

FIFTEENTH
YEARBOOK

STATUS
OF RESEARCH
In Industrial Arts

AMERICAN
COUNCIL
ON
INDUSTRIAL
ARTS
TEACHER
EDUCATION

1966

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EDUCATION

A DIVISION OF THE AMERICAN INDUSTRIAL ARTS ASSOCIATION
AND THE NATIONAL EDUCATION ASSOCIATION

1966

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Foreword

Periodically, the members of a profession must stop and evaluate specific facets of their discipline in order to identify the rate and degree of progress. This yearbook accomplishes this important function in the area of industrial arts research. Within this framework of industrial arts research, the reader will find three major areas of contribution. *First*, the yearbook provides a thorough and descriptive status report on all types of industrial arts research. *Second*, it identifies major shortcomings and needed areas for immediate and future consideration. *Finally*, it provides information on how the teacher educator interested in performing research can overcome his two greatest handicaps — time and financial support.

The publication of the Ninth Yearbook, *Research in Industrial Arts Education*, in 1960, first identified the need for a thorough status report on industrial arts research. The authors of that yearbook discovered a minimal amount of research being conducted by industrial arts teacher educators. There were so few studies in progress or completed that John Fuzak, in Chapter III, stated

The situation with regard to research work as a continuing activity by industrial arts teacher educators is a shocking one. It represents one of the darkest blots on the reputation of the profession.

This statement and the supporting evidence were received with considerable alarm and concern by the members of the profession. The effect of that yearbook, coupled with an increased emphasis on research in all facets of education and society, provided the necessary incentive for industrial arts teacher education research. Although the situation has greatly improved since 1960, the expansion of research activities by teacher educators remains a major goal of ACIATE. The accomplishment of such a goal will be aided by the encouragement and research guidelines provided by the authors of this yearbook.

In addition, the growing availability of research funds, as described in the last chapter, will help dedicated educators overcome the financial burden of well organized and planned research.

The Fifteenth Yearbook will fill a void which has long existed in our profession. There has been a growing need for a single volume of this type which carefully identifies and analyzes the current status of industrial arts research. This book will prove invaluable to teacher educators and graduate students interested in full or partial careers in research. It will serve as a starting point for experienced researchers identifying or investigating a new problem or area of study. Professional researchers from related professions will be able to use this yearbook as a guide and introduction to research in the industrial arts.

The ACIATE gratefully acknowledges the efforts and dedication which the editor and authors have exhibited in the preparation of this volume. They successfully maintained the high standards of professional writing and thorough investigation which the organization has encouraged and sought for the yearbook series. It is through their dedication that the status and progress of the profession in the area of industrial arts research has been recorded in this volume.

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Preface

The production of a Yearbook on research is a prolonged exercise in the making of value judgments. At the onset it is necessary to make fundamental decisions regarding the structure of the Yearbook and then individual authors must decide what to include and what to exclude with reference to their individual chapters. Yearbook XV is characterized by both breadth and depth. No claim is made, however, that all important studies, of recent years, have been reviewed, nor have all areas of research been included.

Yearbook XV is more than a status report to the profession. In addition, a direct attempt has been made through examples, suggestions, and procedures to illustrate what may be done in research, and how one may secure support for such research. Whether or not these varied approaches have merit will depend on the responsiveness of industrial arts teacher educators.

There are still very few people in our field, in contrast to most other professions, who devote full time to research for any period of time. Most of our researchers continue to carry a part-time teaching assignment. An interesting question may be raised as to *why* some in our profession have not been content to be just consumers of research, but have elected to join the ranks of producers. This writer suggests that most individuals of this type developed strong research commitments during their graduate study as a consequence of close association with and direction by professors who were actively engaged in research, and hard, yet satisfying work on thesis and dissertation problems that were of personal interest and that were recognized by the profession as important and at the same time, provided significant training for future research. These individuals and others (perhaps those who will become involved in special research training programs under Title IV of the Elementary and Secondary Education Act of 1965) will find a greatly im-

proved climate for research at the smaller colleges and universities. In the final analysis, *initiative* to do research will still rest with the individual industrial arts teacher educator. When we begin *to really recognize* that research is as important as most of our traditional teacher education functions, we will likely experience progress of the sort that is without precedent in our profession.

