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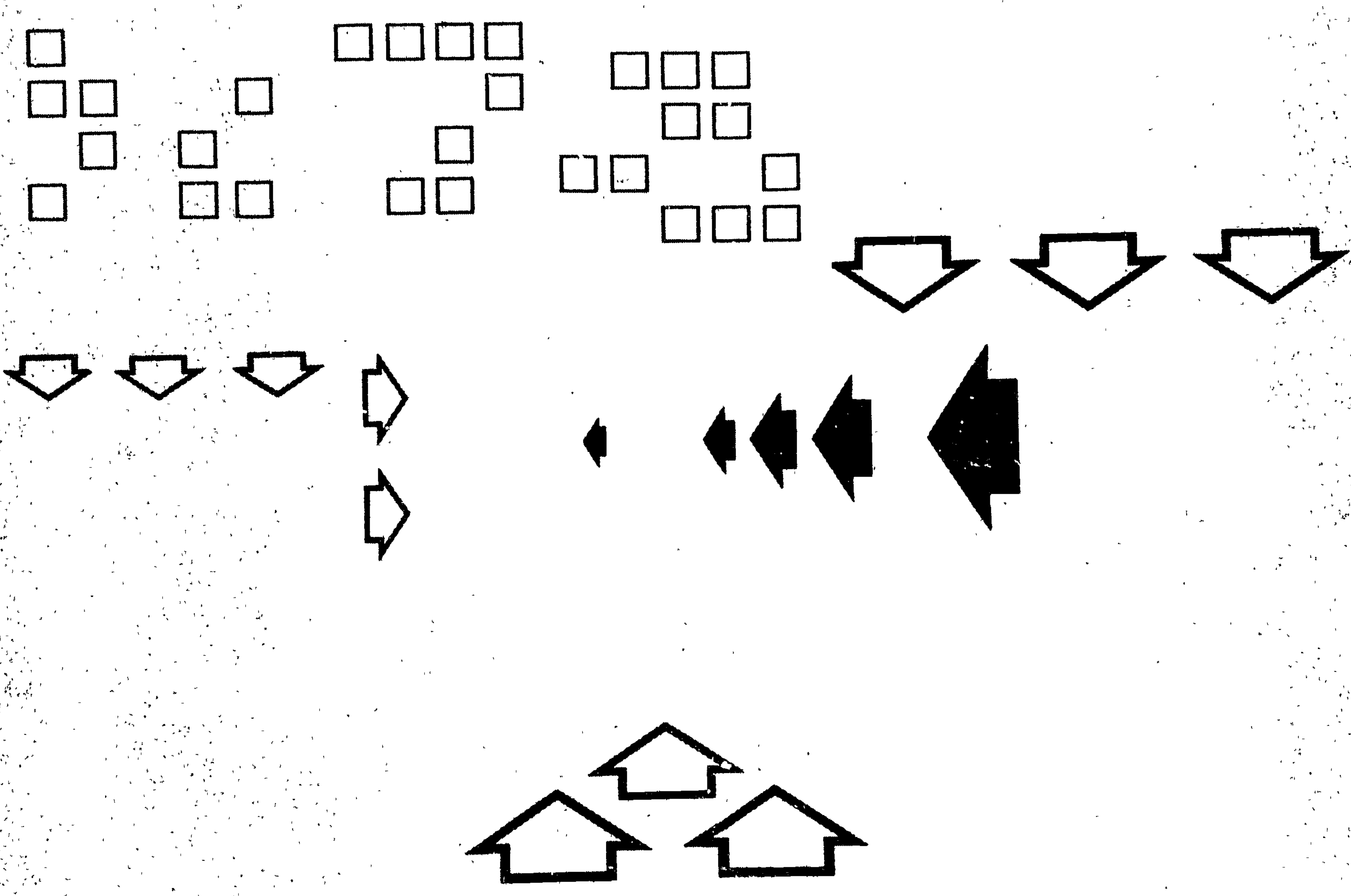
ABSTRACT

The purpose of the 2 1/2 day seminar held in July 1967 was to develop a systematic procedure for evolving long-range research plans in distributive education. The 12 participants included national leaders in distributive education and resource personnel representing educational research and the behavioral sciences. Papers presented in the report include: (1) "Some Problems of Design for Educational Research," and "The Development of a Matrix in Distributive Education Research," by William W. Farquahar, (2) "A Strategy for Psychological Research," and "Planning the Research Program," by William D. Hitt, and (3) "Development of a Research Matrix for Distributive Education," by Neal E. Vivian. (JK)

LEADERSHIP SERIES NO. 22

# A PLAN FOR RESEARCH IN DISTRIBUTIVE EDUCATION



## REPORT OF A RESEARCH PLANNING SEMINAR



THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION
THE OHIO STATE UNIVERSITY
1900 Kenny Rd., Columbus, Ohio, 43210

*LEADERSHIP SERIES NO. 22*



FINAL REPORT
ON A PROJECT CONDUCTED UNDER
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# A PLAN FOR RESEARCH IN DISTRIBUTIVE EDUCATION

## REPORT OF A RESEARCH PLANNING SEMINAR

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The Center for Vocational and Technical Education
The Ohio State University
1900 Kenny Road
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NOVEMBER 1969



U. S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE

Office of Education
Bureau of Research

# PREFACE

In July of 1967, The Center sponsored a research planning seminar in distributive education. Participating in the seminar were national leaders in distributive education and resource personnel from educational research and the behavioral sciences. While the primary purpose of the seminar was to develop a systematic procedure for evolving long-range research plans in distributive education, it is believed that the mode of attack and strategy has relevance for other areas.

During the two and one-half day meeting, several papers were presented to the group. This report is a compilation of the papers utilized during the seminar. We believe they will be of use not only to distributive educators, but to personnel in other areas of vocational education as well.

Recognition is due Neal E. Vivian and Edward T. Ferguson of The Center staff for their contribution to the development of the report.

*Robert E. Taylor*

Director
The Center for Vocational
and Technical Education

# INTRODUCTION

A review of the research in distributive education compiled in 1966[1] revealed research in this area to be almost entirely descriptive in nature. The reviewers were able to locate only one experimental study and one comparative study in distributive education. A narrow scope of research also proved evident, with 75 percent of the studies reported being concerned with four major areas: examination of teaching methods, guidance and personnel services, curriculum, and evaluation. Relatively little treatment had been given to areas such as teacher education, philosophy and objectives, facilities and equipment, administration, supervision, and instructional materials.

It would be fair to say that slow progress has been made regarding research in distributive education and that the vast majority of research completed over the past 30-odd years has been narrow in focus, confined to minor problems, and, for the most part, local or regional in scope. Further, almost no effort has been made to coordinate research in the field or to direct research resources to problems of major significance.

Although the quality of descriptive research has shown great improvement over the last decade, it is obvious that distributive education cannot expand and improve on the strength of this form of research alone. A major effort must be made to conduct a variety of types of research that will add to knowledge in the field as well as evaluate existing beliefs.

The effort to enhance research achievement in distributive education would be facilitated if major problem areas were identified and research were established. The resulting structure could be useful to individual investigators and make possible the coordination of research resources from institutions and agencies across the nation in a focused attack on specific problem areas. Coordination of agency and institutional research resources might be accomplished through existing state and university structures by an appropriate national agency.

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[1]Meyer, Warren G., and Logan, William B., *Review and Synthesis of Research in Distributive Education*, The Center for Vocational and Technical Education, The Ohio State University, Columbus, 1966.

# CONTENTS

# RESEARCH PLANNING SEMINAR

## SEMINAR OBJECTIVES

A research planning seminar was held at The Center during July 1967 with the purpose of formulating long-range plans for research development in distributive education. Three objectives of the seminar were:

- To discuss the present status of research in distributive education.
- To establish research priorities in distributive education.
- To develop a framework for long-range planning of research activities through a research matrix.

## SEMINAR OVERVIEW

The seminar was conducted on the premise that critical problem areas and research priorities could be identified by a group of leaders in distributive education and educational research. These leaders, not only familiar with the problems of distributive education, but also competent in research, would propose research priorities and develop a matrix which could facilitate long-range research planning based upon estimated priorities and availability of funds. To this end, members of The Center's Distributive Education Advisory Committee joined with other educational research consultants and with The Center staff in a two and one-half day meeting. (See Appendix 3 for seminar participants.) Several background papers, presentations, and other materials were made available to the group prior to the seminar. The following papers were selected for inclusion in this publication to provide a rationale for, as well as a better understanding of, the suggested distributive education research matrix presented in this report.

# PAPERS RELATING TO THE SEMINAR

# Some Problems of Design for Educational Research

*WILLIAM W. FARQUHAR*

Michigan State University

It seems to me that the major problems of educational research design are related to 1) theory development, 2) oversimplified designs, 3) manipulation and control of variables, 4) adequacy of criteria, 5) ethics, and 6) funding.

## THEORY DEVELOPMENT

Some educational researchers have few problems with theory because they dismiss it as unnecessary. They contend that as facts accumulate, theory will evolve to explain them. Furthermore, they maintain that the rush to develop theory and the seeking of verification only prejudices the researcher's inquiry. Others maintain that theory in the social sciences is so loosely constructed that it has limited value in explaining empirical phenomena.

The case for the use of theory as a research base rests on its 1) explanatory, 2) interpolation-extrapolation, and 3) heuristic value.

If the educational researcher decides that he will use theory to build models and generate hypotheses, he faces the problem of choosing which theory. In educational research, ultimately, the individual is the unit of study. The researcher may choose to emphasize only one aspect of the individual, but he cannot forget that the variables being studied are constantly being modified by other aspects which the theory may ignore. In short, he has a complex set of variables to consider. For example, when the researcher employs learning theory largely borrowed from psychology, he usually ignores the cultural aspects of the child's background, which might explain his results equally well. Every theory magnifies certain variables, oversimplifies others, and completely ignores others. The net effect is that the educational researcher is always left fretting over his lack of closure in interpreting research results.

The researcher who attempts to use theory as a guideline for hypothesis generation and testing encounters a number of problems. For most social science theories, constructs are not sufficiently defined so that many intervening variables can also account for the research findings. Often we oversimplify by defining single traits or characteristics and ignoring the relationships which exist among other constructs and those we feel are important. That is, one might predict "x" from "y" providing "all other things being equal" and "j" or "u" did not also occur. We have been extremely limited in providing information about the "j's" and the "u's."

## OVERSIMPLIFIED DESIGNS

The most common error evidenced in educational research is assessing complex acts (such as teaching or counseling) with rudimentary designs. It is a safe generalization to say that certain techniques work for certain individuals with certain personalities. The generalization holds for both the experimenter and the subject of the experiment. Yet rarely does the research design take this aspect of human beings into account. N subjects are subjected to treatment X from experimenter Y with disappointing, non-significant results. We would not think of doing such a thing in our daily living, but somehow this is all forgotten when we design a research study. A relevant, but not directly related, article to the field of education by Kiesler (1966) neatly delineates the above problem.

## MANIPULATION AND CONTROL OF VARIABLES

Once the researcher passes, for the moment, the theory stage, he is faced with the practical problems of 1) selecting adequate samples and 2) defining a plan of action which will randomize chance errors, minimize or assess the effects of systematic errors, and maximize the chances that "x" is actually functionally related to "y." An excellent guide to many educational design problems can be found in the recent publications of Campbell and Stanley, *Experimental and Quasi-Experimental Designs for Research*, (1966).

### SAMPLE SELECTION

At some point the educational researcher has to decide how big his sample will be. The problem becomes one of juggling cost, available sample, representativeness, and the researcher's conservative-grandiose tendencies. As you are well aware, the most common fallacy is the assumption that big samples are good samples. (See Appendix 1 for Sampling Chart.)

MINIMUM LIMITS

There are some minimum limits that educational researchers try to keep in mind. In classical experimental studies, it is nice, but not absolutely mandatory, if the smallest sub-class for any one sample hovers around 30 individuals. This observation is a "seat of the pants" rule developed by reading probability tables backward, attempting to find points on the curve where the relationships between sample size and difference-error ratios become linear. Of course, the above minimum limit is based on classical theory. Controlled laboratory experiments in which the researcher begins with a sample of one are also feasible. Once the researcher has found techniques which work for that one person, he can then increase his sample size sequentially, specifying which treatments are appropriate for which individuals under a given set of conditions.

For factor analytic studies, we strive for minimum samples of around one hundred simply because experience indicates that the raw data coefficients of factor analyzing begin to stabilize with this size of n.

REPRESENTATIVENESS

What is done in survey work, especially in practice, differs greatly from what should be done based on the large body of available empirical data about good survey methods. As we know, in initial broadcasting of a mail survey, approximately 50% of the individuals will respond. Subsequent follow-ups will pick up more individuals who tend to be different in nature from those gathered in by the first request. Generalizations based on responses from less than 80% of the sample are extremely tenuous. Results based on a carefully canvassed sample of 100 individuals with effort being spent to insure almost total response may be much more meaningful than those based on responses of 5,000 individuals who represent only a 50% return of the original selection. In both cases, the cost might be almost the same, but the value of the information from the smaller but high return sample is clearly more valuable.

A common dodge to circumvent the problem of low-sampling returns is to select a group of individuals to sample and at the same time to randomly select an alternate for each person in the chosen sample. What the researcher fails to realize is that his sample now must be considered to be all individuals who responded as well as all individuals who did not respond. The probabilities are high that the researcher has merely increased the representativeness of the number of cooperative respondees. Let me clarify. Researcher "x" selects a sample of 50, along with 50 alternatives. Twenty-five people respond on first contact. He uses 25 alternatives, 12 of whom respond. His sample remains at a 50% return because his total sample was 75, not 50; and he has obtained responses from approximately half the individuals. He would better have spent his time persuading the reluctant individuals to respond, or trying to determine why they were reluctant to respond.

## ADEQUACY OF CONTROLS

Selecting adequate controls is a major bug-a-boo for educational researchers. A common mistake is to choose school "x" as experimental and school "y" as control. The error in this approach is that there may be intrinsic differences between the students or environment in schools that account for the observed group differences other than those attributed to the experiment. (Stanley and Beeman, 1958, p. 94.) The final effect of such restrictions is that most studies have to be done within schools which have two or more classes of any one age level meeting at any one time, allowing the students to be randomly assigned to control "x" or treatment "y." One can better generalize, however, to a defined population in this latter situation.

## ABSOLUTE VERSUS RELATIVE CONTROLS

Control problems are further complicated by the fact that in most educational situations it is impossible to use an absolute control method of completely withholding treatment. Even if the researcher does withhold treatment, he cannot assume that nothing is happening to the individual from the initiation to the completion of the study. For example, in studies of psychotherapy control groups where supposedly treatment was withheld, there is indication that such was hardly the case at all. (Orne, 1962) Investigations of the control groups indicated that these individuals talked about their problems to friends, ministers, and their physicians. If a person is hurt enough to need help, he will find it. If he is not hurt enough to need help, he may not be comparable in make-up to the experimental treatment groups at the initial phase of the study anyway.

In educational research, relative controls ("competing treatments") are usually used in which the researcher attempts to answer the question of whether treatment "x" is better than "y"; not whether either "x" or "y" are of any value at all. With relative controls, when the researcher finds differences, he "wins" because he can interpret one method as superior to another; but when no differences are apparent, he "loses" because he is not sure whether the treatments were equally good or equally poor.

## VALUE OF MATCHING

Educational researchers use matching as an attempt to develop adequate controls. That is, they build their experimental and control groups by matching individuals on one or more traits which are known to correlate with the criteria. On first inspection, this approach would seem desirable because the researcher could be fairly certain his experimental and control groups were equal before beginning the study. However, matching has a number of pitfalls: 1) when subjects are matched on a number of variables, results tend to be conservative estimates of differences because extreme individuals are lost, leaving a restricted range in variability; 2) the researcher is never quite sure which are the pertinent variables on which to do the matching; and 3) just about any variable one selects on which to match has an error of measurement which gives no real assurance that equal scores represent more than some similarity on the variable.

