been administered in the Men's Department. This is the basic difference as far as comparison with the Women's group is concerned.

The assumption has been used that the model developed within the Health, Physical Education, and Recreation Department for use in the Women's freshman course would be effective for the men. Little evidence exists that this is necessarily true, and some sort of evaluative tool should be used to attempt to find out if the assumption is valid.

BUT IS IT A SYSTEM?

The majority of the conclusions reached in the study of the Women's Department would apply equally well in this situation. It is not a system in the sense that it was analyzed and possible alternatives were ruled out or left in the decision making procedures. A true systems approach would have taken a different approach. The same conclusion might have been reached, and the organization channeled in the direction of the closed circuit facility; but more than one avenue or method would have been considered.

In practice, a system of instruction was borrowed from another group within the same department, and the assumption was made that it would work equally well in this new set of circumstances. Evidence gained from oral interviews, questionnaires and discussions within the department from both faculty members and students, would indicate that the system is working reasonably well.

The case for closed circuit television in the Men's Department of Health, Physical Education and Recreation is weakened a great deal, however, by the failure to administer a well developed instrument for evaluation of the television-centered instructional system.

Real evidence of any sort is lacking on the effectiveness of this system of instruction in the Men's part of the Department.

The next portion of this study concerns itself with another department, and another innovation of a different kind and perhaps a different order. Programed learning is the innovation under study and the Natural Science Department is the department under analysis.

CHAPTER IV

PROGRAMED INSTRUCTION IN THE DEPARTMENT OF NATURAL SCIENCE

The development of the programing experiment coupled with the extensive use of programing in the Department of Natural Science in the University College is an extremely cogent study in terms of systems approaches to instruction. In this instance is found the closest thing to a real systems approach to an instructional problem encountered in this study. The relationship of systems thinking and programing is strikingly parallel. In many respects the criteria and rationale for systems study and for programing take the same form.

BACKGROUND

The same problem of enrollment requiring a change in instructional procedures in Men's and Women's

Physical Education was a prominent factor in the Natural Science Department's determination in 1955 to undertake a new method of instruction.

In 1955 Dr. Chester Lawson, Chairman of the Department of Natural Science of the University College, was already probing for answers to the question of maintaining a high level of instruction despite an anticipated flood of students. Predictions were for steadily increasing enrollments with staff becoming harder to obtain. Course standards were not to suffer in the crisis ahead.

Chairman Lawson studied the existing facility for closed circuit television and rejected it as not being suited to the needs of his department. His analysis was that large sections, overhead projectors, amplifiers and some uses of motion pictures would be a superior method to that of using closed circuit television.

Although no systematic pattern was employed to identify and study all available alternatives to meet the challenge, at least the department recognized the obvious assistance which might be gained from television in their pattern of instruction. The "mass media" aspect of television could deliver lectures to many more students than the traditional instructional method. Despite the obvious advantage in "spreading" his best lecturers to more classes, Dr. Lawson was not convinced that television held the answers to the department's dilemma.

It was at this time that Dr. Lawson read something on the work of B. F. Skinner, first publicized in the now well-known article in the Harvard Educational Review.[46]

The potential of programing as a new approach to instruction infected Dr. Lawson, and he immediately began to stimulate others in the department, especially Dr. Mary Alice Burmester and Dr. Clarence Nelson. Studies were begun in the area, and initial experimental programs were written and tested by these Natural Science instructors.

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[46] Burrhus F. Skinner, "Science of Learning and the Art of Teaching," Harvard Educational Review, XXIV, No. 2 (1954), pp. 86-97.

Lawson infers that a natural relationship within the course structure gave the professors a powerful advantage in the programing development. The laboratory sections in the course had been built into a sequential, teacher-directed pattern that was harmonious with the sequential principles of content development in the programing concept. Although the laboratories were not self-directing and did use a teacher to guide the students, they had been developed as step by step, sequential experiences for the students. Thus the step from the laboratory level to formal programing in certain sections of the course was not an unnatural development.

After initial studies in programing theory, the department aligned itself essentially with Crowder's branching (intrinsic) methodology in programing. They did not reject the Skinnerian view, but adopted the branching technique as being more appropriate to the content under study. The department did not want to completely associate itself with the linear (extrinsic) technique of programing, as much of the content of any subject in the university is available to students only in printed form. Library assignments are an important part of all higher education.

Accordingly, the branching method was used as a base, with some linear programing employed in the sub-routines of the programs. Often, introductory blocks of material appeared in a traditional text-explanatory form, followed by a branching program to inject additional concepts or syntheses of information. The first unit written and tested was in Genetics.[47] It was a branching program, bound in a textbook format. Bound programs of the branching type are normally called Scrambled Books.

In support of the problem as identified in this study, Lawson, Burmester, and Nelson reported:

> The Scrambled Book was developed as a possible means of handling more students per staff member by placing greater responsibility for their own learning upon the students themselves. To be acceptable for

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[47] Chester A. Lawson, Mary Alice Burmester, and Clarence H. Nelson, "Developing a Scrambled Book and Measuring its Effectiveness as an Aid to Learning Natural Science," Science Education, XLIV, No. 5 (Dec., 1960).

this purpose, the scrambled book would have to meet these criteria:

1. It should be almost completely self administering, thereby not increasing the workload of the individual staff member even if more students were assigned to him.