JOHN D. ROWLETT

Editor

CHAPTER ONE

Introduction

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Any field quickly can become moribund if it lacks adequate research. Industrial arts is no exception. The speed with which danger becomes imminent is particularly great if allied or competitive fields are developing rapidly. The extensive changes occurring in technology, occupational structure, availability of free time and leisure time, population mobility, distribution of the population, lengthening periods of school attendance, and a host of similar developments are well known. Developments are occurring daily in programs designed to cope with some of these changes, e. g. technical education, manpower development and training programs, the job corps, work-study programs, federally reimbursed vocational education, recreation programs, studies designed to effect curriculum revision. All of these changes and all of these programs plus many, many more have an impact upon industrial arts.

Research involves a quest for new knowledge or for more fruitful interpretations of facts which are already known. In the face of the changes noted above, unless industrial arts develops an even stronger research program, it will tend to remain static, less and less related to reality, and less and less effective in comparison to competitive programs which are designed to meet needs of society which could and perhaps should be met by industrial arts. Change can occur without research and planning, but such change will be blind, random, and unevaluated.

Obstacles to the Development of Research in Industrial Arts

Six principal obstacles have retarded the growth of quantity and quality of research in industrial arts. There is a great deal of inter-relationship among these obstacles, but it may be appropriate to discuss each of them separately.

Shortage of Trained Personnel

In theory, those who are responsible for preparing trained personnel in any professional field have a responsibility for forecasting demand and for preparing people for positions which will exist, rather than for those which have existed. In practice, however, this ideal is seldom achieved except in a few isolated institutions, and then usually only for brief periods of time. Most professional schools are content to prepare for the market of the moment. Thus, when employers of industrial arts teachers and industrial arts teacher educators wanted only better trained woodshop and drafting teachers, this is what most teacher-education institutions and graduate programs produced.

If the shortage in quantity and quality of such teachers seemed to increase, there was a rash of convention programs demanding more effective undergraduate and graduate instruction in skills. Similarly, if skills seemed to be over-stressed at the moment, an outcry was raised for increased emphasis on cognitive and attitudinal aspects of the program. Most teacher education programs tend to move in response to these demands. Almost certainly the current outcry for preparation of competent research personnel will lead to similar curriculum revisions, whether or not well prepared teacher education personnel are available to implement them. It is a rare institution that may be expected to maintain a balanced program based upon careful estimates of teacher needs for the future.

Failure to Utilize Personnel from Related Disciplines

The most obvious source of immediately available research manpower (and manpower for curriculum revision as well) lies in disciplines which are related to industrial arts. These include industrial sociology, industrial psychology, industrial relations, industrial anthropology, economics, and economic and industrial history. Personnel from these fields can be induced to study problems which are of interest to industrial arts. Personnel

from these fields can teach certain subject matter in industrial arts much more effectively than can many of the personnel now employed in our college and university departments of industrial arts. There seems to be no valid reason why any sizeable industrial arts program, either in high school or college, should not employ specialists from these disciplines to teach certain of our courses. Certainly such specialists could do a far better job than could a man who has not studied industrial sociology except from another industrial arts man, who in turn learned from another industrial arts man, ad infinitum.

Similarly, research projects in industrial arts must employ such people, at least as consultants, to assure that our research, as our teaching, does not become inbred. Industrial arts researchers who have learned research in part through working on teams with people from other disciplines inevitably will be more broadly based than those who have not had this experience.

Not only do we frequently fail to use the advice and services of personnel from related disciplines, we also fail to use their findings. How many industrial arts researchers know of Bric-kell's *Organizing New York State for Educational Change* or deGrazia's *Of Time, Work, and Leisure* or even such a classic as Weber's *The Protestant Ethic and the Spirit of Capitalism*?