## REPLICATION--CROSS VALIDATION

The most common inadequacy in educational research design is lack of evidence of replication or cross-validation, i.e. repeating the study at least once. Most educational experimenters do their study once and then, depending on whether they get positive results, publish their findings. I have often wondered what would happen if we could adequately keep track of all the negative-findings studies. It has been said that our field needs a *Journal of Experimental Failures* or *Negative Findings*. When the "misses" are ignored, we are enamored by the "hits." Our probability estimates for the studies that do get published are thus not accurate representations of reality. Ultimately, we can only hope that journals will 1) reject studies which lack replication, 2) properly label such research as pilot or exploratory studies, or 3) publish brief abstracts of failures.

Poor operational definitions account for many of the problems we have in attempting to replicate each others work. For example, Payne and I (1964) found many different definitions of the term "under- and over-achievement." When we applied these definitions to the same data we found they selected different individuals. It is easy to see that generalizations based on the various definitions might be to entirely different populations, questioning whether one should expect verification at all of the original study being replicated.

## PLACEBO EFFECTS

It is well known that just doing something will produce change in some individuals. Such a principle is extremely important to the educator because it may be the show of interest on the part of the experimenter in the subjects or the novelty of the experiment which produced the findings. The usual assumption is that selecting a control group will solve the problem, but this is not always the case. The fact that an experiment of any type is going on in the school setting may have subtle, pervasive effects. It is not uncommon to find the control group improving as much as the experimental group--in few cases, even more.

One approach to coping with this problem when a teacher has both experimental and control groups in the same class is to select a "pseudo-control" group. That is, an experimental group and two control groups are selected. The teacher is told about the "pseudo-control" group and given instructions to treat them as she would "normally." What she does not know is that the real control group is another sample not revealed to her until the study is completed.

### REGRESSION EFFECTS

Ever since human individual differences have been studied, it has been known that under repeated testing the extremes tend to regress toward the mean. Studies based on individuals who are selected on the basis of scoring at the extremes of an independent variable are particularly vulnerable to this effect. The forgetful researcher who overlooks this principle might find himself in a predicament where his high groups get worse and his low groups get better after exposure to experimental treatments. He scratches his head in bewilderment trying to interpret his findings until some bright graduate student points out the obvious.

### PRE- POST-TEST EFFECTS

Designs which involve testing at the beginning of a study and then testing after treatment to measure change are the vogue. It would seem like a perfectly logical approach to research until one realizes that the pre-testing broadcasts what the experimenter anticipates as outcomes of the treatment. The use of a control group helps to balance the effects of the initial test on final outcomes, but does not solve all problems associated with this design. For example, the problem still exists of the notorious unreliability of "change" or "difference" scores.

## ADEQUACY OF CRITERIA

Limitations of criteria beseige the educational researcher in many domains--particularly if he is attempting to measure personality traits or values. The educational researcher is not free of the problem even when he assesses in the traditional academic achievement and aptitude areas which have a long history of developing acceptable measures.

## PRE- POST-TEST PROBLEMS

Trying to measure a child's increment of improvement in the achievement domain is difficult. Suppose the researcher uses the same test at the beginning and the end of the study. He then faces the problem of finding a test which will be sufficiently easy to permit the student to be on the scale at the beginning of the study and still be difficult enough so that there is ceiling left for improvement at the end of the study. Equivalent forms of the same test can ease this problem but not completely eradicate it.

## OUTCOME BIASING

When a researcher uses a test to measure the outcomes of an experiment, he has to be extremely careful that he has not prejudiced his results by choosing a test which favors or disfavors one of the experimental treatments. One solution is to involve disciples of each treatment in the selection of a fair criterion.

The training of the experimenter also contributes to a source of error in educational experiments. Human beings being what they are, apparently they are not quite able to mask their hidden prefrences for one method over another. We have learned to monitor our experimental treatments to attempt to determine if the treatment were actually administered. But some research questions how effective we are, even with these sanctions. (Orne, 1962)

Surveys are particularly subject to biasing difficulty. One has only to examine the myriad of questionnaires sent out each year in the educational field to observe that the conclusions for some of these studies could be written before the data was returned. Removing biases is extremely difficult. Partly it is a matter of good sense; pilot testing of surveys on unsophisticated individuals with close monitoring such as asking for explanations for each of their responses helps.

## VALIDITY PROBLEMS

A frequent error that researchers in education make is to attempt to evaluate the outcomes of a study using a single criterion. The problem becomes further compounded when the criterion has only questionable validity. In the past few years, thanks to the work of measurement people, we have developed much clearer standards of what constitutes a valid measure. For research purposes, we accept devices with restricted evidence of validity but when we do, obviously we increase the probability of negative or uninterpretable findings.

RELIABILITY

We are beyond the point where we mistake stability as evidence of validity, but we still ignore the impact that an unreliable measure can have on making probability statements. Unstable measures increase the error of our estimates and probably contribute to conservative estimates of true differences.

We are often insensitive to reliability problems in the criteria we are trying to predict. If we are doing an experiment in which we are trying to predict a child's grade point average, we have to appraise the effect of the unreliability of the judgments of the teachers who provide the composite estimate of the child's achievement. Some researchers rely on standardized achievement tests as criteria because they tend to have higher stability than teacher grades. However, this solution is not a panacea because some students do well in one situation and not in the other. The choice depends on what the researcher is interested in ultimately predicting. Designers of educational research need to provide evidence of the reliability of their measures with samples under study, for only in this way can we obtain some small estimate of the current stability of the criteria.

## ETHICS

Realistically, the designer of educational research is not restricted not only to the formal or theoretical problems of design in conducting his inquiry. He must cope with the human concerns of the subjects of his experimentation and the members of the community where the research is being conducted. Some individuals have raised considerable flack on this issue to the point of having brought some projects to a complete halt. Recent experiences in medical research reported in the *Saturday Review* testify to problems of values in experimental research. The *American Psychologist* (1965) has devoted a whole issue to the problems of ethics of psychological testing. I can testify that the effects of the small, but vocal protestors are frustrating, particularly when timid government agencies force one to remove important questions which might offend the well organized opposers of human research. The State of Michigan is currently considering a law to prohibit the use of psychological tests without written parental consent, which would seriously hamper educational research efforts. We are partially responsible for the criticisms. If the researcher ignores the audience responding to the questions, he is asking for trouble. He creates problems for generous school personnel who have agreed to participate in the study. On the other hand, a small vocal group should not make us "gutless" in our attempts to understand and help human beings. Children and adults are not so fragile and naive that questions about sex, religion, or personal values will in some sinister manner flip them into mental ill health. The researcher has the responsibility to 1) protect the confidentiality of the data 2) not put the individual results in the hands of untrained school personnel and 3) not release individual data from partially validated tests. Furthermore, as Carl Thoresen said at the 1965 meeting of the American Personnel and Guidance Association, we have the responsibility to seek the best treatments we can as part of our ethics. (Thoresen, 1965)

The research designer must question whether he has the right to withhold from the child what is thought to be the best treatment available. Researchers who are conscientious on this point try to write into their design assurance that remedial help will be offered to any subjects who are handicapped because of the inadequacy of a particular treatment.

## FUNDS FOR EDUCATIONAL RESEARCH

One of the problems that a designer of educational studies faces is trying to find sources of funds to support his endeavors, particularly if he wants to do basic research. It is easy to understand why this situation comes about after one works with school administrators. The whole reward system is set up on almost the antithesis of how we do research. The school administrator is judged by his effectiveness, which generally translates to being his capacity to almost simultaneously sense a problem and take action. Over the years, many administrators have learned that for the school bond issues, this approach can lead to disaster. Here he tries to analyze the problem by using community surveys, identify the hard and soft change elements, set up a plan of action in light of the mallable variables and then steadfastly work to attain the goal which is measured in the sought outcome--a favorable vote. But it has taken years for some school administrators to arrive at this point with this one element of their job, and for some it has been an extremely painful learning experience. The problem of educational researchers comes in the fact that these very men who are so prone to immediate action with low tolerance for ambiguity, migrate to the controlling boards or administrative positions of foundation granting agencies. One year applied studies are welcomed; two year studies are tolerated; three year studies are looked upon with askance; and studies requiring more time than this are obviously subversive. In the past, the U. S. Office of Education has been a likely source to turn to for support of basic educational research--both in the training of researchers and in finding projects. The recent shift in policy in the U. S. Office of Education indicates that those days may have come to an end. The dialogue between the respected professionals of the educational field and the members of the U. S. Office of Education is being severed.

In recent years, educators have received considerable help from the physicists, biologists, mathmeticians, and chemists in curriculum development. Now we are going to need the same support in loosening the private foundation for governmental agency support for basic educational research.

## A PARTING COMMENT

We who do educational research have many assets in doing our work that are not fully realized by outsiders and sometimes by ourselves. School administrators may not think the same way we do about problem solving but they have an excellent record in opening their schools to our pursuits; a recent survey (Clasen, *et. al.*, 1966) substantiates this point and further indicates that the door to access is some form of a personal contact. In highlighting our problem, I do not want to indicate that the situation is totally bad, or without many rewarding features.

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# A Strategy for Psychological Research

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The basic proposition underlying this paper is that no single theory or method is adequate for the scientific study of man and his environment. A general strategy for psychological research that transcends specific theories and methods is proposed. The concept of "ideal types" serves as the unifying theme for the proposed strategy. Included in the strategy are three basic steps: 1) investigation of the present situation, 2) construction of an ideal type, and 3) formulation and implementation of recommendations. Within the proposed framework, the traditional methods of empiricism, rationalism, and pragmatism may be viewed as being complementary rather than contradictory.

## INTRODUCTION

Psychological theory is currently plagued with controversy. There are Skinnerians and there are Rogerians; there are Freudians and there are neo-Freudians; there are Gestaltists, phenomenologists, functionalists, existentialists, field theorists, information theorists, pragmatists, neo-pragmatists, and others. Many of these psychologists seem to believe that their school or theory is right and that all others are wrong. Often the contending parties argue for their theory within the framework of that theory. Few psychologists are able to "move back" from their preferred theoretical orientation in order to compare and contrast two or more theories objectively. Confusion, uncertainty, and conflict are evident throughout psychology.

Associated with this conflict among theoreticians in psychology is the ongoing debate about methodology. The clinical method and the statistical method, for example, are frequently compared (see Meehl, 1954). The advocates of the clinical method believe that they obtain a more valid picture of man, while the proponents of the statistical method believe that their approach is more scientific. And so the argument continues.

The basic proposition underlying the present paper is that no single theory or method is adequate for the scientific study of man and his environment. A corollary to this proposition is that each theory and each method may be appropriate for certain problems. It then follows that there is a need for a framework or rationale for comparing different theories and different methods, and for selecting the ones that are most appropriate for given problems.

The purpose of the present paper is to propose a general strategy for psychological research that transcends specific theories and methods, but makes use of all of them. The concept of "ideal types" serves as the unifying theme for the proposed strategy.

## PRINCIPLES

Max Weber introduced the notion of "ideal types" in the social sciences. Weber clearly demonstrated the usefulness of comparing actual events in history with "ideal" constructions of these events (Gerth and Mills, 1958; Parsons, 1964; Weber, 1949). More recently, the concept of ideal types has been used in the behavioral sciences. Tanner, Birdsall, and Clarke, for example, have shown the value of formulating an "ideal observer" in psychophysics (1960). Similarly, Anatol Rapoport and others have discussed the pros and cons of constructing "rational strategists" in the study of conflict and cooperation (1964).

In each of these uses of ideal types, some type of comparison is made between the empirical and the rational, between the realistic and the idealistic, or between the descriptive and the prescriptive. It is not one versus the other but the relation between them that provides the basis for understanding complex situations involving man and his environment. Watkins suggests that "One might improve one's appreciation of a roughly circular object by placing over it an accurate tracing of a circle" (1953, p. 725).

The impetus for the current use of ideal types results from studies in operations research, systems analysis, and cybernetics. Many of the specific studies in these relatively new disciplines apply some version of the following three-step strategy:

1) Investigation of the present situation,
2) Conceptualization of a desired or "ideal" situation, and
3) Formulation of recommendations for moving from the actual toward the desired.

The literature offers several different definitions of ideal types. Lefebre defines ideal types as "conceptual constructions which portray what would be possible if all possibilities of a given set of conditions were completely carried out" (1957, p. 490). Watkins suggests that "A holistic ideal type is not a guess about reality, but an a priori word-picture--in other words, a definition" (1953, p. 726). Talcott Parsons points out that the ideal type as used by Max Weber is both abstract and general: "It does not describe a concrete course of action, but a normatively ideal course, assuming certain ends and modes of normative orientation as 'binding' on the actors" (1964, p. 13).

For purposes of this paper, an ideal type is defined as a conception of the optimum state of a given system. A system may be defined as an assemblage of elements or variables united by some form of regular interaction or interdependence. The state of a system is the set of numerical values that its variables have at a given instant in time. An optimum state of a system is the most favorable state according to specified criteria. A system in psychology might be a set of behaviors, a person, the decision-making mechanism of a person, or even a body of knowledge in a given area. In regard to the proposed strategy, psychologists might formulate ideal types for any of these systems.

The term "ideal" is frequently associated with words such as "excellence" and "perfection." It must be noted, however, that the values associated with ideal types, as the term is used here, may not correspond to the values of society. Evaluative adjectives, such as "good" or "bad," are meaningful only insofar as they relate to the arbitrary criteria established by the investigator. Thus, a psychologist might just as easily construct an ideal type of a criminal as an ideal type of a policeman. In either case, the ideal is merely a conceptualization of the best possible "performer" according to certain arbitrary criteria.

It is also important to note that an ideal type, as used here, is not illusional. Ideal types go beyond actual knowledge of the present situation but are influenced by practical considerations. "Ideals are admittedly not fully realizable," according to Michael Polanyi, "but they must not be wholly impracticable. Their status is like that of 'pure engineering,' which I have defined as comprising the operational principles of machines" (1963, p. 63). Thus, an ideal type may be viewed as a conception of a desired situation that is grounded in reality.

The proposed strategy provides a framework for answering these three questions: 1) What is the present situation? 2) What would be an ideal situation? and 3) How can the ideal be achieved? Guidelines for answering these three questions are presented below.

To answer the question "What is the present situation?" the psychologist needs a comprehensive understanding of the present situation. He attempts to view the problem situation in the broadest practical context and explores each facet of it from different points of view. He formulates basic questions that need to be answered about the problem situation. The psychologist searches for counter arguments to his primary arguments and attempts to identify inconsistencies in the situation. He effectively applies the dialectical method of thesis, antithesis, and then synthesis, in order to get every possible insight into the present situation. Data are collected and analyzed as needed.

Guidelines for answering the question "What would be an ideal situation?" show what might be accomplished. The psychologist must specify arbitrary criteria for the situation, such as maximum performance, minimum cost, and minimum risk. He also must identify the actual constraints imposed upon the situation, such as time, money, and the innate capacity of people. Then, within the framework of the arbitrary criteria and the actual constraints, he generates new concepts that go beyond the present state of the system under study. These concepts may be developed by brainstorming, question asking, systematic ideation, or any other method that is conducive to the generation of new ideas.

Guidelines for answering the question "How can the ideal be achieved?" are directed toward identifying the reasons for discrepancies between the actual and the ideal, and recommending courses of action for moving from the former toward the latter. The psychologist first attempts to identify the obstacles standing between the actual situation and the accomplishment of the ideal. He considers all major avenues for moving from the actual toward the ideal, which includes the formulation of "extremes"--the worst possible alternatives and the best possible alternatives. He "thinks through" the likely consequences of various alternatives, and he demonstrates the reasonableness of certain alternatives and the futility of others. He then takes appropriate action.