2. It must not result in a deterioration of quality of learning on the part of the student.

3. It must be regarded by a majority of both the students and staff members as a genuinely useful and stimulating aid to learning and not as a mere novelty.[48]

Early testing of the genetics material in programed form was reported by Lawson to be exciting and promising. Using a pretest-postest research design, learning gains of 70 to 80 percent were noted by faculty assigned to the sections using the programed material in the genetics unit. An interesting and comprehensive discussion of the evaluation is available in the Science Education article.[49]

In the spring of 1961, ten sections of the Natural Science 181 were involved in an experiment.

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[48] Ibid., p. 354.

[49] Ibid.

Five of the sections used the programed material, and five used the chapters in the regular course manual in introductory heredity.

Two measures of effectiveness were sought. Discernable differences in the level of learning, and the degree of student acceptance were the basic questions to which answers were desired by the experimenters.

So far as learning was concerned, all students in all ten sections were administered a thirty item objective test including reasoning, analysis, interpretation, and the application of what had been learned in the new situation. The T score means and standard deviations are shown in Table 1.

Table 1

Natural Science Evaluation in Unit on Genetics

	Experimental Group (Used Program)	Control Group (Used Regular Manual)
Number of students (n)	144	131
Mean of scores	19.75	17.93
Standard deviation	4.87	4.63
T-test of significance	3.17	

From the table of T values this figure 3.17 gives a significant difference well beyond the 1% level of confidence.[50] The T-value for the 1% level is 2.57 for this data.

The major variable in the above study was the program and it was therefore concluded that the program was the major determinant in the comparative achievement of the two groups. This was evidence that the programed unit on genetics had enhanced the quality of the learning.

A questionnaire was administered to the programed sections and although no statistical treatment was given the responses, indications were that the majority of students preferred the programed instruction over the lecture-demonstration for the genetics unit. It was noted in the report that the majority of those students responding to the program in an unfavorable manner did so in language that was structured in an inferior manner to those that favored the program. The research group infers that those students who read

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[50] *Ibid.*

and managed their language well tended to like the program treatment better.[51] Therefore to succeed in programed learning, the student must read well. This generalization is not new in instruction, but it is interesting to note it in this instance.

Since the initial experimental work in 1959 and 1960 with Genetics, other portions of the Natural Science sequence have been programed and incorporated into the instructional pattern of the department. At this writing most of the material in the first quarter of Natural Science 181 follows the programed format. Something over half of the material in the second quarter and a small portion of the third quarter of the course have been put in scrambled book form.

Further evaluations of the programed approach have continued to indicate strengths of this pattern of instruction in Natural Science. There appears little doubt that the approach used is effective in reaching objectives defined by the department.

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[51] *Ibid*.

One important bit of information shown by departmental studies reports that the attitude of the instructors is significant in student learning results with the programed material. A negative viewpoint on the part of the instructor regarding the programed materials was reflected in the test scores of their students.

The extensive use of programing in the Natural Science Department of the University holds a particular significance. No other institution of higher learning uses in a science department a locally written and tested program as extensively as here at Michigan State. Much credit must be reflected toward Dr. Lawson and his colleagues for writing and testing the materials. Careful attention to most programing principles is evidenced in the application of this idea over a span of several years.

PROGRAMING AND COURSE REORGANIZATION

At the time of this writing, the Natural Science Department of the University College has a serious curriculum revision study under way. New and different approaches to the course are under study. A new curriculum is being developed and decisions concerning the use of the programed materials in the Natural Science Department are expected to manifest themselves by the Fall term of 1966.

The natural direction for the researcher at this point is to institute a line of questioning to find the rationale for the decision to re-structure the curricula of the Natural Science courses. Members of the Department varied widely in their responses on this question. The current study can only reflect this diversity. Though beyond the scope of this investigation, a more thorough analysis of faculty reactions to the programed instruction sequences and of their relationship to the continuing patterns of instruction might be worthwhile.

Some members of the Department, particularly those who were originally involved in the preparation of the programed materials, felt that the curriculum study was triggered by the programing experience. The principles employed by the program writer tend to make him more critical of his objectives and his teaching materials. This could well have been reflected in the department's decision to re-study the courses.

Other members of the Natural Science faculty felt the decision to reorganize the curriculum was not associated with the programing experiment, but was a natural decision made by a department anxious to improve the quality of its course offering.

The Department professors exhibit an interest in returning to a course which is more laboratory oriented. At the present time the course does contain certain laboratory experiences but the pressure of numbers has reduced the laboratory experiences by the student to a minimum. The faculty indicates much interest in incorporating into the course more "wet" laboratory experiences by the students. By "wet" laboratory they mean more individual manipulation of laboratory materials by the individual student. They cite no evidence that the "wet" laboratory, or more laboratory of any kind, is superior to the programed approach employed. In fact, in the face of evidence to the contrary, it seems clear that other unidentified factors must account for the apparent regression.

It would be comfortable for the systems analyst to conclude that the Natural Science Department's experience with programing was the major factor leading to the decision to re-evaluate the course. Not enough evidence of this is present, and so the question must be left open.

IS IT REALLY A SYSTEM?

The Natural Science Department programing efforts come closer to the system paradigm than any of the other examples studied in this investigation.