Disagreement on Objectives

Industrial arts, probably more than any other profession, remains quite unsure of its objectives. Manual training may have had the wrong objectives for the wrong reasons, but at least it had a good idea of where it was going. Industrial arts has no such assurance. At various times during our history, industrial arts as general education, as pre-vocational education, as pre-technical education, or even as vocational education, has had numerous adherents. It appears that even today many people in our field do not know what their goals are, so it is difficult to plan research and implement programs which can be goal-oriented.

Emphasis on Teaching in Higher Education

While many critics of academia bemoan the "flight from teaching," and "publish or perish" as an indication of gross overemphasis on research activities in higher education, it should be apparent that they have not studied the industrial

arts teacher education field. *Our* typical academic lock step is a career progression, based upon seniority, from woodshop teacher to drafting teacher, to teacher of "professional subjects," until at last, the senior professor becomes the department head and hence "Custodian of the Keys." There is no reward for research, so research does not get done. Teaching loads which are comparable to those in public schools may result in a motto of "publish *and* perish," for if the person who writes does not perish from his writing at night and on weekends, his demise may occur from the jealousy of a frustrated department chairman who cannot bear to see the young staff member get recognition which he himself has never been able to achieve. Too frequently, the frustrations of the Custodian of the Keys lead him to insist on being the sole advisor of doctoral candidates. With no research experience to transmit to the candidates, he actually detracts from the cultivation of a new crop of researchers.

Use of the Dissertation for Instruction Rather Than Research

Anyone who has frequented industrial arts departments which award doctorates has heard the phrase, "your dissertation is a learning experience." The statement is, of course, very true. Moreover, if the dissertation topic is chosen at the whim of the individual, and is completely unrelated to other studies, or to problems of theoretical interest to the field, it remains *only* a learning experience for the individual. If the topic is properly chosen, however, it can in addition contribute to the sum total of knowledge in the field. Properly planned, a series of dissertations can shed remarkable light upon some of the unexplored avenues of industrial arts and can allow each of these dissertation writers a feeling of accomplishment. Far too often, the doctoral student's greatest wish after passing through one of these "learning experiences" is to forget about his dissertation and research altogether because he is ashamed of his contributions to knowledge. These feelings of inadequacy are reinforced by the use of doctoral committees which are stacked with industrial arts educators. The doctoral candidate is apt to feel that this was done to protect him, when the real reason was to protect the reputation of the department. The effect on the quality of the dissertation is clear, for the author is denied the help of persons from a variety of disciplines.

Shortage of Funds

No catalog of obstacles to research would be complete without reference to a lack of funds. Almost every subject matter field in education now has funds earmarked for its use except industrial arts and physical education. Moreover, until very recently, it was quite difficult to secure funds for research in industrial arts from any sources of funds which were theoretically available to all of education.

This shortage has applied not only to funds available from outside the field, but also to funds available within it. Since industrial arts has had a relatively costly program which has had low prestige, the tendency has been to ask administrators for funds for equipment and for supplies which were necessary to operate the instructional program, and to recognize that the administrator's tolerance for expenditures has been reached well before internal research funds could be requested. In all fairness to administrators, however, it should be pointed out that money tends to become available for research when worthwhile research ideas appear. It would be difficult to quarrel with a flat statement that we have had very few ideas for research which would justify substantial allocation of funds for their investigation.

Changes in the Research Climate

In spite of the generally pessimistic tone of the earlier parts of this chapter, it must be recognized that changes are occurring and that the climate in industrial arts is definitely more conducive to research now than in the past.

Increasing Availability of Trained Researchers

A small number of persons who are competent both in industrial arts and in research techniques has become available during the last few years. These persons, who generally see a need to supplement their skills with expertise from persons from other disciplines, are gradually expanding the quality and quantity of research being done in our field. Each place where they are working is likely to become a germination bed for the training of other researchers, so in the absence of some strong opposing force, we should be able to look forward to a geometric expansion of their number. Every one of these re-

searchers who is drained off into administration, or full-time teaching, or industrial employment is almost certain to mean the loss of a much larger number of potential researchers who do not receive training because their mentor is gone. Trained researchers, who represent the capital goods of research development, must be conserved and cultivated carefully if we are to continue to make progress.