To apply the above guidelines effectively, the psychologist must have a comprehensive view of his field. This paper proposes a general orientation that transcends specific theories and methods, but makes use of all of them. The essence of this idea is illustrated in Figure 1, in which the field of psychology is conceptualized in terms of a three-dimensional figure, with problem areas, theoretical frameworks, and methods representing the three axes, and findings representing the content of the cube. These terms are defined below.

A problem area is the subject of interest to the psychologist. This might be learning, intelligence, motivation, personality, communication, or decision making. The problem area is the starting point for the inquiry.

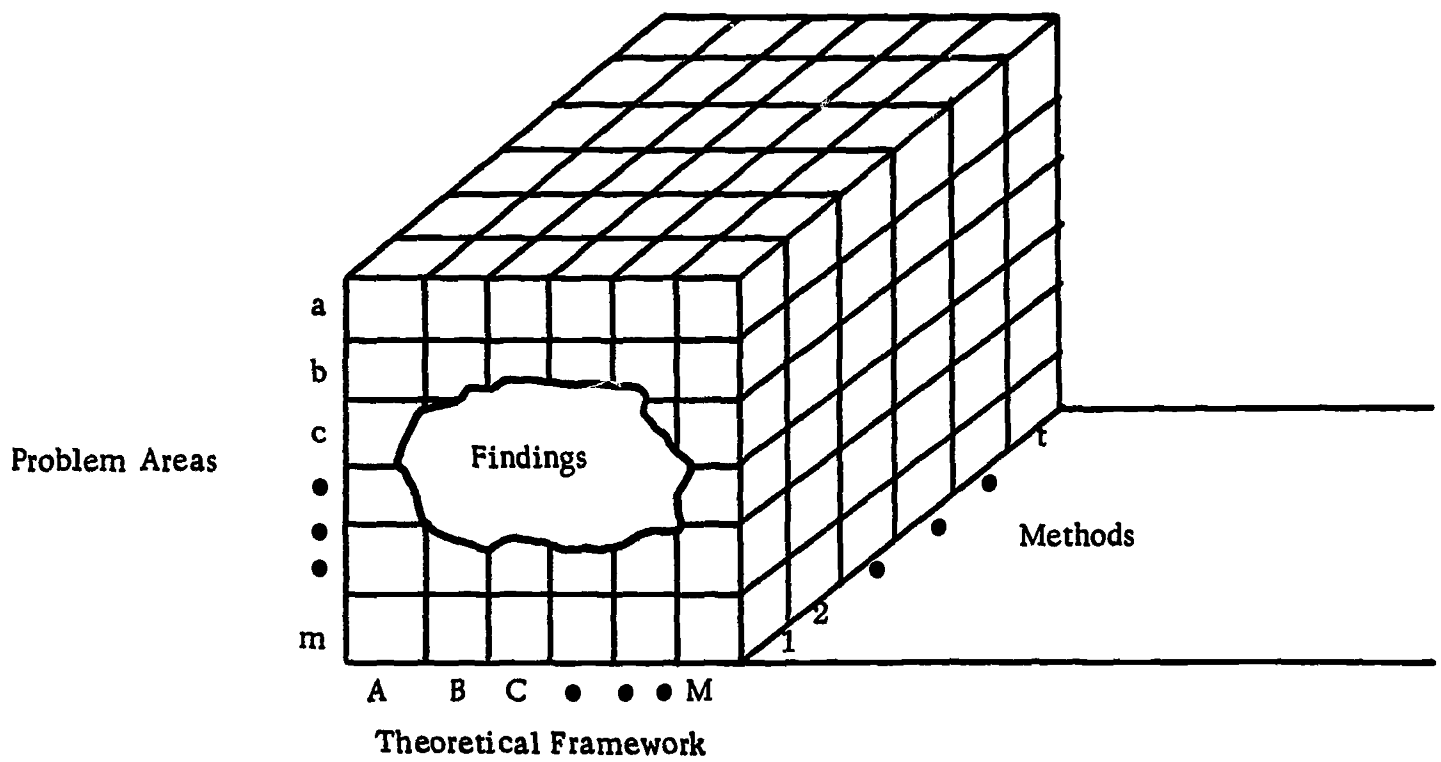


FIGURE 1. RELATION AMONG PROBLEM AREAS, THEORETICAL FRAMEWORKS, METHODS, AND FINDINGS

A theoretical framework may be defined as the general orientation of the investigator; it is his subjective point of view. Examples of theoretical frameworks are common-sense psychology, existentialism, dynamic psychology, psychobiology, behaviorism, and cybernetics. Each of these takes a somewhat different view of man, and each emphasizes certain aspects of man. Theoretical frameworks cannot be proved or disproved; they are not true or false. Some, however, may be more useful than others.

Methods represent different "ways of knowing" for the psychologist. Examples of methods are: everyday observation, introspection, case study, field study, laboratory experiments, and models. These different methods provide different types of information about man and his environment. No single method may be viewed as the "final word;" each has its own strengths and limitations. As we cross the gamut from everyday observation to models, for example, we move from little control to considerable control. At the same time, however, we also move from realistic human behavior and realistic conditions toward simulated behavior and simulated conditions. The investigator obviously must consider the "trade-offs" for each particular situation.

The findings referred to inside the cube in Figure 1 are the results of combining a particular theoretical framework and a particular method to investigate a specific problem area. A well-conducted study should produce useful information regardless of the underlying theoretical framework or the method used. For example, data collected through everyday observation are obviously different from those collected in a controlled laboratory experiment. This does not mean that one set of data is of less value than the other, but merely that they must be interpreted differently. "In the language of science," according to Bronowski, "every fact is a field--a crisscross of implications, those that lead to it and those that lead from it" (1965, p. 52).

The proposed approach encourages the psychologist to view his particular field of interest from "outside" the cube shown in Figure 1. Frequently, a psychologist attempts to structure his entire field of specialization in terms of a single theoretical framework or a single method. This can lead only to bias. The proposed approach gives the psychologist access to the entire cube. Jaspers suggests that, "A wealth of well-established viewpoints and an appropriate adaptation of these to the individual case marks the ideal investigator" (1963, p. 825).

But here there is an obvious question: If the psychologist is able to assume a position "outside" the cube in Figure 1, what criteria does he use in assessing his approach? It would hardly seem reasonable if he used the same criteria as those imposed by one particular theoretical framework, say, behaviorism, or even by one of the methods, say, laboratory experiment. Moreover, it would be just as unreasonable to establish a potpourri of unrelated criteria extracted from all of the theoretical frameworks and methods. Thus, the need for a "higher authority" is apparent.

It is proposed that reason is the most meaningful "higher authority" for the psychologist. Reason, while being difficult to define, does have certain distinguishing characteristics. It is man's highest power of intellect. Reason is a joining of logic and intuition, grounded in facts but inspired by imagination. It unites reality and possibility by establishing a fact, extrapolating beyond this fact, and then establishing another fact. It relies on rules of logic, but is more than these rules of logic. The presence of reason can lead to scientific discourse among all psychologists--from existentialists to behaviorists, or from phenomenologists to mathematical-model builders. Reason provides the common ground for all scientists. It is the essence of the proposed strategy for psychological research.

## PROPOSALS

On the basis of what has been said thus far, a general strategy for psychological research is proposed. The three major steps included in the strategy are shown in Figure 2.

In Step I, the present situation is viewed in the broadest practical context. The investigator attempts to get every possible insight into the problem by looking at it in terms of different theoretical frameworks and by means of different methods. Meaningful questions are generated. Data are collected and analyzed.

In Step II, arbitrary criteria are specified, actual constraints are considered, and new concepts are introduced. Then the investigator constructs a description of the most favorable state of the system under study. This description constitutes the "ideal type."

In Step III, the psychologist formulates and implements recommendations. The relation between the actual and the ideal is analyzed, and an attempt is made to determine the reasons for any existing discrepancies. Different routes for moving from the actual toward the ideal are considered, and their consequences are evaluated. Recommendations are formulated and appropriate action is then taken.

## AN EXAMPLE

A comprehensive study of human decision-making is used as an illustration of the application of the proposed strategy. The

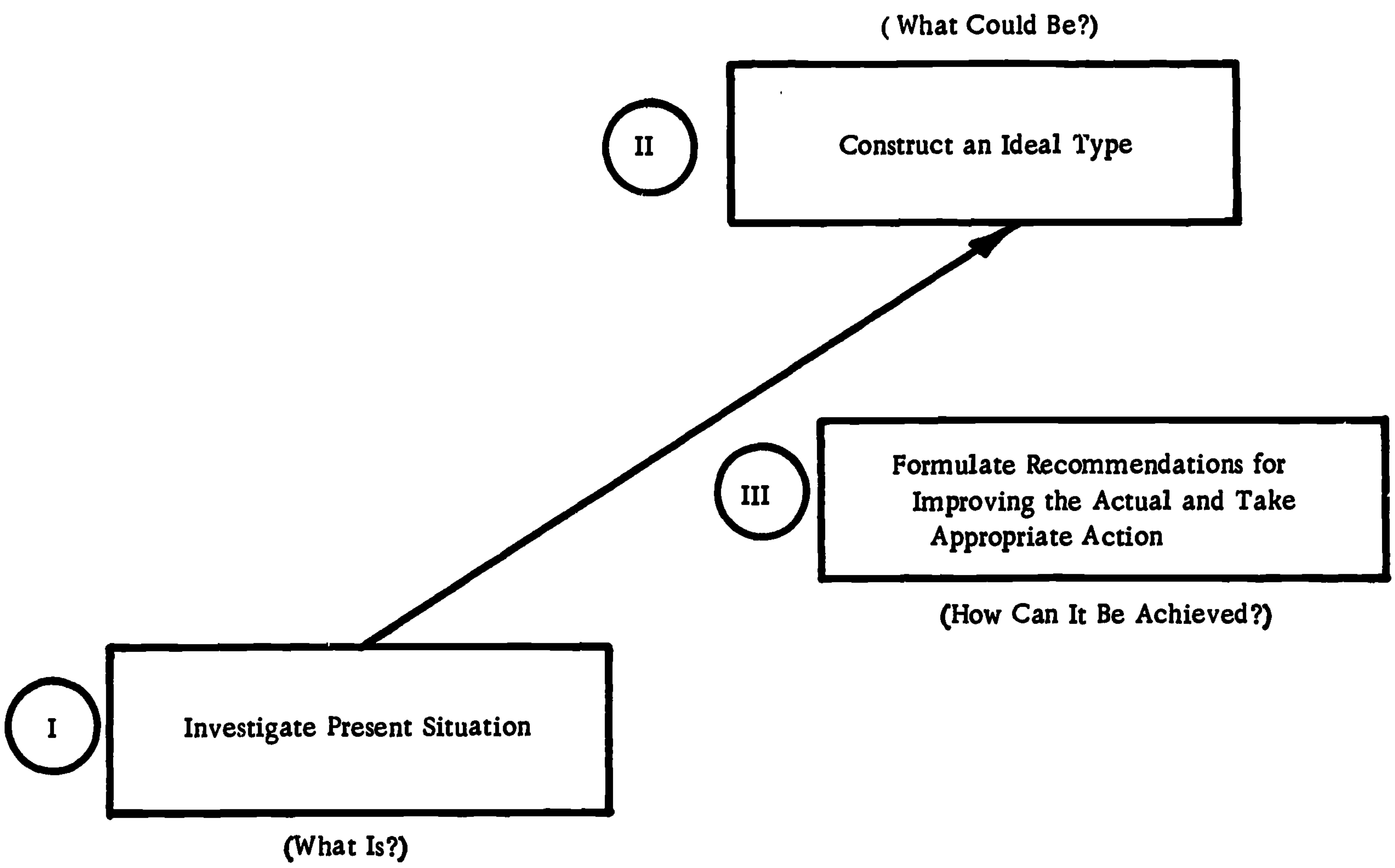


FIGURE 2. MAJOR STEPS IN THE PROPOSED STRATEGY

psychologist first wants to attain a thorough understanding of empirical knowledge about decision-making. To achieve this understanding, he constructs a framework consisting of problem areas, theoretical frameworks, methods, and findings, such as that shown in Figure 3.

By viewing the different problem dimensions "through the eyes" of different theoretical frameworks, the investigator is able to pose a number of questions. For example: 1) Common-sense psychology: What does my own judgment, based upon a lifetime of everyday experience, tell me about decision-making? 2) Existentialism: What is the basis for subjective probabilities? 3) Dynamic psychology: What motivates the individual to make the choice he does? 4) Psychobiology: What is the nature of decision-making behavior in brain-damaged patients? 5) Behaviorism: What is the nature of the relation between contingencies of reinforcement and decision-making behavior? 6) Cybernetics: What is the nature of the feedback loop in decision-making?

Then, by use of a variety of methods, the psychologist proceeds to collect information about human decision-making. For example: 1) he may observe children choosing team members for a baseball game; 2) he may introspect about his own decision-making experiences and attempt to identify significant factors that influenced particular decisions; 3) he may conduct a case study of a great leader considered to be an outstanding decision-maker; 4) he may investigate the relation between patterns of communication and the effectiveness of management decision-making in an industrial organization; 5) he may conduct a laboratory experiment to analyze the relative effectiveness of different types of reinforcement on decision-making; 6) he may study the decision-making behavior of an electronic computer programmed to simulate human decision-making behavior.