First, there was a serious look at a number of methods of approaching the Department's dilemma, maintenance of course quality and the physical problem of growing enrollments due to register in the required courses. The Department administrators considered closed circuit television, large lecture-demonstration sessions, and the programed instruction method. It would appear that no financial or cost factors were considered. The inherent properties of each of the different systems of presentation of materials for the course was the determining factor. Instructional system analysis cannot ignore the cost factor, and failure to include such considerations in making the basic decision limits the usefulness of this example in systems analysis.

Secondly, after the decision to use a programed learning approach in the department, a number of professors were charged with the responsibility of preparing the materials. Nothing was commercially available so the materials had to be created. Frame writing, along with continual testing of the frames, was incorporated into the pattern. This procedure follows programing principles in an accepted fashion.

Thirdly, programed materials were incorporated in several units of the three courses. This was done on a gradual basis, and the College Evaluation Services were used extensively to test the results. This does suggest a strength parallel with instructional system thinking, as the use of unbiased outside sources for the testing makes for a stronger set of conclusions in any research experimental situation.

Fourthly, output behaviors, in terms of the course goals and objectives were identified and constantly evaluated. This is also a strong compliment to the department and those interested in the programed learning experiment.

THE FUTURE OF PROGRAMED INSTRUCTION

THE NATURAL SCIENCE DEPARTMENT

The future of programed learning in the department seems in some doubt. Despite rather convincing evidence that the experiment was a success, in terms of its ability to teach, and the fact that most students liked the system, much concern is observable concerning the possible use of the technique after the department makes basic decisions on curriculum reorganization in the next few months.

A number of factors can be identified from the interviews. There is no way of placing a scalar value system on these, but in the opinion of the author, they are organized in approximately the rank order of their value, from the least likely to the most likely of the factors causing the department to consider leaving the programing system.

1. Programed learning, like many other educational innovations of the past century, is a fad. And, like most fads, it is fading and will not be an influential factor in the future. This feeling was evidenced in a limited manner, and is the least defensible of the reasons advanced for the abandonment of the programing system.

2. Innovations always generate reaction patterns that tend to neutralize their effectiveness. This could be a valid observation within the department, but is discounted to some degree by the observation that much interest in various types of innovative systems is present in the department.

3. Staff turnover makes it impossible to keep an instructional staff that is knowledgeable in programed learning. There is no question that this department shares the major problem of

large departments on all university campuses. Growth alone requires many new staff members every year, and the pirating of instructors in higher education increases the severity of the problem. Most replacement staff members are not trained in teaching with programs. Thus a considerable amount of time and energy are necessary to train them for effective work within the department.

4. A change of administration within the Department has occurred during the programing experience. Any change in administration will evidence, to a degree, a change in organizational interests and goals. One of the realities of the situation that must be recognized is that leadership of the programing experiment, and of the department, rested primarily in a single individual under the former chairmanship. The new chairman has no "vested" interest in programing. He does not evidence any tendency to get rid of it for the sake of change itself,

but neither does he evidence any bias in favor of it. No condemnation or support is inferred by this suggestion of the report, but it is a factor in the study of the innovation.

5. Programed learning experiments do not fit the traditional university lecture-recitation-laboratory pattern found in the science departments of "academically respectable" institutions over the country. This factor is related to the others in many respects, but is without a doubt a basic cause of the problems encountered with this innovation.

6. Closely related to the fifth section of this phase of the report, but much more pragmatic and perhaps at the heart of the problem is the "Time Block Barrier." Programed learning has a number of criteria which differentiate it from other methods of instruction. One of the basic ones is individual pacing which is necessarily a part of it.

Real programed theory (as well as real systems theory) designs the system to meet the objectives, and when these objectives are reached, the system is concluded. On the other hand, most instructional course offerings are designed to fit into a block of time made available within the regular university schedule.

No adjustments were ever made in the department to insure students the advantage of individual pacing. Failure to allow for program flexibility could conceivably lie at the feet of the University or the Department. It is not important where it lies, but failure to include flexibility in the schedules of students taking the programed units could hypothetically be at the base of the possible failure of the experiment.

The programing experiment has not been written off as a failure by most of the instructors and professors interviewed. Most felt that in some manner, in some way or the other, the experience gained in the system would be used in the curriculum revisions of the future.

There is no question that the Natural Science Department stands at a crossroads. Which direction they choose to take, and to what degree the programed learning experience will influence this direction remains to be seen.

CHAPTER V

CONCLUSIONS AND SUGGESTIONS FOR RESEARCH HYPOTHESES NEEDED IN INSTRUCTIONAL SYSTEMS DEVELOPMENT AT MICHIGAN STATE UNIVERSITY

The growing edge of knowledge is reflected as much by the ability of the scholar to ask questions as to find answers. Indeed, the solution of many of the problems perplexing man is not really possible until the proper and precise questions are raised. The purpose of the final chapter of this investigation is to review briefly the study, and then proceed to raise some valid questions.

SUMMARY OF THE STUDY

Purposes The study was designed with three basic purposes under consideration. First, a description followed by a definition of an instructional system model was developed. Secondly, two case studies of departments at Michigan State University were undertaken with the objective of matching the findings in the case studies with the instructional model. Thirdly, after the matching of the case studies with the instructional systems model, similarities and dissimilarities were observed and analyzed. The resulting comparison led to the generation of suggestions and testable hypotheses needing study.