Availability of Funds

The rapid expansion of funds for research in general education and the liberal interpretation which has been placed upon the use of research funds earmarked for vocational education, have led to a marked increase in potential support for studies in industrial arts. There is not now (nor is there likely ever to be) support for studies which are poorly formulated, lack educational significance, are poorly staffed, or are economically unjustifiable. Nevertheless, the research study which meets each of these criteria minimally is much more apt to be supported today than it was even two or three years ago. Any research study which uses these relatively scarce funds should be planned to add not only to our general knowledge, but to our supply of trained researchers.

At the present time, funds from the Vocational Education Act of 1963 are available for industrial arts studies. Absolutely no prostitution of goals need be made to secure support. There is a real possibility that an opportunistic researcher may bend his study in a vocational direction, however solely because he thinks it is necessary to get support. Moreover, it is already clear that certain jealous industrial arts professors are willing to charge prostitution of goals when none exists.

Insistence by Additional Institutions on Scholarly Publication

More and more former teachers colleges want to be called universities and to behave like universities. More and more industrial arts departments in universities want to be as academically respectable as other departments in their institutions. Inevitably this seems to lead to an insistence on scholarly publication as a criterion for the various types of rewards available to professors. More and more school systems want to be known as innovators rather than as followers, so they tend to reward teachers for scholarly publications. These developments will lead

and have led to the production of a great deal of trash which does not deserve publication. Nevertheless, they have led also to the production and dissemination of many worthwhile ideas. As these trends continue, it is to be hoped that there will be greater insistence upon quality rather than upon quantity. If this occurs, the field will begin to advance much more rapidly.

Recognition of Varied Objectives

Perhaps the most hopeful sign for research in industrial arts is what appears to be a recognition that industrial arts has different programs with different objectives, rather than one program with a general education objective. It was difficult for a researcher to avoid symptoms of schizophrenia when he had to pretend that he did not observe a high school industrial arts class in which the teacher had a prevocational objective, the students had a variety of objectives ranging from vocational to pre-engineering, while the teacher and the course description stated that the course had only general education objectives. Whenever it is necessary to pretend that actual differences do not exist, research is impossible. Whenever there is freedom of inquiry and no "party line," then research can prosper.

Deficiencies Which Still Remain to be Corrected

All of the obstacles to the development of research in industrial arts which are listed above still remain to some extent uncorrected. Of these obstacles, however, undoubtedly the most important is the extreme shortage of research personnel who are interested in the study of industrial arts problems. Trained personnel who have ideas can find funds. They can establish their own tentative objectives, if the rest of the field cannot agree upon them. They can use the current imbalance between supply and demand for trained personnel to bargain for enough released time from teaching to accomplish their research, or, failing that, can buy freedom from certain instructional duties in order to conduct research under outside auspices. In most situations, they can secure access to graduate students and teachers and train them on the job in research. If they direct dissertations, they can make certain that these experiences provide information which is additive rather than fragmentary and isolated. If they are extremely well trained, they will have no hesitation in calling upon people from other disciplines for

assistance, because they will feel secure and unafraid of the comparisons which inevitably will be made. Every researcher and every administrator should take this as a personal challenge. It may be that twenty years from now we, too, will be deploring the flight from teaching. We have a long, long way to go, however, before our individual flights become migrations, and hence a cause of worry.

In the meantime, we are making very real progress. Half a dozen sizeable research efforts, involving people from a variety of disciplines and from a variety of schools, are hard at work on some of our most vexing problems. Research resources from external agencies have helped to develop support from internal, institutional funds. The prospect is the best it has been for many years, as will be seen from the following chapters.

CHAPTER TWO

Research Related to the Achievement of Industrial Arts Objectives

WESLEY S. SOMMERS AND WESLEY L. FACE

Stout State University

“. . . neither my colleagues nor I are acquainted with any studies relating to the achievement of industrial arts objectives.”

“I think this is an interesting topic for such a research study and surely someone somewhere has done something in this regard.”