After making a thorough analysis of his findings, the investigator constructs a description of an ideal decision-maker. The arbitrary criterion in this particular case might be that the ideal decision-maker is able to select the best alternative from among those immediately available or potentially available. ("Best" means that the value of the potential payoff of a given alternative is considered in conjunction with such constraints as time, effort, and risk involved.) The ideal decision-maker might then be described as follows: He has an effective overall philosophy that guides his daily actions. This person does not assume constraints to exist when they actually do not. He is aware of the real alternatives in a situation--he is able to see below the surface. The ideal decision-maker is effective in coping with conflict situations, and he is able to think in terms of continua and probabilities. Alternatives are critically re-evaluated during the pre-decision period, which reduces regret

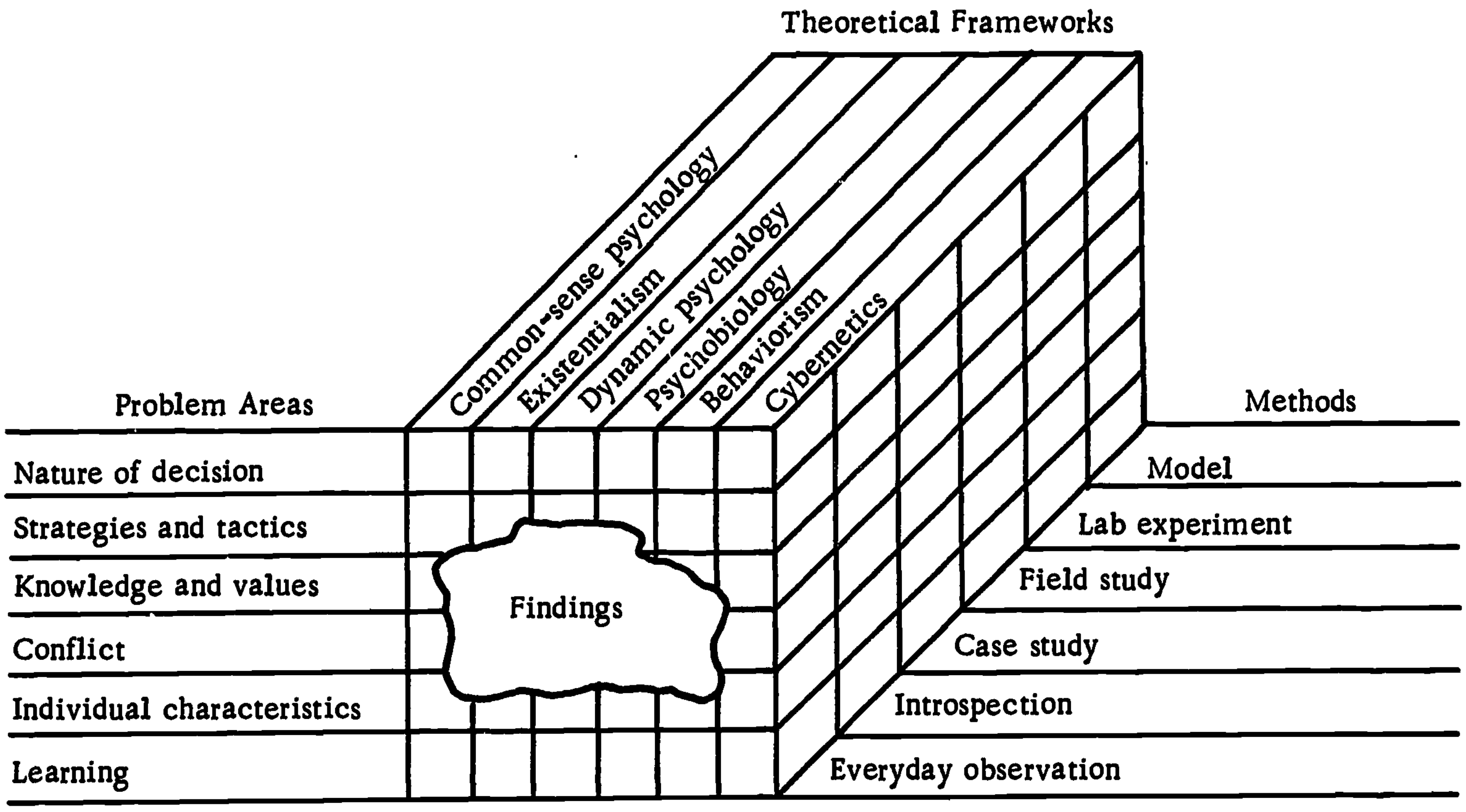


FIGURE 3. RELATION AMONG PROBLEM AREAS, THEORETICAL FRAMEWORKS, METHODS, AND FINDINGS IN DECISION MAKING

after the decision is actually made. He can deal effectively with both objective probabilities and subjective probabilities--and both simultaneously. He learns from his decisions and uses this knowledge in subsequent decisions. This is a description of an "ideal."

The investigator studies the reasons for the discrepancies between the actual and the ideal, and then formulates recommendations. Some of the most general recommendations might be: 1) researchers need to achieve a better understanding of the decision-making process and to develop methods for teaching people how to be better decision-makers; 2) the schools should consider training youngsters to be effective decision-makers in the primary grades; 3) the individual needs to formulate a meaningful over-all philosophy in order to be effective in his day-to-day decisions. The psychologist would also participate in the actual implementation of these recommendations.

The three steps in the proposed strategy are obviously interrelated. The implementation of recommendations would be expected to change the present state of the art in human decision-making, which, in turn, would bring about a new version of the ideal type, which would then lead to new recommendations, and so forth. We can describe the three steps in the proposed strategy as three interrelated components of a dynamic feedback-control system, in which each component continually changes its form as a result of the influence of the other components.

## A SUMMING UP

A general strategy for psychological research has been proposed. The strategy is based upon the notion of an "ideal type," which is defined as a conception of the optimum state of a given system. The proposed strategy consists of three basic steps: I) investigation of the present situation, II) construction of an ideal type, and III) formulation and implementation of recommendations.

There are several important characteristics of the proposed strategy. First, it assumes that the psychologist is interested in understanding and influencing man and his environment. Second, it is problem oriented rather than theory or method oriented. Third, the strategy makes use of different theories and different methods, and does so in a systematic manner. Fourth, while it is grounded in reality, it encourages the behavioral scientist to look beyond what is presently known. Fifth, it is guided by reason.

The proposed strategy is related to other methods of inquiry. For example, Step I, investigation of the present situation, is empiricism in the best sense of the word. Step II, construction of an ideal type, may be viewed as one version of rationalism. Step III, formulation and implementation of recommendations, is clearly consistent with the pragmatism of William James (1907). Each of these approaches--empiricism, rationalism, and pragmatism--offers something different to the behavioral scientist. Within the framework of the proposed strategy, however, these different approaches may be viewed as complementary rather than contradictory.

Several words of caution are in order at this time. First, the proposed strategy encompasses both fact and speculation, and the investigator must keep in mind which is which. Second, we must not lose sight of the fact that ideal types are dynamic and can be expected to change with time. Jaspers illustrates this point by stating that, "Ideals of man collapse, but they serve as a goal to his march forward. Ideals in a sense can be schemata of ideas, road signs" (1949, p. 62). A third word of caution is offered by Max Weber, who emphasizes that, "The construction of abstract ideal types recommends itself not as an end but as a means" (1949, p. 92).

The proposed strategy holds these promises for psychology: 1) it can help bring together scattered facts in an objective manner, 2) it can provide a framework for determining the appropriateness of different theories and methods for given problems, and 3) it can indicate directions for appropriate action. In addition, the proposed strategy provides a systematic means for isolating facts, assumptions, arbitrary criteria, speculations, ends, and means.

We may conclude with a quotation from Karl Jaspers that points up the value of ideal types: " . . . in order to grasp the reality, we must see the possibilities. In the present, a formulation of the possibilities is the area in which I gain certainty concerning what I decide; without possibility, I have no freedom; without a vision of the possibilities, I act blindly; only a knowledge of the possibilities enables me to know what I am actually doing" (1964, p. 238).

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# Planning the Reseach Program
# (A Summary of Reports)

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The systems approach to planning a research program is very effective. Research efforts are directed toward specific objectives when researchers are looking at their resources and constraints. The boundary lines, the alternatives, the costs and benefits become factors in the research planning.

A systems approach involves great emphasis on the interrelated aspects of the whole. Flow diagrams are a valuable assistance in seeing the relatedness of the various aspects. Thus the research plan can be looked at as a road map. The map offers a general outline of where you are going and how you plan to get there. The plan offers direction but does not inhibit you because it should be flexible. The research plan does not have to stifle creativity. On the contrary, it should foster creativity because it allows certain freedom within the sphere of activity.

The persons who provide the plan should be directly involved in carrying out this plan from initiation of the idea to final evaluation. One of the first stages of planning is the conceptualization of a major theme which tends to pull things and people together, to serve as an umbrella for the activity.

Within such a conceptual framework the questions basic to systems analysis can be more effectively answered. Does the research effort have realistic objectives and are they stated in operational terms? What are the limits of the resources and the time available?

What kind of standards will be built into the objectives? If the effect is going well, how will it be known? How can a system of checks and balances be built into the system? Are the researchers interested in the number of publications, number of hours expended, public opinion?

While the program is in progress, will efforts be made to capitalize upon new sources of money, time and people? Does it make any difference if the research effort becomes involved in another area or concern which varies from the original concern? What are the restrictions built into the design of the program?

How will the alternative cost and benefits of the program be estimated? What substitutions are available as a result of modifications? How will the costs of such things as reputation, frustration, inconvenience enter into the plan?

Who will be responsible for implementing the plan? Has proper sequencing been considered? Which activities should be completed first and which completed thereafter in a workable sequence? Does a feedback group exist wherein corrective action can be taken if the need arises? Does a plan exist for updating the plans, or modifying the plan in order to make it more realistic. Is it possible to change the emphasis of what is being done?

Sequencing provides special problems for the researcher. Sequencing involves both idea generation and idea evaluation. Researchers are generally geared to problem solving, but do not know how to identify a problem. Problem identification requires real skill and most people are not trained for it. Generally things are seen as we want them to exist. Researchers must be trained to see what actually exists first. Then, if there is a discrepancy between what exists and what we desire, progress can be made toward what we want with scientific help.

Working at the interrelationships of problems is also important. In addition, people often think differently about the same problem. Two differing persons or institutions could reinforce each other, aid in costs and provide an informal system of checks and balances.

It is important to determine the results required and to estimate the time needed to produce these results. Sometimes a research group must have results the first year. Other research does not require immediate results. A hard look must be taken at all capabilities. A few people are top notch researchers but aren't worth a fig in designing in terms of needed outcomes.

In planning for research these steps are suggested:

1. Identification of the areas of needed research;
2. Assignment of some sort of priority to the various research areas identified;
3. Development of a matrix or matrices of research activities;

4. Planning the next steps--what research needs to be done presently, who should do it, how it should be done, and where it should be done.

# The Development of a Matrix in Distributive Education Research

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Most anything we do can be researched. The problem is to decide those things that are important enough to warrant our attention, energies, and monies. Most frequently, the decision is made by independent investigators pursuing their own particular interests. In recent years, as government and industrial funds have become more and more available for research purposes, the rise of a) a major organizational schema whereby a plan is adapted and sub-parts are confiscated by individuals and institutions, b) cooperative research ventures where a project is conducted by multiple investigators and c) the rise of research institutes or regional centers where a major theme of investigation is carried out by a particular group have all become a forceful part of the research scene. Our discussion will be concerned with the framework of research which might fit any of the above.

This paper will be concerned with 1) developing a matrix for planning research in distributive education, 2) a discussion of various types of designs which might be employed to answer some of the questions proposed by the matrix, 3) some general statements about the flow of research, 4) a discussion of the fine art of proposal writing, and 5) some general comments about processes for monitoring research activities.

## A MATRIX OF RESEARCH DESIGN

There are any number of schema available for planning major research projects. For example, Figure 1 is extracted from the paper by Frank Wellman.[1] His approach has some fairly useful organizational purposes for the counseling process, but I seriously doubt its direct applicability to the kind of problem proposed for distributive education. It is possible to move from a matrix

[1]F. Wellman, *The Assessment of Counseling Outcomes: a Conceptual Framework*, unpublished mimeo-paper, January 1967, p. 30.

| Environmental Dimensions / Developmental Dimensions | REFERENCE POINTS | | | REFERENCE GROUPS | | |
|---|---|---|---|---|---|---|
| | EDUCA-TIONAL | VOCA-TIONAL | SOCIAL | FAMILY | PEERS | SIGNIF-ICANT OTHERS |
| LEVEL I<br>1. Perceptual<br>a. awareness<br>b. differentiation<br>2. Role Identity | | | | | | |
| LEVEL II<br>1. Conceptual<br>a. relationships-meanings<br>b. concept formation<br>2. Role Concepts<br>a. acceptance<br>b. evaluations-adequacy<br>c. normative values<br>3. First Order Integration | | | | | | |
| LEVEL III<br>1. Generalization<br>a. action-pursuit of purpose<br>b. accomodation<br>c. satisfaction<br>d. mastery<br>2. Role Performance<br>a. adjustments-normative tolerances<br>b. commitment to purpose<br>c. value formation<br>3. Integration | | | | | | |

FIGURE I

such as Wellman has proposed to a model which approximates a flow chart. In Figure 2 an example is presented for the research and development center for learning and re-education.[2] Many examples of this type of model can be found in the literature. It has many uses but is limited in bringing about higher level experimental studies. I would like to propose one (Figure 3) which has utility for many different settings and one which I believe can be adapted to the needs of distributive education groups directly. If you will inspect Figure 3, you will see that the vertical axis is concerned with the problem areas which your group will have to define as being worthy of research attention. It would help if these problem areas were arranged in a hierarchy of importance. (The hierarchy may not contain absolute ranking, but it would seem to me that you should be able to arrive at a somewhat broad judgment of which problems are most pressing and important.) The horizontal axis contains three levels of research: descriptive, predictive and experimental. Let me define these more clearly.

<u>Descriptive</u>: This type of research is commonly referred to as survey and constitutes a good launching pad for finding out the conditions which actually exist. One can think of research at this level as counting or identifying the "x's." It is usually not too exciting, but it certainly is necessary for a field to have a broad base of description in order to be aware of its current status.

<u>Predictive</u>: From here on we begin to identify those "x's" which will tell us when "y" will occur. That is, we become more time oriented and become concerned with the linkage effects of certain elements. In fact, one could say that the beginnings of a theory are possible at this point.

<u>Experimental</u>: The third type of research is where we manipulate the "x's" to produce desired "y's." Generally, research done at this level requires a fair amount of sophistication and planning, careful scrutiny in execution, and detailed analysis to be certain that extraneous variables do not account for the outcomes.

## DESIGNS FOR MATRIX 3

Campbell and Stanley[3] have summarized the effects of various components on internal and external invalidity of experiments.

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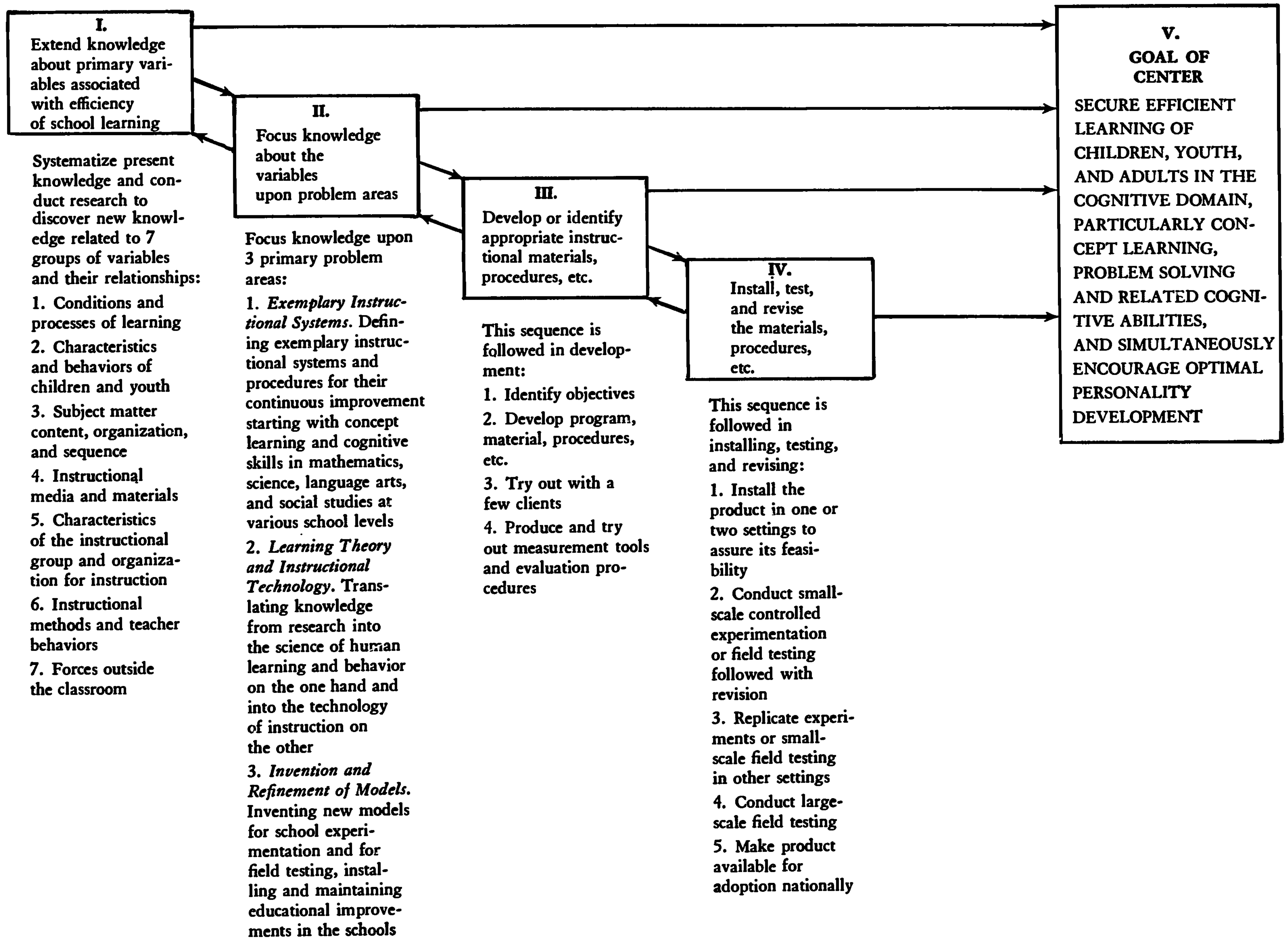
[2]Newsletter, Research and Development Center for Learning and Re-education, Vol. II, No. I.