<u>Prodedures</u> Five basic approaches were used to develop the investigation. First, the problem was discussed and the terms were defined. Secondly, the literature on general systems theory and on instructional systems approaches was surveyed. Thirdly, a model instructional system was developed from descriptions and definitions developed in studying the literature. Fourthly, two basic case studies were undertaken in the Department of Health, Physical Education and Recreation and in the Department of Natural Science. Recent major innovative techniques used in the departments differed and were studied as possible sources

of data of interest to instructional systems theorists. Lastly, a number of conclusions and hypotheses were suggested as a result of the investigation.

Findings Along with abstract analyses, the descriptive dissertation has the function of raising questions worthy of further investigation. In terms of instructional systems development at Michigan State University as observed in two major departments, this investigator raises several pertinent questions. Answers to these questions could contribute materially to future systems efforts toward solution of instructional problems at this University. At this point consideration will be given to a discussion of these findings.

For purposes of differentiating between these suggestions, they are classified as primary and secondary suggestions. No value position is suggested in this division, but rather a difference in the breadth and depth necessary in designing studies of the two levels. More time and energy would be needed for quality studies in the primary area than in the secondary area. They may be of equal importance so far as their production of new information and knowledge is concerned.

PRIMARY QUESTIONS

<u>A Comparative Evaluation</u> Neither of the two cases studied in this report can be classed as a true system within the framework of a concrete instructional systems model. Each evidence some features of an instructional system, and both have been analyzed in that light.

<u>Contrast of Media</u> One of the interesting questions remaining unanswered in the study is the comparative difference observed between that quasi-system employed by the Department of Health, Physical Education and Recreation (using the closed circuit television system as its chief instructional tool), and that quasi-system employed by the Department of Natural Science (using a programed learning approach as its chief instructional tool). No direct comparison

can be made between the two different systems, but one interesting point can be raised.

Evidence would indicate that the system employed in the physical education classes has gained wide acceptance and seems to have become an accepted pattern of operation. Nowhere was there any indication that the system would be abandoned or that the department might choose to return to the teaching system employed before the innovation.

In the Natural Science Department there exists a different situation and there is a chance that the programing innovation will be abandoned. It seems to be generally felt among the respondents that it will become a less important instructional factor in the future, if it is not abandoned altogether.

What hypotheses can be generated that might account for this divergence?

A. The nature of the subject matter is at the heart of the observed difference. One is a skill training situation and the other is an intellectual mastery situation.

B. Are professors of physical education more adaptable to innovation than professors of natural science? This could very well be studied and appropriate innovation scales used to test this hypothetical difference.

C. Could administrative patterns, or personalities, be at the base of the difference? A study of the administrative networks within the two departments could assist in answering this question. Certainly leadership is important in any social organization and an intensive study of the administrative structures of each department could be fruitful.

D. Is teaching with closed circuit television superior to teaching with programed learning? Certainly no conclusions can be drawn from the present study pertaining to this question. Research evidence proves either system to be legitimate. Despite the fact that this might seem to be an "apple and orange" question comparing different fields, this is exactly the question the system designer must face. Carroll suggests:

> The preparation of instructional materials and teaching procedures is a task that requires countless decisions. It is not possible to base all of them on directly relevant research findings; intuitive guesses, based both on experience in teaching and on psychological theory, must be made at every turn.

As instructional system principles and theory are developed, an increasingly scientific methodology can be utilized to make important systems decisions. It is necessary for the systems analyst to make decisions of the programing-television nature as carefully as possible. No amount of avoiding the question can suffice, for the decisions will be made, if not on sound systems and instructional

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[52]John B. Carroll, "An Analysis of Reading Instruction: Perspectives from Psychology and Linguistics," Theories of Learning and Instruction: The Sixty-Third Yearbook of the National Society for the Study of Education (Chicago, Ill.: The University of Chicago Press), p. 353.

principles, then on a political or chance basis. Much research needs to be pursued on the vital decision question.

E. Are evaluation systems adequate for studies of the kind reported? Both the Women's Health, Physical Education and Recreation Department, and the Natural Science Department seem to have used carefully-written, well designed systems of evaluation on their programs. It is possible that these two subjects lend themselves to accurate evaluative techniques better than other academic disciplines. Testing procedure in both studies seem to be legitimate.

Perhaps the challenge of the instructional systems designer is to identify that set of conditions under which closed-circuit television is a superior method of teaching compared with other available systems. Furthermore, the challenge might be to identify that set of conditions under which any given procedure is a superior method of organizing instruction.

Identifying these sets of conditions might be a fruitful area for future studies. Sound generalizations could be of inestimable value to instructional learners in all kinds of educational institutions.

The Equifinality Problem Another major conclusion of this study is that the concept of equifinality deserves further study. The systems approach implies decisions between alternative systems. If such decisions are to be efficient, then the question of equifinality, essentially that of "equal systems," requires the questioning of certain commonly held assumptions.

Is it possible to have equally good instructional systems in terms of operational goal identification and behavior patterns, and equally good in terms of financial or energy costs?

The hypothesis that the condition is true should be carefully investigated. This means more than simply a time and motion study, but rather a systems approach to the whole area of instructional design.