“In its narrowest sense this assignment would seem to imply collecting the results of experimental research directed toward behavior changes. I imagine that this could be reported on a postcard.”

The above statements are representative of the responses from leaders in industrial education concerning a request for information on the topic under study. The authors of this chapter faced the prospects of preparing this manuscript primarily concerned with how to present the available research in a form which would be both interesting and informative. After a review of the professional journals there was some concern as to whether such research had ever been undertaken. An obvious answer to the problem appeared to be that of contacting educators throughout the country. The responses were kind and did result in the identification of a small body of research which directly relates to the assignment.

Some thought was given to the possibility of broadening the problem. This was even implied when the editor of the yearbook inadvertently referred to the subject as “Research Related to Industrial Arts Objectives.” One of the letters of

inquiry also produced this reflection: "That word *related* would seem to give you the *divine right of kings*." The subject was selected by the yearbook committee as being significant and accepted by the writers as an important body of research which needed to be reported, so no change was made.

It is not the intent of the writers of this chapter to promote any specific set of objectives which have been proposed for industrial arts. It is the intent of this chapter (1) to review several studies which have been undertaken, (2) to propose a strategy for developing a structure of industrial arts objectives, and (3) to propose several considerations to be made in the preparation of educational objectives.

Review of Available Literature

It should be noted that this review makes no claims to cover every piece of research that has been undertaken dealing with the achievement of industrial arts objectives. The studies reported are those which leave little doubt as to their applicability to this chapter. No attempt has been made to summarize the various articles and reports which logically promote or propose a particular set of objectives. These statements usually establish a rather logical base for the objectives they propose but rarely attempt to evaluate their success in meeting these objectives.

Each of the studies to be described was undertaken by students as a part of the requirements for the master's or doctor's degrees. This would appear to be unfortunate. This is not intended as a criticism of the specific studies, but rather a challenge to the field. Certainly a subject of this importance deserves the concentrated study of a research staff and should not be left to students who are in the process of developing their research talents.

James Bailey (1961) attempted to ascertain the relation of experiences in industrial arts to achievement in design. Data for the study were obtained by administering a design test to 806 students in 31 high schools in Michigan. Six groups of high school senior boys with increasing amounts of industrial arts were compared on their knowledge of design. Analysis of variance was used to find if the groups differed significantly in their design scores, intelligence, and scholastic ability.

Based upon the findings of this research Bailey reported the following conclusions:

1. Continued study of industrial arts does not yield an advanced knowledge of design.
2. Students who elect an increasing number of industrial arts courses tend to be of lower intelligence.
3. Students who elect an increasing number of industrial arts courses tend to possess lower scholastic ability.
4. Neither industrial arts departments nor art departments are making significant contributions to the design knowledge of high school senior boys as measured by the test instrument utilized in the study.
5. In general, the more intelligent students are, the less likely they are to elect more than one unit of industrial arts.

Walter Burdette (1955) proposed to determine the extent to which industrial arts instruction has contributed to the consumer knowledge possessed by high school boys, concerning the selection, uses and care of industrial products. A specially constructed instrument was used to examine 781 high school senior boys in twenty public schools in Central Minnesota. These conclusions may be noted in Burdette's study:

1. More consumer knowledge is possessed by high school boys concerning the care of industrial products than that which relates to the selection and use of industrial products.
2. Students of individual schools vary in the consumer knowledge possessed with respect to industrial products depending upon the scholastic aptitude of the students of such schools, the amount of instruction in industrial arts they receive, its quality and the emphasis given consumer knowledge in such instruction.
3. The size of the school has little if any relationship to the consumer knowledge possessed as a group by high school senior boys.
4. Students who take industrial arts courses are likely to be below average, as a group, in scholastic aptitude, and the group scholastic aptitude is likely to be still lower than average with increased amounts of industrial arts.
5. Industrial arts instruction has little influence on the consumer knowledge, relating to industrial products, possessed by high school boys of low scholastic aptitude.