[3]D. T. Campbell and J. C. Stanley, *Experimental and Quasi-Experimental Designs for Research*, Rand McNally and Co., Chicago, 1963.

**Fig. 2**

**Detailed Program Plan of the R & D Center for Learning & Re-education**



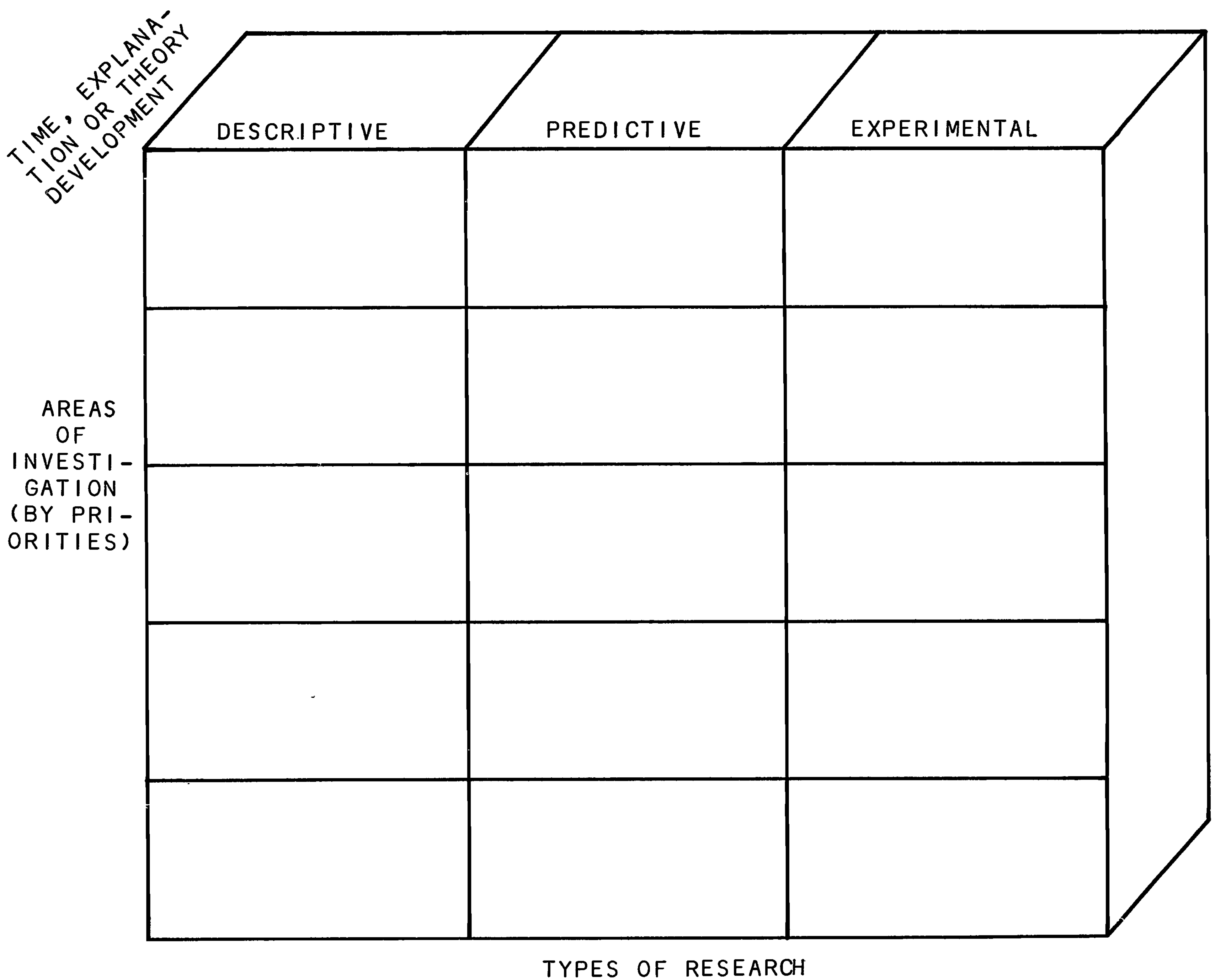



FIGURE 3. A MATRIX OF RESEARCH PLANNING

Their definitions are summarized below.

Internal Invalidity

History: other events occurring between a first and second measurement in addition to the experimental treatment.

Maturation: biological or psychological processes which systematically vary with the passage of time per se, independently of the experimental treatment or other events.

Testing: the effects of a pre-test on subsequent behavior.

Instrumentation: changes in the measuring instrument itself, or in the observers or raters, which might account for an $O_1$ - $O_2$ difference.

Regression: the universal tendency of extreme scores to be closer to the mean on a second test.

Selection: pre-treatment inequality of experimental groups.

Experimental mortality: the differential loss of persons from the treatment groups.

Selection-Maturation Interaction: the effect obtained when treatment groups have different maturation rates.

External Invalidity

Testing and X Interaction: in which a pre-test increases or decreases individual sensitivity or responsiveness to the treatment and thus makes the experimental results for pre-tested individuals different from what they would have been without the pre-test.

Selection and X Interaction: Generally speaking, the greater amount of cooperation the experiment requires, the more it disrupts routine, and the higher the refusal rate, the greater will be the selection and X interaction.

Reactive Arrangements: whenever an experiment has obviously artificial aspects we need to fear reactive arrangements.

Multiple-X Interference: is a problem whenever multiple treatments are applied to the same persons.

In Tables 1, 2, and 3 from their recent publications can be seen the control of the three sources of invalidity in relation to a number of designs.

## THE FLOW OF RESEARCH

If we assume that the purpose of research is to make probability statements about the nature of reality or to discover knowledge, we can begin to catch the cycling implication of research. Research always starts with a hunch that a certain set of conditions exist, which are not known or that certain events will predict other events, or that the manipulation of certain events will produce certain results. Researchers do not set out to prove negatives. Our goal is to establish positive findings. Therefore, we begin with either:

Level I: a hunch (a kind of focusing or pre-theory),

Level II: an accumulation of past studies which raise some question marks,

Level III: a conceptualized framework or theory which generates testable hypotheses.

It is important that the researcher recognize where his launching pad of inquisitiveness exists because the three previous conditions determine the type of research hypothesis he will formulate. All have in common the fact that the research hypothesis anticipates a relationship or a difference to exist. However, at the lowest level (focusing, survey, descriptive) the researcher is often not able to designate what the direction or magnitude of the relationship will be. More highly developed research fields place more demand upon the researcher to anticipate a priori the direction of his hypothesis.

Once the researcher has formulated his basic hypothesis which is in essence a narrowing of the definition of his problem, he then gathers data, manipulates that data in some manner and makes a decision about whether to accept or reject his hypothesis. In this process, his research hypothesis is changed to a statistical hypothesis. (A taxonomy of statistical tests for various designs and a number of statistical tests are included in appendix II.)

For practical purposes, statistical hypotheses are always null in form, that is, we enter our probability tables with the assumption that no differences exist. (Mind you, this is simply a parsimonious, status quo, statistical maneuver, not a resume of our initial gut level plunge into doing research.) It is in the alternate hypothesis that we find the essence of the difference of the levels we employed when we initiated our studies. For example, if we have hypothesized only the null form, $H_0 : u_1 = u_2$ the alternate hypothesis (Level X) not designated, we are prepared to accept differences no matter whether $u_1 > u_2$ or $u_1 < u_2$. This is what we call a two-tailed test. If we had moved to levels

II or III where we had past studies or theory, our hypothesis stated in the same initial null $H_0 : u_1 = u_2$ but in addition we designate either $u_1 > u_2$ or $u_2 < u_1$. Because we will only accept one condition, we employ a one-tailed test which generally means that the $\alpha$.05 will actually be equal to the table value of $\alpha$.10 because most of our statistical tables are two-tailed. We now have three conditions to cope with: a) we find that $H_0 : u_1$ does equal $u_2$ b) $H_0: u_1 \neq u_2$ and that $H_a : u_1 > u_2$ as we had hypothesized so our research hypothesis is confirmed or that c) $H_0: u_1 \neq u_2$ and that $H_a : u_1 < u_2$ which we did not hypothesize. In Cases 1 and 3 our research hypothesis is not confirmed. In Case 1, we may decide to abandon the research for any number of reasons some being that the original idea was poor or the instrumentation was inadequate. In the second case, where we have a confirmation of our hypothesis, we should be able to tie our finding back to our theoretical structure and test other elements or other constructs. In the third case where our findings were contrary to prediction, it is almost mandatory that we replicate the study but that prior to this we revamp our theoretical base for making our hypothesis. A point of caution, if we had done a number of hypotheses and only one or two came out contrary to prediction, the theory may stand but we may have to modify some of the concepts of how side variables influence outcomes, i.e., social expectancy.

## THE ART OF PROPOSAL WRITING

Krathwohl has prepared a carefully documented guide for writing research proposals.[4] I have a few general comments about proposal writing.

1. I think it is extremely important that you know the nature of the agency for whom you are preparing the proposal. This is the same advice one would give to an author in writing a book.

2. If you can in any way have part of the research begun so that the funding agency is convinced of the seriousness of your intentions the chances are increased that your proposal will be accepted.

3. Be extremely cautious in the kinds of comments you make in the proposal because the agency will undoubtly hold you financially responsible for completing those things for which you have contracted, i.e., state samples of approximately such and such a number will be gathered.

[4] D. Krathwohl, How to Prepare Research Proposals, unpublished paper.

4. Prepare your budget carefully with the help of an experienced person. Your goal is to secure the proposal with sufficient funds to conduct the project, but without such a large outlay that the proposal will automatically be turned down as being too expensive. Remember that no matter how close you figure your expenses, unexpected events will occur and they always cost money.

5. Try to secure the grant with the line items freed so that you can shift them without long entangled red tape. This will give you much more flexibility in conducting your research.

6. Remember that the bureaucratic mind operates in such a manner that he wants justification for your expenditures. Consider travel for example. You probably will not know all the travel you will need to do, but you can make average estimates (and then add a few because you will always have to go back--particularly when you are trying to secure cooperation in a project).

7. Be cautious of half-time secretary commitments. It is hard to secure a part-time person.

8. Choose your co-workers carefully. Supplement your own limitations, i.e., if you are compulsive, find a more expansive free-wheeler to lend balance. (But make sure he will come through on the work.)

MONITORING RESEARCH ACTIVITIES

The PERT process of monitoring research activities has unusual value in coordinating long-range planning. Desmond Cook's work on this topic is well known. In brief, it is a system permitting the individual to map his critical decision-making points --thus permitting preparation for those points and estimates of time needed to get from decision to decision, or from initiation to termination of the project.

# Development of a Research Matrix for Distributive Education

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## INTRODUCTION

The need for a program of research in distributive education was indicated at a conference held in Washington, D. C. in June 1960. One of the findings and conclusions reported at this conference was the following:

> Distributive education in reaching maturity finds itself in need of principles against which practices may be sounded. During recent years considerable emphasis has been given to questioning educational practices as well as practices in the field of distribution. Distributive educators have been in the unhappy position of having very little literature in their field. Information about the majority of areas basic to the development of the distributive education program has not been available. Such provincialism must be eliminated.
>
> There is tremendous need to find answers and to find ways to get at the answers. Distributive education has arrived at a period in its existence when it is important to locate significant opinion and erroneous opinion. The urgency does not lie in digging up new facts or in conducting research simply in order to have research. In this bread-and-butter stage, the primary job is one that calls for careful thinking to identify and solve problems.
>
> The immediate goals of such an approach can be realized through a 4-step procedure.

1. Identifying the areas in which facts are needed.

2. Finding out who has conducted studies and what these studies have revealed in the areas in which facts are needed.

3. Applying these findings not only to content but also to practices and methodology in distributive education.

4. Conducting studies in the areas in which no answers are now available.

Distributive educators must find out what research has been done or is going on that has implication for distributive education and then find out how this tests out in terms of practices and program operation. The importance of learning how to evaluate both formal and informal research needs to be recognized more adequately. This is a responsibility of all distributive education personnel.

## TIMELINESS OF RESEARCH EMPHASIS

In view of the status of the distributive education program, events taking place in the national economy and in the schools, plus the awakening interest of distributive educators, the present is a timely period for initiating nationwide emphasis on simple, formal, cooperative, and experimental research. The benefits of such emphases will be felt at all levels of program operation through the development of services factually conceived and confidently provided by distributive education leadership.

Now is the time to create the authority and the foundation for growth of the distributive education program. Now is the time to prove distributive education's worth and to reinforce the acceptance and respect of those who are asked to provide funds and lend support to this program. Today distributive educators must find out what they need to know in order to develop the kind of program they want to have several years from now. The trend away from provincialism toward professionalism is evident. Distributive education can become a truly professional field through the quantity and quality of the research it makes available and uses in the development of its program.

In accepting research as the substance of distributive education, it might seem logical to establish a broad base for such activities. Actually the contrary should be true. Distributive education research should have a specific focus in order to bring to the total program a productive concentration of resources and people.[1]

At this conference, considerable attention was also given to the establishment of research priorities. In this regard the following recommendation was made:

In setting up the desired research program it would be important to determine research items for immediate action and others which would be planned for a matter of five or ten years hence. These would be assigned to their proper level and research classification, perhaps by means of a checklist of minimum research to be carried on within each level of activity. This would encourage the designation of a wide range of studies as the preferred action program. The top priority at each level should be given to that research which would help distributive education personnel develop the research habit and the research point of view.[2]

Although this need for a long range program of research was recognized, little, if anything, was done to implement the recommendations made at the National Distributive Education Research Conference in 1960.

The purpose of the first part of this paper is to review briefly the research planning seminar and report the various factors considered in the planning seminar. The latter part of the paper describes and outlines a research matrix which was later developed to fulfill one of the objectives of the seminar.

As a preliminary preparation to the seminar the participants reviewed several publications concerned with distributive education, research design, and research management. During the seminar a review was made of the systems approach and other research management techniques available to determine if any of these could be useful in planning and programming a system with practical applicability in educational research.

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[1]U. S. Department of Health, Education and Welfare, *Patterns of Research in Distributive Education.* Washington, D. C.: Government Printing Office, 1961, pp. 11-12.

[2]*Ibid.*, p. 14.

During World War II the concepts of operations research and the systems approach to research management by scientists and military personnel were developed. In the 1950's, the I. E. Dupont De Nemours Company developed a network analysis technique called the Critical Path Method (CPM) and later the Bureau of Ordinance, U. S. Navy, designed and implemented the Program Evaluation and Review Technique (PERT). Today about 50 variations of formalized planning, scheduling and control techniques can be identified.[3]

This paper will focus upon a technique of planning and programming research that has been found effective in bio-chemical research.