Instructional Systems, Remodel or New There are two basic approaches to instructional improvement in public education. If the system theorist is concerned with instructional improvement as well as with financial advantage, he must come to grips with all pertinent factors involved in the improvement of instruction.

The first approach is the more obvious. This is stated as a "new system design" problem. All vestiges of the old system (regardless of its effect upon the students involved), as well as the culture within which it operated, would be scrapped and replaced with a new system of instruction.

Advantages of the system approach are many. Old ideas sometimes die hard and the social situation operates more effectively if the cut is clean and complete. Evaluation is easier if there is no contamination of the new system with the old. Such an approach is occasionally found in industry when planning is undertaken for the production of a completely new product.

Describing parameters and inputs, and measuring outputs with a greater degree of accuracy is possible if the system is new and if the organization is able to operate within this framework. It is somewhat analagous to moving into a new school building. The plant is new and in order to operate it to its fullest efficiency within the context of its design, the old materials and furnishings might better be replaced, as well. Carried to its logical but impractical extreme, this principle would require that the old administration and teaching staff should also be replaced.

Given a set of conditions describing "all things being equal," the instructional system designer could well hope for the opportunity to build a model instructional system within the parameters described above. This would be the easier way to design instructional systems, and indeed, it is possible under certain circumstances. For example, the educational institution that is growing rapidly must develop new programs that do not necessarily have to be coupled with older programs. School districts opening many new schools in new sub-divisions each year might enjoy the hypothetical advantage of completely new systems and personnel.

In most respects, however, it is not possible to design completely a new system from a set of basic descriptions without making provision for some contaminating factors from the old. In the first place, the staff that must operate the system must be drawn from already existing school systems and will inevitably be influenced by its past experience. Materials cannot be developed from scratch, and when the commercial producers of books and materials enter the system, another limitation is introduced which must be manipulated by the system designer.

The hypothesis therefore is that the instructional system designer should concern himself primarily with models and patterns of the "remodel or renovate schema" of system thinking. In a word, best results will normally be obtained by modifying existing accepted patterns of instruction. This reinforces what others have concluded, but the important distinction in this instance is that the innovation be developed to fit the <u>problem</u> rather than to fit an existing instructional capability. It is suggested that the latter is the usual pattern of innovation instituted in public education.

Perhaps a fruitful study of this double-edged problem could be made. Does the system designer organize his recommendations to fit a given and unique problem and set of circumstances? Or does the system designer manipulate the circumstances and the problem to fit into an accepted method of instruction? It is reasonable to suggest that systems analysis, to be optimally effective, must be able to encompass a variety of alternatives including some which may be radically different from existing patterns. The fact that they are radically different may preclude their actual adoption, but without the freedom to propose radical solutions the system designer can only, in effect, put new wine into old bottles.

Instructional Resources and Systems Design

Michigan State University has provided many instructional resources for departments of the University to use in planning programs of instruction. Typical of these are an audiovisual center with major production and service units, and a closed circuit television facility.

The instructional systems approach cannot be considered seriously without adequate support facilities. For real instructional systems to be possible, a sufficient number of trained systems analysis personnel must be available at the resource facilities.

The major flaw in the present support facilities is their differing administrative methods and policies. For example, the closed circuit television facility is available to departments without cost to the budget. Most other resources must be paid for at cost by the department requesting them. The history of these support facilities is different and the resulting inconsistency in operational policies is a major deterrent to effective system design with respect to media use. Economics of the department budgets appear to be a major factor in decisions to use or not to use certain resource facilities.

It is suggested that the University should make services and support facilities available to instructional programs in terms of need rather than in terms of departmental ability to pay. Until this is done, decisions will not be made in terms of instructional efficiency, but rather in terms of budget availability. It is doubtful that true instructional system patterns can develop until unbalanced cost factors are removed from departmental consideration in the use of university resources.

The Function of the Teacher If genuine instructional systems philosophy is to be incorporated into school curricular patterns, the role of the teacher will have to be seriously studied and redefined.

It would appear necessary, for example, for the instructor to move away from the traditional role of the lecturer-demonstrator and toward the functions of a planner and manager of instructional experiences. Instructional systems require planning, careful coordination and precision in execution. The human factor makes it even more important that the role of the teacher be increasingly that of a leader and organizer. To accomodate the new role of the teacher, it appears that current concepts and methods of teacher education will require fundamental and possibly extensive revision.

In the preparation of teachers to manage instructional systems, as well as in the re-training of teachers in service, the instructional systems planner must recognize that change in procedures is seldom effected from the outside. Rather, the training program must recognize that until teachers themselves decide to implement new patterns of instruction, real change will not take place.

Both in a democratic society and in modern educational institutions, good ideas frequently do not realize their potential because of inept introduction or failure of those in responsible positions to recognize the requirements of effective innovation. People change, but people are not changed.

Consideration of the above factors suggests that as instructional systems studies are pursued within existing patterns of education, parallel studies are needed in how higher institutions of learning can prepare teachers to function effectively and comfortably within sophisticated instructional systems.

The Necessity for Open-Ended Systems Instructional systems designed to use in given instructional situations must remain open-ended. There is an inherent danger in using the systems procedure in the instructional process and the system designer must recognize it. It is a problem similar to that faced by systems designers in the military, in science, or in industry. The easy method is to design a system in terms of quite limited boundaries and to omit factors that are not easily controlled. Building overly restrictive limits into a system tends to create an organizational pattern that does not provide for innovation within itself.