6. As the scholastic aptitude of the high school boys more closely approximates the average, the contributions of industrial arts instruction to the consumer knowledge possessed can be expected to be moderate in extent.

Wendell Deen (1964) conducted a study to investigate the degree to which industrial arts teachers were fulfilling the objective of developing student understanding of modern tools, processes, and materials of industry. A questionnaire was distributed to industrial arts department chairmen in 108 randomly selected high schools in California. Deen was attempting to determine the various methods that were being used to develop industrial awareness. He found that:

1. Cooperative group studies, field trips, and speakers from industry were not commonly used in teaching industrial arts.
2. Few instructors require modern industrial occupational research.
3. Drawings of shop projects were required by a vast majority of teachers.
4. Learning tool names and parts was almost a universal requirement.
5. Students occasionally carried industrial arts experiences into hobbies.
6. The respondents also indicated a lack of interest and ability in student-teacher occupation discussion, request for advanced books, and industry trips by individuals.

Deen was apparently equating the learning of industrial awareness with the type of methodology being employed in the industrial arts classroom.

Richard Hartman (1964) as a part of the requirements for the Master's Degree, attempted to determine to what extent the attainment of the goals of industrial arts increased pupil awareness of the industrial society. It was his objective to determine if a pupil's ability to identify stock metal materials and metal manufacturing processes will be increased through industrial arts metalworking courses to a greater degree than that which might be expected as a random occurrence. A testing device, which consisted of panels containing samples of selected materials and illustrations of metalworking processes, was used with test questions appropriate to each sample. This testing device

was used with all sixth- and ninth-grade boys and girls within Berks County, Pennsylvania. It was found that the mean scores of ninth-grade boys who had received metalworking instruction was significantly higher than ninth-grade girls, sixth-grade boys and sixth-grade girls.

On the basis of the data gathered Hartman concluded:

1. Significant differences do exist between pupils who had industrial arts experience and those who did not.
2. A pupil's awareness of the industrial society in which he lives appears to be increased through participation in industrial arts education.
3. A core of common metalworking knowledge was found to exist in each school district.

John Hawse (1964) studied the amount of agreement held by industrial arts leaders in Illinois, industrial arts teachers, administrators, industrial employment officers and parents from Lake County, Illinois as to the relative importance of the nine industrial arts objectives published by the AVA in 1953. An opinionnaire was developed with the aid of a jury of 36 industrial arts doctoral students. The instrument consisted of six descriptive statements for each of the nine AVA objectives. Each statement described a characteristic that might be possessed by a boy upon graduation from high school. The respondents were asked to rank each characteristic according to its importance.

Hawse found in analyzing these data that there was agreement in opinion among the five population groups used in the study. All groups rated Objective 2 (Appreciation and Use) as "desirable," and the following five as "very important": Objective 3 (Self-rationalization and Initiative), Objective 4 (Co-operative Attitudes), Objective 5 (Health and Safety), Objective 6 (Interest in Achievement), and Objective 7 (Orderly Performance). Four of the five population groups agreed on the ratings of the other three objectives. The author concluded, from the findings of his study, that there is basic agreement on the value of the industrial arts objectives subscribed to by industrial arts teachers.

Bryce March (1961) attempted to assess informational and problem solving achievement in industrial arts mechanical drawing, electricity, metalwork, and woodwork as listed by instruc-

tors and state courses of study. Test items were developed from the content entitled "Things the student should know." A test instrument was developed and administered to seventh-, eighth-, ninth-, and tenth-grade students enrolled in industrial arts in Missouri during one scholastic year. The major findings were:

1. The highest ranking factors being taught were found to be closely associated with the importance ascribed them by the teachers.
2. The results of the test indicated that the students of teachers with Master's degrees were superior to students of teachers with Bachelor's degrees.
3. There was significant difference between the informational content achievement evidenced by the student of the inexperienced and the experienced teachers.
4. Ninth-grade industrial arts students who had industrial arts in the seventh and/or eighth grade had better informational achievement results.
5. The students in the districts other than the large city systems obtained the highest scores.