Fundamentally, planning based on network analysis techniques consists of breaking down a project or work effort into a number of elements, determining the logical relationships between the elements, depicting these relationships by means of a network, and making time estimates for the completion of each job or activity.[4] The use of CPM or similar approaches requires that the project or work effort to be planned have several essential characteristics:[5]

1. It must consist of a collection of activities which are well-defined and which, when completed, mark the end of the project.

2. Activities may be started and stopped independently of each other, within a given sequence, thus eliminating continuous-flow process activities.

3. Activities must be in order, in that performance must take place in a given sequence.

4. Target dates for completion of these activities are usually specified.

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[3]R. L. Martino, "Finding the Critical Path," *Project Management and Control*. New York: American Management Association, 1964, Vol. I, p.5.

[4]R. L. Brown, *Network Analysis: Its Use in Research Management*. London: British Coal Utilization Research Association, 1965, Gazette No. 52, p.1.

[5]F. K. Levey; G. L. Thompson; and J. D. W. Wiest, "Introduction to the Critical Path Method," in J. F. Muth and G. L. Thompson (eds.), *Industrial Scheduling*, p.31.

In most instances all of the elements of a research effort cannot be as specifically identified and described with the degree of precision represented by the above criteria.

In research programs, where the tasks to be performed include many unknown variables and parameters, and when many different individuals and agencies are included, it is not possible to estimate accurately the duration of the project.

In research efforts, the concept of "ordered sequence" has meaning only as it refers to the logic of scientific aspects for pursuing one of several lines of research for the purpose of acquiring the information base to pursue additional lines of research or until sufficient information is derived to validate as fact or particular research assumption or to reach an objective.[6] Although the importance of time as a resource must not be forgotten in any type of effort, it seems doubtful that sharp and meaningful time estimates can be developed as to when certain research activities are to be accomplished or objectives reached.

Some of these factors described prevent the direct application of currently available planning and control techniques to research efforts in general and to educational research in particular. Nevertheless, some of the underlying concepts and philosophies inherent in these planning and control techniques can be utilized to construct a general framework for the planning and programming of some types of research efforts.

## WHY PLANNED AND PROGRAMMED RESEARCH

The benefits of applying more formalized planning techniques in such research situations are generally similar to the results experienced in planning other types of programs. Some of the more significant benefits claimed by experienced researchers include: a) the provision of a framework for the selection (in some situations forcing the selection) of goals, objectives, and sub-objectives and a weighing of their importance; b) provision of a means for the orderly integration of many program elements and the determination of interrelationships and interfaces; c) the provision of a logic framework for the establishment of priorities and the determination of required resources, often in the face of competition for resources that are unlimited; d) the prescription of information, monitoring, and decision-making requirements and of responsiblities for operations within the framework of an integrated effort; e) reminding more easily those concerned

[6] H. Eisner, "A Generalized Network Approach to the Planning and Scheduling of a Research Project," *Operations Research*, 1962, Vol. 10, pp. 115-125.

that a sense of urgency may be in order for reaching some objectives and goals.[7]

## GENERAL STEPS IN PLANNING AND PROGRAMMING RESEARCH

There are certain criteria that should be met by a formalized and structured planning technique if it is to be meaningful and useful in the research environment. Two areas are of fundamental concern: 1) the basis for constructing the general program model and its detailed contents; and 2) the basis for determining the sequential order of events.

The formulation of a general model, the identification and description of major elements, and further reduction of major elements into smaller segments (i.e., projects, events, activities, etc.) must be based on research logic, the substance of the work to be performed, and the discipline involved.[8]

The sequential ordering of efforts for performance within the model should proceed from the determination of the logical relationships between elements or events. Since capability to accomplish every event is either not known or cannot be established with any meaningful degree of accuracy, program success or progress is evaluated on the basis of events being accomplished, rather than specified periods of time or pre-selected target dates.

## DEVELOPING A RESEARCH MATRIX FOR DISTRIBUTIVE EDUCATION

A modification of the Convergence Technique was developed to utilize some of the general features of the systems and network approaches in the planning of research.

Basically, the technique involves the determination of a series of elements which are relevant to the overall objective

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[7] Louis Carrese, and Carl G. Baker, *The Convergence Technique--A Method for the Planning and Programming of Research Efforts*. Washington, D. C.: National Cancer Institute, Department of Health, Education, and Welfare, 1966.

[8] *Ibid.*

and sequentially ordered on the basis of research logic, and graphically represented by a matrix.[9, 10]

The basic proposition of the Convergence Technique modified for our purposes may be stated as follows:

> If the logic used for the construction of the matrix represents a valid model of the content of the program to be conducted, and if the sequential ordering of the program elements is accomplished on the basis of this logic, then in reality, as research elements or cells are implemented within the matrix, the intermediate objectives of each step and phase will be achieved and the scope of the program will become narrower until all efforts converge on the end point which has been established as the over-all program goal.[11]

## CONSTRUCTION OF THE MATRIX

Within the framework of some general procedural rules for the development and construction of the program matrix, use of the technique requires the formulation of a logic system judged to be valid for the achievement of specific objectives in the area of research being planned.

The most important steps involved in this process are:

1. The identification of broad areas of needed research.

2. The establishment of priorities of research efforts.

3. The selection and formulation of the end goal of the program and a series of major intermediate objectives requisite to the achievement of the program goal.

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[9] C. G. Baker; L. M. Carrese; and F. J. Rausher, "The Special Virus-Leukemia Program of the National Cancer Institute: Scientific Aspects and Program Logic," *Symposium on Some Recent Developments in Comparative Medicine*, Proceedings of the Zoological Society of London, (in press).

[10] C. G. Zubrod; S. Schepartz; L. M. Carrese; and C. G. Baker, "The Cancer Chemotherapy Program," A report to the National Advisory Cancer Council. August 1965, four volumes, Vol. LV, *Proposal for the National Cancer Institute Cancer Chemotherapy Program.* (In preparation for publication).

[11] Carrese and Baker, op. cit.

4. The identification of the various elements, segments, sub-divisions and dimensions of the program or problem area.

5. The development of a logical system to provide the framework for the delineation of sub-units as indicated by these previously identified elements and dimensions, the determination of the logical-sequential order in which research is to be performed, and the establishment of the interrelationships among the research elements.

In the development of the suggested matrix the general technique including the steps listed above were followed.

## IDENTIFICATION OF AREAS OF NEEDED RESEARCH

After a review of research and the literature relating to research in education and distributive education, the following areas of needed research were identified:

Philosophy and objectives
Curriculum development
Student personnel services (guidance)
Learning processes--teaching methods
Educational programs
Facilities and equipment
Instructional media
Administration and supervision
Evaluation
Teacher education
Research
Manpower needs--employment opportunities

These suggested areas are not necessarily thought of as distinct units or divisions in terms of contents or activities, but separate groupings of logically related categories based on the judgment and experience of those involved in the seminar.

## FIRST PRIORITY--CURRICULUM DEVELOPMENT

Perhaps the most important and difficult decision made at the seminar was the identification of a single area of highest priority. After considerable discussion and reviews of literature and upon the advice of those present at the seminar, curriculum development was judged to be the area of most critical research need.

## DEVELOPING THE GENERAL SYSTEM

Steps three, four, and five outlined in the construction process were all interrelated and the matrices were developed after consideration of the following elements:

Levels of research
Occupational levels
Educational levels
Steps in curriculum research
The competencies within the D. E. curriculum
Standard terminology for curriculum and instruction in distributive occupational classifications

The initial matrix of distributive education curriculum research was developed with the following dimensions or parameters: (See Chart I)

Competencies of areas of instruction
Occupational and educational levels
Steps in curriculum research

Curriculums for instruction in distributive education may be classified as basic job curriculums, career development job curriculums and specialist job curriculums. Each corresponds to a level of employment responsibility and is identified with the degree of competency needed in specific distributive employment.[12] The levels are offered to high school and post-high school students as well as adults.

The substance of the distributive curriculum is identified with the competencies universally needed in distributive employment. The subject matter is divided, therefore, into areas of instruction which correspond to these competencies.[13] Five major categories of instruction are included in each curriculum in order to develop competencies in the following areas:

Marketing
Product or service technology
Social skills
Basic skills
Distribution in the economy[14]

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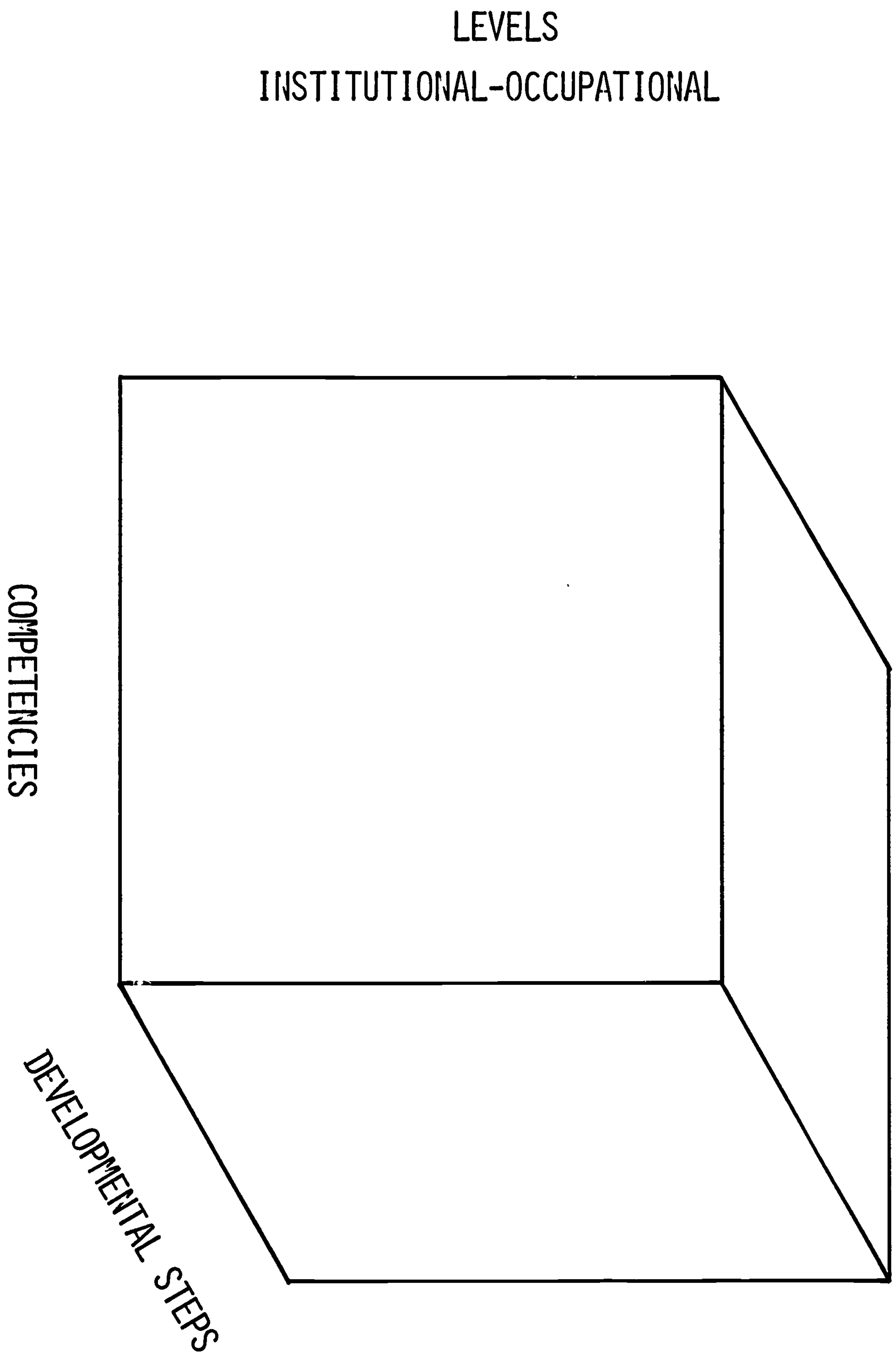
[12] U. S. Office of Health, Education, and Welfare, Office of Education, *Distributive Education in the High School*, Washington, D. C.: U. S. Government Printing Office, 1965, p. 15.

[13] *Ibid.*, p. 21

[14] *Ibid.*, p. 22.




FIRST ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH

CHART I

The generally accepted steps in curriculum development are:

Formulation of objectives
Organizing the learning experiences (content)
Evaluation

Thus, the completed first-order matrix of distributive education curriculum research shows the following parameters and their logical sub-divisions. (See Chart 2)

Educational Levels
- High schools
- Post-high school
- Adult

Occupational Levels
- Basic
- Career development
- Specialist

The Distributive Competencies
- Marketing
- Technology
- Social skills
- Basic skills
- Economic

Steps in Curriculum Development
- Objectives
- Content
- Evaluation

This matrix is the general model containing the major elements referred to on page 48. Its ultimate completion or implementation to the over-all program goal is the convergence.

The sub-division of the matrix into sub-matrices is accomplished through further reduction of the major elements into smaller segments. A conscientious effort was made to observe the logical sub-divisions of each element and the taxonomies or classifications as generally accepted by the discipline.

The development of a sub-matrix involves the same steps and same types of decisions as the development of the original matrix, i.e., the establishment of priorities, the identification of the sub-units and the determination of logical sequential orders of activities.

The marketing competency was selected as the instructional area with the highest priority. Sometimes referred to as the

FIRST ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH AFFECTING LEVELS, COMPETENCIES AND DEVELOPMENTAL STEPS

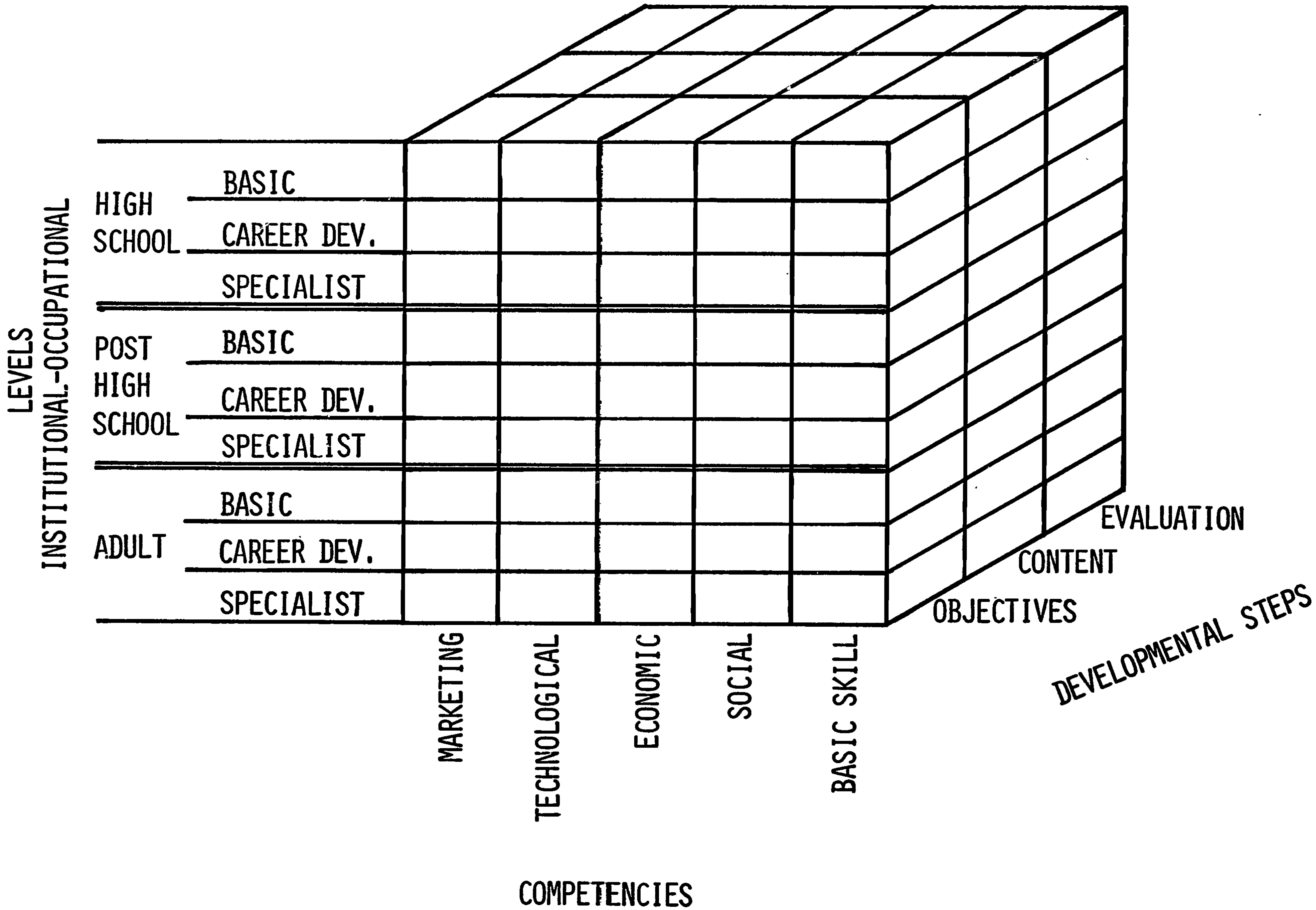



CHART 2

"discipline of distribution"[15] it is the one competency that is unique to our field.