The pages of history are replete with the tragedies of social systems which proved incapable of adapting to changing demands. An integral part of effective system design, therefore, is a built-in capacity for constructive change. In this sense, a major function of any system is to lead in the direction of better and more effective systems.

It is important to state that a major recommendation of this study is that the instructional systems planner should approach the problem very carefully, in order not to trap himself in a "closed" network. Instruction is a process of inducing change and this process must necessarily be a part of any legitimate instructional system.

A Team Approach to System Development Leadership in instructional system development may come from a number of sources. Such leadership may well come from the instructional media or audiovisual technologist where he has had appropriate preparation and experience. It may come from alert administrators, curriculum directors or other educational planners with the requisite vision, capabilities, and positions of responsibility.

Regardless of the source of the leadership in systems planning, a major effort is not possible unless a team approach is used for solving the problems needing study in instructional systems development. Specialists are necessary from subject matter areas, from psychology, from curriculum areas, from evaluation services, from instructional media centers, and strong support is necessary from the administration. No one individual is likely to have all of the training and knowledge necessary for the task and could not function in isolation if he had. The effective media generalist is among those most likely at this stage to generate interest and initial action in systems since he is by nature an innovator with broad competencies, leadership qualities, and a primary concern for the improvement of teaching and learning.

SECONDARY SUGGESTIONS FOR STUDY

Within each of the three departments studied can be found problems which are in need of research of a practical type. None of these is difficult to design or administer. In the conduct of the present study certain important questions could not be answered because of the lack of information which studies of the types suggested below could provide.

Women's Health, Physical Education and Recreation Two studies would provide additional information useful for the administrator and essential for a system analysis of the department.

A. A careful comparison of the cost factors operating in the television experiment should be made. Information is necessary on the real costs of using the closed-circuit television facility, including both the costs to the university of the television system and the costs to the department to produce the television demonstration tapes. Staff people should be able to compare these costs with costs of other forms of instruction as one important factor in administrative planning and systems development. Accurate and comparable information of this nature is not currently available in this or in most other institutions of higher learning.

B. A study of the administrative pattern within the Department of Women's Health, Physical

Education and Recreation should be undertaken. It is suggested that the success of the innovation discussed is reflected from this pattern. Such success in innovation patterns is rare enough to warrant a search for the key. A trained administrator from education, sociology, or political science should design and conduct this study.

Men's Health, Physical Education and Recreation Two suggestions for further research are made with respect to the use of instructional television in the men's basic physical education classes.

A. A serious evaluation study of the televised course is indicated. Although patterned after the women's program, there is little evidence that the system works as effectively with men as with women. It is suggested that an initial study be made of the evaluation pattern used in the women's department, and that an evaluation of the experiment within the men's department be designed. This study should be of greater precision than the comparable study used by the women, for the initial study by the women's department suggests certain improved techniques that might be used.

B. Some evaluation should be made of the apparent assumption by the Department of Health, Physical Education and Recreation that the same instructional system is equally valid for both men and women at the freshman level. While no evidence is currently available that this assumption is either true or false, it is possible that the assumption is valid. Evidence on that point is sufficiently important from both administrative and system analysis standpoints to warrant early investigation.

<u>The Department of Natural Science of the University College</u> A number of questions are raised in Chapter IV concerning the programing experiment in the Natural Science classes. Many are of an administrative

and policy nature, but should be considered in detail if the department is to make major changes in course structure.

The major question that is open to hypothetical testing is the use of the programed learning sequence within the department without provision for changes in timing and scheduling. Universities operate on time and schedule blocks, but one of the basic tenets of programing is broken if the students cannot maintain their own pacing, and are forced into predetermined time schedules.

It is suggested that until the programed material is used with substantial groups of students, without limitations in either direction (minimum time required or maximum time allowed) in their completion of the material, that the rather extensive evidence collected in the programing experience will not have sufficient validity for major decisions.

CONCLUSIONS

The technological approach to the problems of instruction in this generation cause concern to many educators. Demonstrated success with instructional approaches of the type discussed in this study have been made in the armed services and in industry, but not, to the present time, in public education.

The problems of the university, and in most respects, of all of public education, are not identical with those of industry and the military. Yet, there are many analogous situations in which teaching-learning patterns in public education are no more complex than some of the systematically organized learning situations in non-school agencies.

Equalization of Educational Opportunity At the base of almost all of the crucial issues in American education today is the problem of providing an adequate education for all of the children and young people of this nation.

The American educational system, developed over many generations, evidences much strength and has done a better job of education for all than mass education attempts elsewhere in the world. But the unfortunate fact remains that the system as it now exists misses many youngsters entirely, and does a partial job on many others. This waste of individual talent is a loss that our culture cannot afford.

The problem is deeper than that of resource allocation. Certainly Americans have evidenced a willingness to appropriate a reasonable share of their national income to education of the young. Substantial increases in these resource allocations could help solve the problem of meeting all of the needs of all of the youth capable of educational opportunities.

The professional educator is not excused from exploring new and better methods of using the resources currently available to education. New ideas and innovations must be considered and integrated into the educational patterns of this country.