Lloyd Nelson (1955) studied the extent to which selected factors are operative in a youth's original choice of a hobby and his subsequent development in that hobby. The main purposes of the study were to:

1. Develop an instrument which could be used to identify factors and circumstances associated with the leisure time activities of high school students.
2. Test selected hypotheses associated with circumstances which influence the youth to get interested in his present hobby.
3. Test selected hypotheses relative to factors involved in a youth's development of interest in his hobby subsequent to his initial interest.

Data were gathered from high school students through the use of an initial questionnaire and a structural interview. There was insufficient evidence to single out any one factor as a strong influence. Neither the age of first interest in the hobby nor the range of participation in other activities had significant effect upon hobby strength at high school age.

Joe Talkington (1962) compared the Q-Sort responses of the industrial arts teachers in the public schools of Colorado

with the Q-Sort responses of thirty-five selected prominent persons in industrial arts to determine whether there was unity of direction as to the priority of industrial arts objectives on a state and on a national level.

The Q-Sort instrument used in this study consisted of fifty-four behavioral statements which were representative of the nine industrial arts objectives established by the AVA. Each statement was printed on a card. The participants were asked to arrange the cards into an order of importance in describing the desired behavioral change for a "typical" industrial arts student.

In comparing the work of objectives of the prominent persons with the Colorado industrial arts teachers, the two groups gave identical rankings for the following three objectives: Objective 7 (Habits of Orderly Performance) in first priority; Objective 9 (Shop Skills and Knowledge) in second priority and Objective 3 (Self-Realization and Initiative) in eighth priority. Disagreements on the priority ranking were found on the remaining six objectives. This led Talkington to conclude that a unity of direction for industrial arts objectives was not found on a state or a national level.

Toward an Operational Structure of Industrial Arts Objectives

The original purpose of this chapter was to review and summarize research effort related to how well industrial arts was achieving its objectives. As a result of the search for pertinent studies, new goals for the chapter evolved. In addition to presenting the indictment that there has been little effort to evaluate industrial arts in terms of its own objectives, the authors felt an obligation to suggest an approach to improving this effort.

The original charge to the authors implied that there does exist, or should exist, a significant research effort to evaluate industrial arts in terms of its stated objectives. A reasonable search of the literature and survey of leaders in industrial education revealed a minimal amount of such evaluative effort; and that which did exist was a smattering of unrelated and uncoordinated studies. In addition, it was noted that such studies resulted from the efforts of graduate students working to fulfill requirements for a degree. In sum, research related to the achieve-

ment of industrial arts objectives has been scarce, uncoordinated, and has been conducted by graduate students.¹

Identifying Basic Structures

The lack of evaluative research in industrial arts, although serious of itself, has focused attention on a serious defect of greater priority—the lack of an *operational structure* of objectives. Such a structure must be specific enough to provide guidance for developing and evaluating programs and must meet with general consensus of the profession. This structure is an imperative to the future success of industrial arts.

Without the establishment of an acceptable operational structure of objectives, there can be no rational evaluation, and it is not logical to expect educators to support a program of industrial arts when there has been little done to evaluate it.

The authors consider two areas as important to the development of the required operational structure: (1) the strategy necessary for development, and (2) the specific guides to the form and content of such a structure.

Strategy for Developing Structure

The remainder of this section is concerned with suggested steps that should be taken in order to achieve the very necessary operational structure of industrial arts objectives. The steps listed here are only intended as a guide to the type of planning and action that must take place in order to achieve the desired structure—a feasible plan would have to be worked out by those persons having actual planning responsibilities.

The first requirement is that the leadership in industrial arts must take this need seriously—in other words, there must be a national commitment to develop such a structure of objectives. There must be the realization that unless industrial arts has a uniform and rigorous set of goals it cannot expect respect from either its own or other professional educators. Without

¹EDITOR'S NOTE: Since this chapter was written, the *National Commission on Industrial Arts Education* has been established by the AIAA and is to be funded with a grant. This commission represents business, industry, labor, and government, as well as industrial arts and related educational disciplines. It is a three-year study to: (1) determine objectives for each level from elementary school through higher education, (2) define the body of knowledge, and (3) define student behavioral characteristics for each level. Eleven members and a curriculum specialist have been appointed by the AIAA president and approved by the executive board. The chairman of the commission is William J. Micheels, president of Stout State University.

national commitment, the first and most important step cannot be taken.