The marketing competency has been classified into six functions:[16]

Selling
Sales promotion
Buying
Operations
Market research
Management

A sample or suggested second order matrix of distributive education curriculum researched on the marketing competency is developed with the six marketing functions as sub-divisions of the marketing parameter. (See Chart 3)

The development of the third order matrix proceeded on the decision that the determination of objectives was the logical first step in the sequential ordering of curriculum research.

Educational objectives have been classified by Bloom, Krathwohl, and Simpson into three domains: Cognitive, Affective and Psychomotor.[17, 18, 19]

This classification was accepted in the sample third order matrix involving objectives of the marketing competency. (See Chart 4)

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[15] Edwin L. Nelson, "Bases for Curriculum Development in Distribution," A paper presented at the National Clinic on Distributive Education, Washington, D. C., October 1963.

[16] *Ibid.*

[17] Benjamin S. Bloom, *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain*. New York: David McKay Co., Inc., 1956, p. 207.

[18] David R. Krathwohl, *Taxonomy of Educational Objectives, Handbook II: Affective Domain*. New York: David McKay Co., Inc., 1964, p. 196.

[19] Elizabeth Jane Simpson, *The Classification of Educational Objectives: Psychomotor Domain*. Urbana, Illinois: University of Illinois, 1966, p. 35.

SECOND ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH ON THE MARKETING COMPETENCY

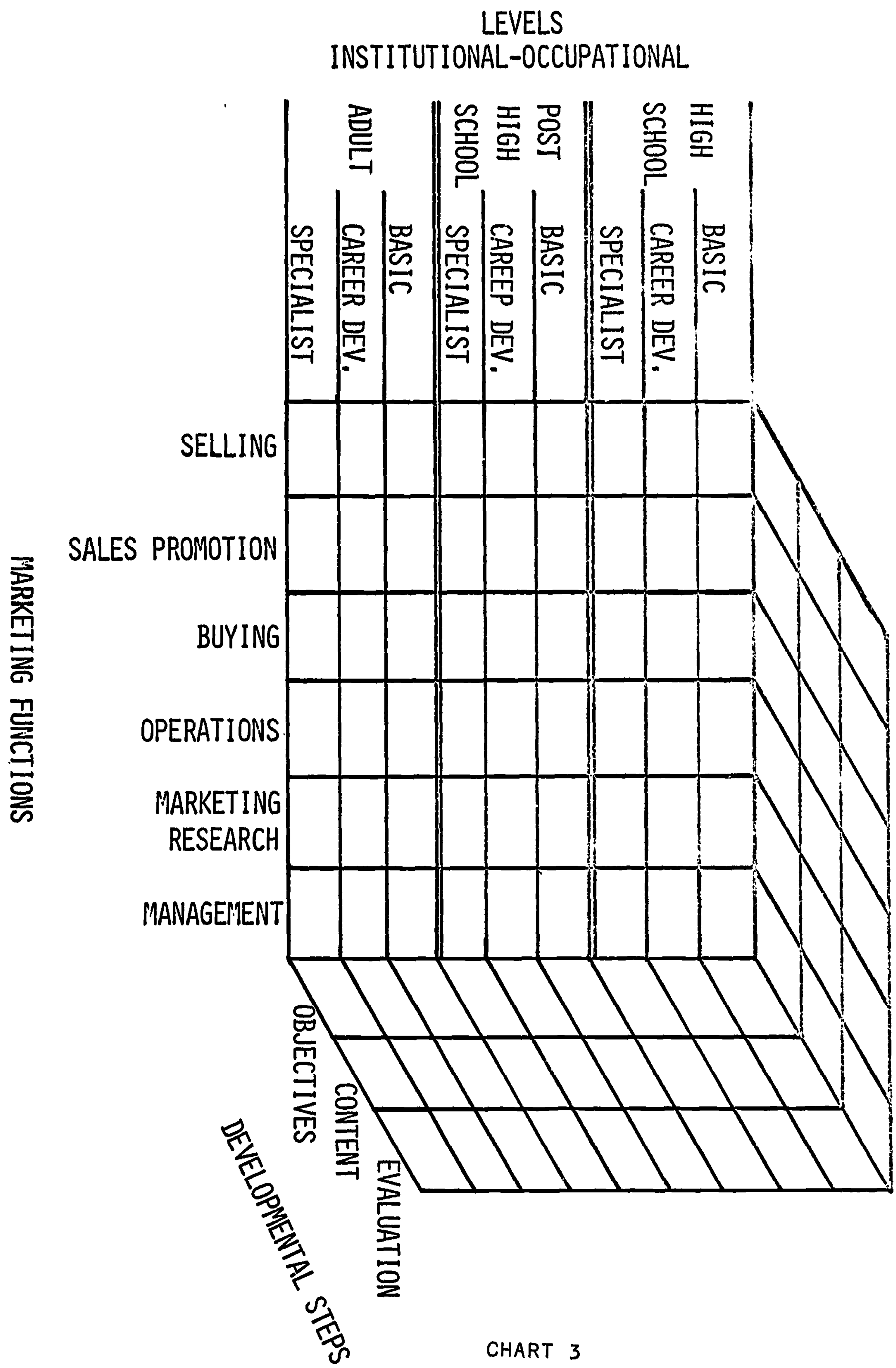


CHART 3

THIRD ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH ON OBJECTIVES IN THE MARKETING COMPETENCY

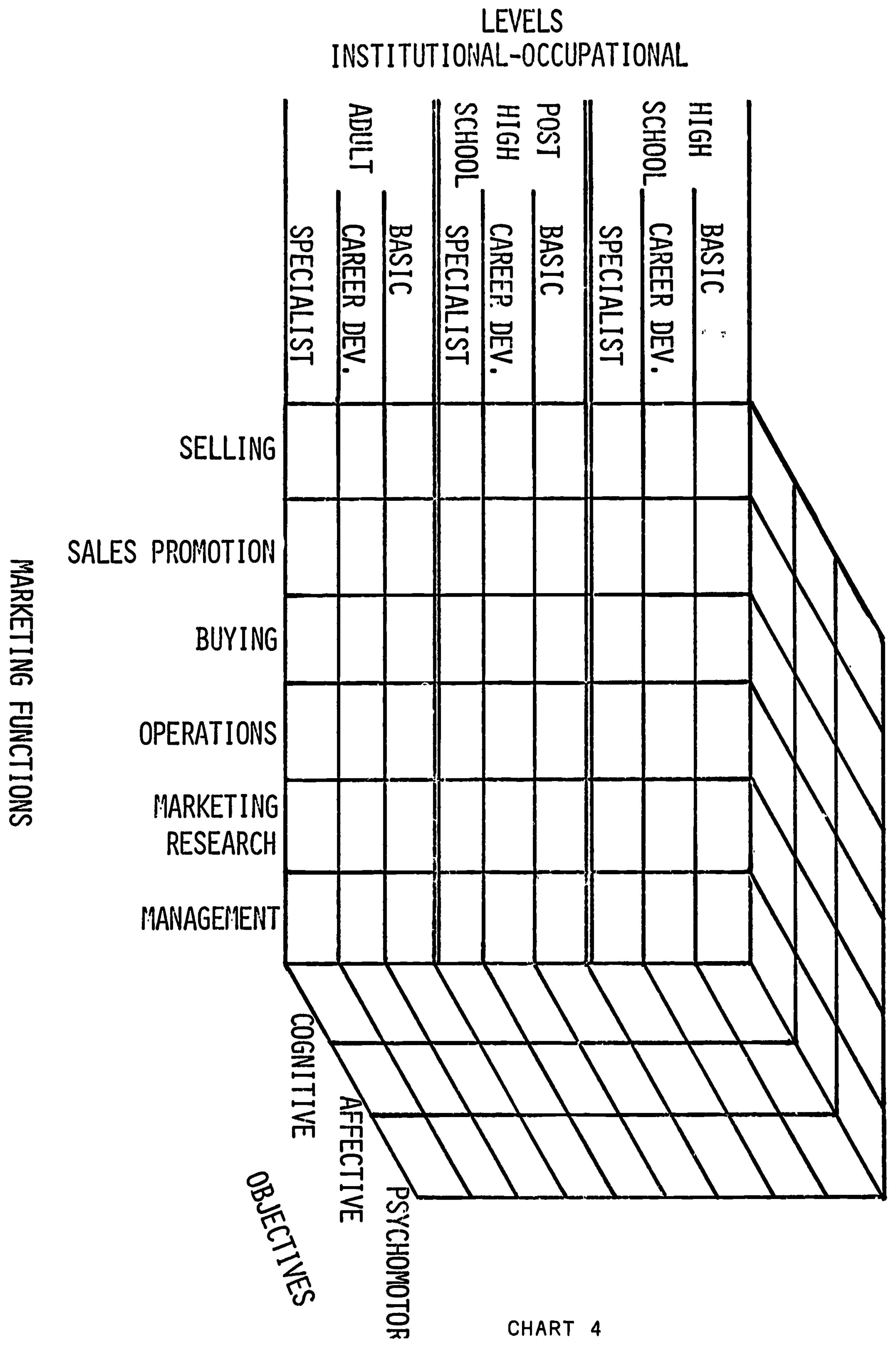


CHART 4

A sample fourth order matrix was developed based on the selling function in general merchandise instructional program listed in the *Standard Terminology for Instruction in Local and State School Systems*.[20] It is evident that in a broad field such as distribution there is diversity in these functions as they are performed in the various areas. In order to break down this function into more accomplishable research segments, the U. S. Office of Education Classification was used. The major considerations affecting this decision was its general acceptance by distributive educators.

The sample fourth order matrix involves the general merchandise program and its interrelationships with the institutional-occupational levels, the three domains of objectives and the instructional programs in the U. S. Office of Education Classification. (See Chart 5)

The fifth order matrix represents further refinements of the U. S. Office of Education Classification by observing their process of sub-dividing the classifications and is concerned with the various general merchandise sub-divisions. (See Chart 6)

Further reductions are possible, e.g., the sub-dividing of the cognitive domain into its broad categories and even further into its various sub-categories. The decisions regarding the extent of these further reductions may be affected by such factors as time, resources, talents and facilities of the researchers. However, it is believed that at this stage a researcher could select any cube within the suggested matrix as an individual research project.

One example of a research effort that would be a logical step in the proposed programmed approach has already emerged, a master's thesis by Oma Rebecca Hawkins.[21] This is an excellent example of the contribution of a single researcher within the framework of a long-range program of research and development.

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[20] U. S. Office of Education, *Standard Terminology for Instruction in Local and State School Systems, State Educational Records and Report Series*. Handbook VI. Washington, D. C.: Government Printing Office, 1967, p. 670.

[21] Oma Rebecca Hawkins, "The Construction and Classification of Educational Objectives to Develop Selling Competencies Needed by Workers in the General Merchandise Category of Distribution," Master's thesis, Virginia Polytechnic Institute, 1968. (Unpublished)

**FOURTH ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH ON OBJECTIVES WITHIN THE SELLING FUNCTION BY THE OFFICE OF EDUCATION CLASSIFICATION**

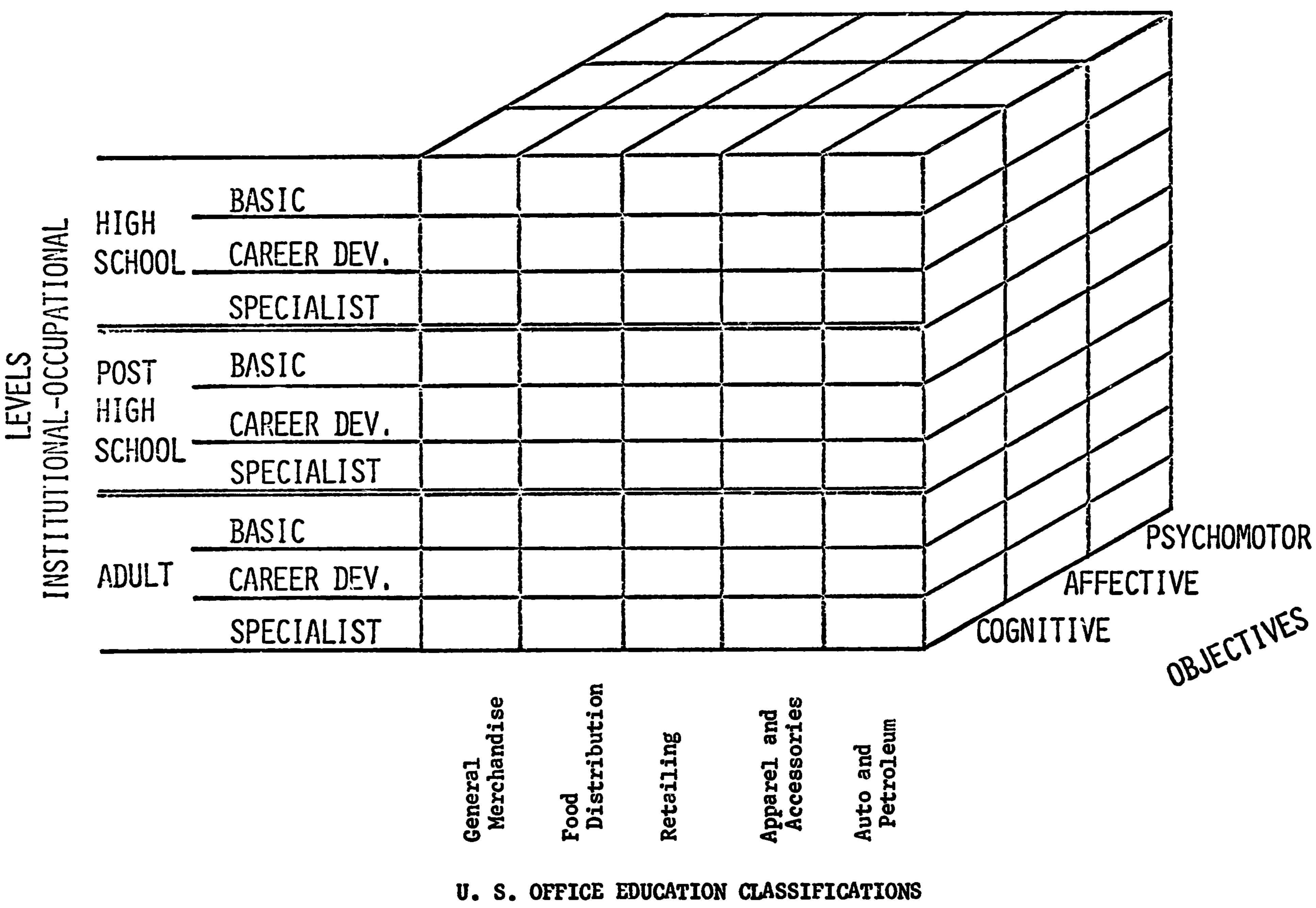


CHART 5

FIFTH ORDER MATRIX OF DISTRIBUTIVE EDUCATION CURRICULUM RESEARCH ON
OBJECTIVES WITHIN THE SELLING FUNCTION OF THE GENERAL MERCHANDISE INSTRUCTIONAL PROGRAM