<u>Educational Systems and the Educational Establishment</u> Professional educators have an inherent obligation to study and experiment with any reasonable approach to the solution of the great problems facing education today. Failure of the profession to undertake serious and concentrated efforts to analyze and

resolve its problems would constitute abdication of its professional responsibilities. The magnitude of those problems is such as to require fundamental rethinking of the schools' role and of the methods by which its goals are currently sought.

The nature and scope of systems analysis and of the systems approach are such as to be peculiarly well-suited to attacking massive problems in industry, the armed services, and in government. There is good reason to assume a comparable applicability to the problems of education.

SUMMARY OF RECOMMENDATIONS

The following recommendations are summarized as a result of this study of incipient instructional systems development at Michigan State University.

Primary Recommendations

1. Systems of instruction differ and inferences can be made that outcomes of these systems will also be different. Controlled experiments

should be designed to compare different approaches to similar problems of instruction. An investigation to explore those criteria under which one or another method of instruction is superior would yield valuable information.

2. The equifinality problem, differing systems using the same resources and reaching the same goal, should be explored. Experimentation should be undertaken with similar groups of students using similar instructional systems to determine whether the same goals are reached in the same manner.

3. The instructional system designer must face the basic problem of deciding between developing a new instructional system or amending an old system. A study to identify those conditions under which either of these approaches is superior is indicated.

4. Instructional resources at Michigan State University should be equalized in terms of costs to academic departments. Instructional decisions are currently being made that are influenced to an unreasonable degree by costs rather than by instructional factors.

5. The role of the teacher and the teacher education program should be studied in light of the systems approach. Present methods are inadequate to prepare teachers to use systems analysis as a tool of instruction. New courses and patterns of educational offering should be designed, with the role of the instructor more analogous to that of the planner of instructional experiences. More administrative theory is indicated as legitimate within the sequence. In addition it is suggested that teacher training programs recognize that innovation is not effectively imposed from without, but rather must take place from within. Educators must become convinced of the values of systems

building, for imposition of a structure from without has little chance of success.

6. A major suggestion of this study points to the importance of designing instructional systems with built-in flexibility or propensity to change. Systems must be designed in such a manner that they can modify or replace themselves, with a minimum of difficulty when further innovation is necessary.

7. A team approach to instructional system development is essential to its success. The educational media generalist by nature and in some instances by specialized preparation is in a position to assume leadership in systems thinking and to play a central role in its application to education. The creation of effective instructional systems designs, however, will require the combined best efforts of specialists in learning, evaluation, academic content, organization, methods, media, and administration.

Secondary Recommendations

1. It is proposed that two relatively simple studies be made in the Department of Women's Health, Physical Education and Recreation.

    a. Studies should be made of the real cost of the closed circuit system used by the department. These figures should be compared with cost factors using a traditional instructional pattern within the department, and hypothetically with other systems of instruction that might be designed for the department.

    b. An analysis of the administrative and personnel patterns within the department is suggested.

    The innovation reported in this study has been highly successful. A study in greater depth is needed to identify and evaluate the factors contributing to its success.

2. It is proposed that two studies be made in the Department of Men's Health, Physical Education and Recreation.

a. An evaluation of the entire program is suggested. This has not been done by the department and is needed to reinforce their decisions or to indicate necessary changes in their decisions.

b. A study is needed of the basic assumption that the same general system used to instruct women in the department is equally effective in instructing men. Evidence on this assumption is lacking.

3. In the Department of Natural Science of the University College, a number of inferences are made concerning the status of programing in the department. A study in greater depth is suggested with the specific recommendation that the department experiment with the existing programed materials without limiting students to the conventional university 50 minute period.

APPENDICES

APPENDIX A

INTERVIEW SCHEDULE

April 8, 1964 ... Miss Jean McIntyre, Department of Health, Physical Education and Recreation for Women.

May 26, 1964 ... Mr. Herber Olson, Department of Health, Physical Education and Recreation for Men.

May 21, 1964 ... Dr. Chester Lawson, Department of Natural Science of the University College.

May 28, 1964 ... Dr. Mary Alice Burmester, Department of Natural Science of the University College.

May 26, 1964 ... Dr. Clarence H. Nelson, Department of Natural Science of the University College.

Additional information was made available to the author by Dr. John Barson and Mr. Russell Hornbaker of the Instructional Research Project at the Michigan State University Audiovisual Center.

In addition, approximately two dozen undergraduates enrolled in the courses under study were interviewed.

APPENDIX B

DEVELOPMENTAL SYSTEM INTERVIEW FORM

I. What personnel were involved?

1. From administration?____________________
2. From teaching faculty?____________________
3. Specialists?____________________
4. For production of materials?____________________
5. Other____________________

II. <u>General Decisions</u> <u>Made by</u>?

1.
2.
3.
4.
5.
6.

III. What inputs were specified?

1.
2.
3.
4.
5.
6.

IV. What outputs were specified?

1.
2.
3.
4.
5.
6.

V. What provisions were made for feedback or evaluation of the objectives?

1.
2.
3.
4.