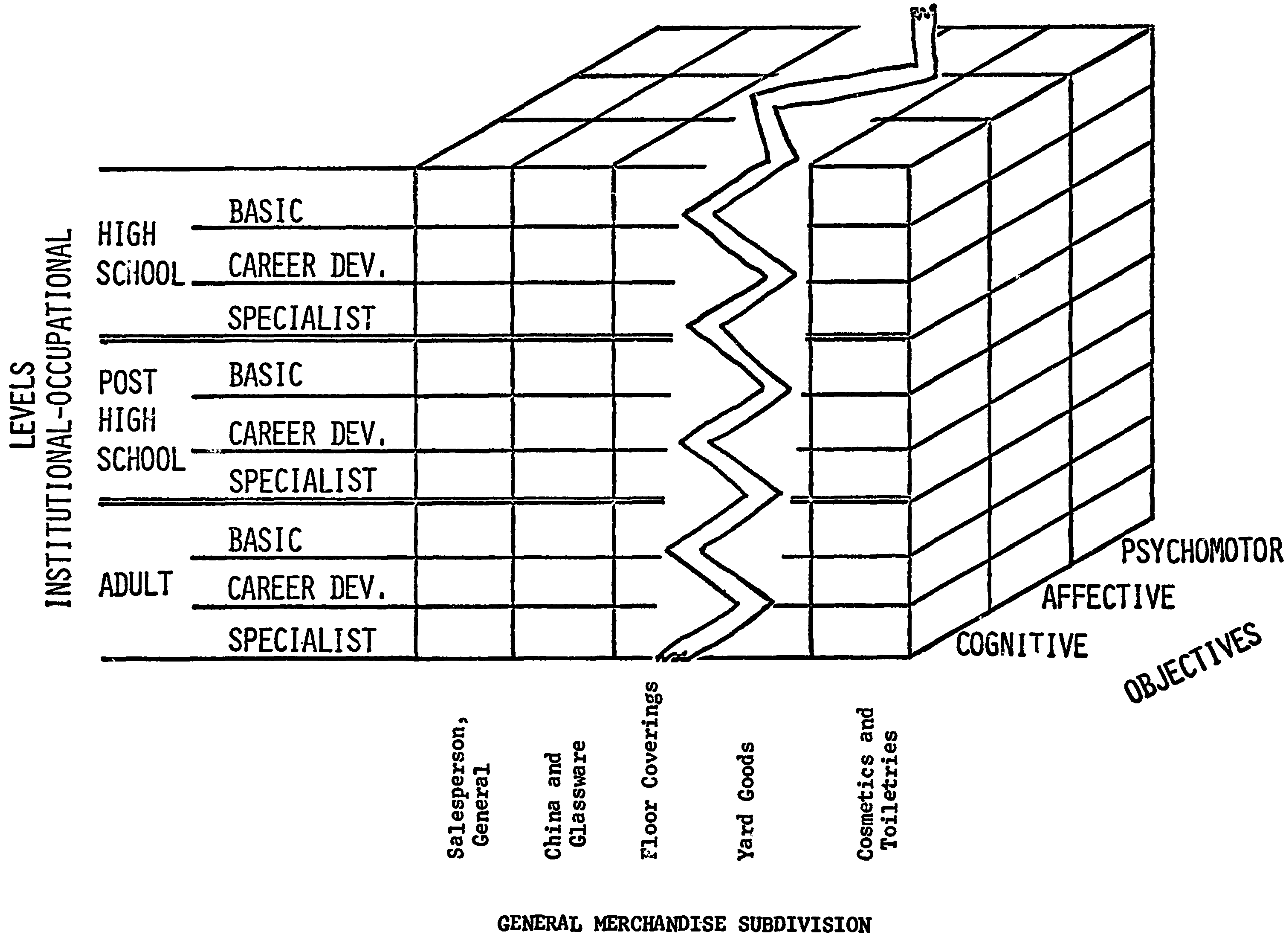


CHART 6

This process of matrix development represents the application of a technique in the planning and programming of research. Neither the technique nor the matrices are considered to be fully developed. Refinements and modifications will emerge with continued applications. As mentioned earlier, this proposed approach represents a modification of a system that has proved effective and productive in biomedical research. Today in distributive education we have a collection of independent researchers and a system of research and development centers, regional laboratories and research coordinating units. It is believed that the proposed matrix can be utilized by all of the above individuals and agencies in the development and implementation of a massive and significant research effort which will yield maximum returns to our profession, our students, and our economy.

# APPENDICES

## APPENDIX 1

### SAMPLING CHART

| Type of Sampling | Brief Description | Advantages | Disadvantages |
|---|---|---|---|
| A. Simple random | Assign to each population member a unique number; select sample items by use of random numbers | 1. Requires minimum knowledge of population in advance 2. Free of possible classification errors 3. Easy to analyze data and compute errors | 1. Does not make use of knowledge of population which researcher may have 2. Larger errors for same sample size than in stratified sampling |
| B. Systematic | Use natural ordering or order population; select random starting point between 1 and the nearest integer to the sampling ration (N/n); select items at interval or nearest integer to sampling ratio | 1. If population is ordered with respect to pertinent property, gives stratification effect, and hence reduces variability compared to A 2. Simplicity of drawing sample; easy to check | 1. If sampling interval is related to a periodic ordering of the population, increased variability may be introduced 2. Estimates of error likely to be high where there is stratification effect |
| C. Multi-stage random | Use of a form of random sampling in each of the sampling stages where there are at least two stages | 1. Sampling lists, identification, and numbering required only for members of sampling units selected in sample | 1. Errors likely to be larger than in A or B for same sample size 2. Errors increase as number of sampling units selected decreases |

APPENDIX 1 (CONTINUED)

| | | | |
|---|---|---|---|
| 1. With probability proportionate to size | Select sampling units with probability proportionate to their size | 2. If sampling units are geographically defined, cuts down field costs (i.e., travel)<br>1. Reduces variability | 1. Lack of knowledge of size of each sampling unit before selection increases variability |
| D. Stratified<br>1. Proportionate | Select from every sampling unit at other than last stage a random sample proportionate to size of sampling unit | 1. Assures representativeness with respect to property which forms basis of classifying units; therefore yields less variability than A or C<br>2. Decreases chance of failing to include members of population because of classification process<br>3. Characteristics of each stratum can be estimated, and hence comparisons can be made | 1. Requires accurate information on proportion of population in each stratum, otherwise increases error<br>2. If stratified lists are not available, may be costly to prepare them; possibility of faulty classification and hence increase in variability |
| 2. Optimum allocation | Same as 1 except sample is proportionate to variability | 1. Less variability for same sample size than 1 | 1. Requires knowledge of variability of pertinent charac- |

| | | | |
|---|---|---|---|
| | within strata as well as their size | | teristic within strata |
| 3. Disproportionate | Same as 1 except that size of sample is not proportionate to size of sampling unit but is dictated by analytical considerations or convenience | 1. More efficient than 1 for comparison of strata or where different errors are optimum for different strata | 1. Less efficient than 1 for determining population characteristics; i.e., more variability for same sample size |
| E. Cluster | Select sampling units by some form of random sampling; ultimate units are groups; select these at random and take a complete count of each | 1. If clusters are geographically defined, yields lowest field costs<br>2. Requires listing only individuals in selected clusters<br>3. Characteristics of clusters as well as those of population can be estimated<br>4. Can be used for subsequent samples, since clusters, not individuals, are selected, and substitution of individuals may be permissible | 1. Larger errors for comparable size than other probability samples<br>2. Requires ability to assign each member of population uniquely to a cluster; inability to do so may result in duplication or omission of individuals |

APPENDIX 1 (CONTINUED)

| | | | |
|---|---|---|---|
| F. Stratified Cluster | Select clusters at random from every sampling unit | 1. Reduces variability of plain cluster sampling | 1. Disadvantages of stratified sampling added to those of cluster sampling<br>2. Since cluster properties may change, advantage of stratification may be reduced and make sample unusable for later research |
| G. Repetitive: multiple or sequential | Two or more samples of any of the above types are taken, using results from earlier samples to design later ones, or determine if they are necessary | 1. Provides estimates of population characteristics which facilitate efficient planning of succeeding sample, therefore reduces error of final estimate<br>2. In the long run reduces number of observations required | 1. Complicates administration of field work<br>2. More computation and analysis required than in non-repetitive sampling<br>3. Sequential sampling can only be used where a very small sample can approximate representativeness and where the number of observations can be increased conveniently at any stage of the research |
| H. Judgment | Select a subgroup of the population which, on the basis of available information can be judged to be representative | 1. Reduces cost of preparing sample and field work, since ultimate units can be selected so | 1. Variability and bias of estimates cannot be measured or controlled<br>2. Requires strong assumptions or considerable |

APPENDIX 1 (CONTINUED)

| | | | |
|---|---|---|---|
| | of the total population; take a complete count or subsample of this group | that they are close together | knowledge of population and subgroup selected |
| 1. Quota | Classify population by pertinent properties; determine desired proportion of sample from each class; fix quotas for each observer | 1. Same as above<br>2. Introduced some stratification effect | 1. Introduces bias of observers' classification of subject and non-random selection within classes |

APPENDIX 2

SIMPLIFIED TAXONOMY OF EXPERIMENTAL STATISTICS

| Type of Data | Type of Samples | | | | |
|---|---|---|---|---|---|
| | One-sample | Two-Samples | | k-Samples | |
| | | Matched | Random | Matched | Random |
| Metric 1 - TREATMENT | | Matched t-test (D 133) (E2 278) (SE 485) (M 101) Two-way Anal. of Variance (E1 158) (M 294) | Random t-test (D 140) (E1 90) (M 102) One-way Anal. of variance (E1 117) (M 265) Anal. of Covariance (E1 281) | Two-way Anal. of variance (E1 158) (M 303) | One-way Anal. of variance (D 178) (E1 117) (M 265) Anal. of Covariance (E1 281) (M 362) |
| k-TREATMENTS | | See K Samples and 1 Treatment | | Factorial designs (E1 175) (M 318) Analysis of Covariance (E1 281) | Factorial designs (E1 175) (M 318) Latin-square (E1 254) Anal. of Covariance (E1 281) |
| Ranked | Kolmogorov-Smirnov (S1 47) one-sample runs test (M 238) (SE 432) (S1 52) | Sign Test (D 236) (E2 288) (M 376) (SE 441) (S1 68) Wilcoxin Matched Pairs Ranks Test | Median Test (D 239) (E2 387) (M 376) (SE 435) (S1 111) Mann-Whitney U (D 240) | Friedman two-way anal. of variance (E2 402) (M 378) (SE 450) (S1 166) | Extension of Median test (E2 389) (M 376) (SE 446) (S1 179) Kruskal-Wallis One-Way Analysis of Variance |

APPENDIX 2 (CONTINUED)

| | | | | | |
|---|---|---|---|---|---|
| | | (D 237)<br>(E2 291)<br>(SE 489)<br>(S1 75) | (E2 417)<br>(M 377)<br>(SE 437)<br>(S1 116)<br>Wald-Wolf-<br>owitz Runs<br>(D 244)<br>(S1 136) | | (D 247)<br>(E2 423)<br>(M 378)<br>(SE 450)<br>(S1 184) |

SIMPLIFIED TAXONOMY OF MEASURES OF RELATIONSHIP
Y-VARIABLE SCALE

| X-SCALE | METRIC | ORDINAL | NOMINAL |
|---|---|---|---|
| METRIC<br>1-variable | biserial r<br>Pearson r<br>tetrachoric r<br>triserial r | Index of order assoc.<br>Kendall's Tau<br>Spearman rho | Eta<br>Point biserial |
| k-variables | Eta<br>Multiple bi-serial<br>Multiple r<br>partial r | coef. of con-cordance<br>Eta | Eta<br>contingency coef. |
| ORDINAL<br>1-variable | Index of order assoc.<br>Eta<br>Kendall's tau<br>Spearman rho | Kendall's tau<br>Index of order assoc.<br>Spearman rho | phi (dichotomous) |
| k-variables | coef. of con-cordance | coef. of con-cordance | contingency coef. |
| NOMINAL<br>1-variable | point biserial | phi (dicho-tomous) | phi |
| k-variables | contingency coef. | contingency coef. | contingency coef. |

| MEASURE | REFERENCE | | | | |
|---|---|---|---|---|---|
| | Downie | Green Edwards | McNemar | Senders | Siegel |
| biserial r . . . . . . . . . | 193 | 188 | 189 | --- | --- |
| coef. of concordance . . . | 209 | 402 | 379 | --- | 229 |
| contingency coef. . . . . | 210 | 381 | 198 | --- | 196 |
| Eta . . . . . . . . . . . . | 199 | 197 | 202 | 229 | --- |
| Index of order assoc. . . | --- | --- | --- | 130 | --- |
| Kendall's tau . . . . . . . | 208 | --- | --- | --- | 213 |
| multiple r . . . . . . . . . | 205 | --- | 169 | --- | --- |
| multiple biserial r . . . | --- | --- | 205 | --- | --- |
| partial r . . . . . . . . . | 203 | --- | 164 | --- | --- |
| Pearson r | 78 | 142 | 112 | 242 | --- |
| phi . . . . . . . . . . . . | 196 | 185 | 197 | --- | --- |
| point biserial r . . . . . | 189 | 182 | 192 | --- | --- |
| Spearman rho . . . . . . . . | 206 | 193 | 203 | 133 | 202 |
| tetrachoric r . . . . . . . | 198 | 190 | 193 | --- | --- |
| triserial . . . . . . . . . | 194 | --- | --- | --- | --- |

| Type of Data | Type of Samples | | | | |
|---|---|---|---|---|---|
| | One-sample | Two-Samples | | k-Samples | |
| | | Matched | Random | Matched | Random |
| | Binomial Test (El 23, 48) (M 46) (SE 404) (S1 36)<br>Chi$^2$ one-sample test (El 64) (E2 221) (SE 402) (S1 42) | McNemar Test for Changes (El 57) (M 52, 224) (S1 63) | t-test for proportions (El 51) (M 50) Exact· probability test (El 55) (S1 96)<br>Chi$^2$ two-sample test (El 69) (E2 367) (SE 418) (S1 104) | Cochran Q test (S1 161) | Chi$^2$ for k independent samples (El 65) (E2 372) (SE 402) (S1 175) (M 230) |

## CODE

| | |
|---|---|
| E1 | Edwards, *Exp. Design in Psychological Research* |
| E2 | Edwards, *Statistical Methods for the Behavioral Sciences* |
| D | Downie and Heath, *Basic Statistical Methods* |
| M | McNemar, Quinn, *Psychological Statistics* |
| SE | Senders, V. L., *Measurement and Statistics; A Basic Text Emphasizing Behavioral Science Applications* |
| S1 | Siegel, Sidney: *Nonparametric Statistics for the Behavioral Science* |

APPENDIX 3

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