VI. What recommendations would you make for improvement of this process?

APPENDIX C

INSTRUCTIONAL SYSTEMS INTERVIEW RECORD

Data Form:

Course (title)__________________________Credits____Prereq.____

College________________________________Terms Offered_________

A. Operation

1. Schedule (see Form 2)
2. Classroom procedure (significant features)
   ____
   ____
   ____
   ____
3. What revisions have been made in the system (short of redoing the entire system)?________________
   ____
   ____
   ____
4. Are any class hours released for independent study?____________________
   Hrs.________________________

B. Machines

1. Types______________________
   ____
   ____
2. Operated by________________
   ____
   ____

C. Personnel

1. How many instructors?____
   Hrs/wk (in days)_________
2. How many assistants?_____
   Hrs/wk (in class)________
3. How many students?_______
4. How many technicians?____
   Hrs/wk (in class)________

D. Instructional Materials

Type	Alone	With Teacher	No. Used Term	Facility

E. Benefits

1. What are the advantages of the new program?____________________
   ____

APPENDIX D

OUTLINE FOR ANALYSIS

Based upon the system definition and the paradigm developed in Chapter II of this thesis, the following general outline was followed in the analysis of the three departments of the university.

1. The nature of the innovation
    a. Reason for its inception
    b. Planning phase
    c. Staff time in the system planning
    d. Media and support facilities used, considered
    e. Materials under consideration

2. Input Stage
    a. Faculty and staff in the operating system
    b. Student populations
    c. Materials of instruction
    d. Media of instruction

3. Operations Stage
    a. Student opinions in the system
    b. Faculty and staff actions and/or interactions
    c. Changes in the system as a result of the on-going process (feedback)

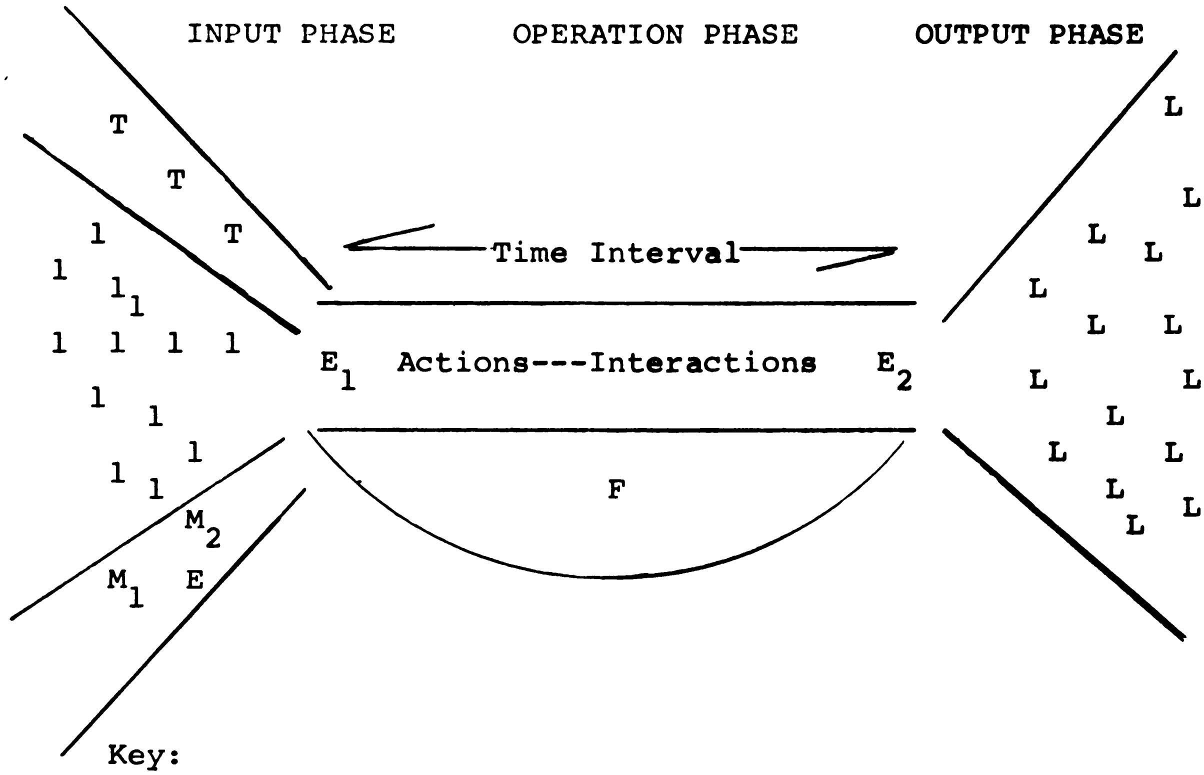
4. Output Stage
    a. Degree of concreteness of goals and objectives
    b. Student Evaluations, pre and post
    c. Student opinions--after the operations phase
    d. Staff opinions

5. General Observations
    a. Relative success/failure of the innovation
    b. Administrative support within the department
    c. Administrative support outside the department
    d. Economic factors and the problem of efficiency.

APPENDIX E

AN INSTRUCTIONAL SYSTEM

SCHEMATIC PARADIGM



Key:

T--Teacher or teachers
1--Students (learners)
M_1-Media
M_2-Materials
E--Environmental factors

F--Feedback Loop
L--Students (Learners)
E_1-Evaluation, major
E_2-Evaluation, major

Note: M_1 and M_2 are generalized conceptions of Media and Materials, encompassing the instructional methods inherently necessary when they are inputs into the system.

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