The development of the objectives must be a coordinated effort involving members of all professional industrial arts organizations. This coordinated effort should bring together the top theorists and practitioners in industrial arts.

The planning for the development of this structure as well as the execution of that planning should follow the best in good industrial management techniques. It is suggested that an excellent technique to be used for this planning would be the PERT (Program Evaluation Review Technique) program that is now being employed by two major curriculum projects directly related to industrial arts.

Some of the major steps in the development process can be identified as:

1. Representatives of the national professional organizations should meet together to establish an initial steering committee.
2. A specific group created by the initial steering committee should spell-out the preliminary goals for the development of the operational structure of objectives.
3. A group should be established to obtain material and financial support for the project.
4. A project manager or coordinator with a permanent staff should be appointed.
5. Advisory groups to react and advise the permanent staff should be identified.
6. A fully developed PERT program should be organized for planning and implementing the project.

The total development would be a long-range project. The goals of this project should be a structured set of objectives that are specific enough to be used to develop learning activities that go to make up an industrial arts program as well as being used for evaluative research. Obviously, the above steps are not a specific plan—they are simply an approach to the development of a feasible plan.

The initial step is critical in the light of our professional history. Few, if any, knowledgeable persons in industrial arts will argue that the existence of competing professional organizations has not weakened industrial arts through the dilution

of effort, the confusion of aims, and outright conflict. It is doubtful if industrial arts should continue the debilitating luxury of separate and competing professional groups.

The major purposes of the initial steering committee are to: assure support of all persons and institutions concerned with the survival and advancement of industrial arts; create a specific group responsible for getting the project underway; and provide general guiding statements of purpose to that group.

The specific group identified by the initial steering committee has the responsibility for: establishing the statement of goals related to the specific project of developing an operational structure of objectives; developing a general plan for achieving the goals; initiating the activities necessary to provide adequate project support; and the appointment of a full-time project director and staff. If possible, this group should be a permanent committee responsible for close guidance and support for the staff.

The total project would be of several years duration. The planning group must attempt to avoid the extremes of planning for a project of too short a duration or one that has no foreseeable end. The problems of communication between the project coordinators and the various consultant groups will be of major proportions. The PERT program is suggested because of its effectiveness in coordinating projects of many different groups.

The definition, creation, and filling of the positions of project director and initial staff are additional steps of major importance. Professional competence—technical and theoretical—is essential. Management competence—the ability to utilize resources efficiently and to work with people effectively to achieve project goals—is a must. Such persons must be assured of adequate: support by all cooperating groups; financial and resource support; and compensation for a specific length of time. The project staff together with the advisory group would be responsible for developing the long-range PERT plan to achieve the project goals as well as carrying out that plan.

It must be recognized that the intended structure does not rule out independent research and development in industrial arts. Rather, it should provide a known and accepted framework that can be used as a point of departure for investigations intended to clarify and extend our understandings. Also, it should

provide the same base for those dissidents who as a result of the structure can more clearly identify with what they are disagreeing, and in what ways they disagree.

It is important that there be consensus about the structure—that is, agreement by an identified majority of industrial arts professionals. However, such agreement does not mean agreement on every specific statement. Rather, it means that as a profession we are agreed upon those objectives that we all can accept and those objectives that are still in dispute.

It is also important to recognize that the development structure should not be a static one. In fact, it would be essential to have a dynamic structure with built-in procedures for periodic review, challenge, and revision.

Considerations for the Preparation of Educational Objectives

Before any meaningful research concerned with the achievements of industrial arts objectives can be undertaken, there must be consensus as to those objectives which may be considered unique to industrial arts. After the major objectives have been identified there are certain considerations that must be given as to the preparation of these objectives. Industrial arts teachers have been guilty in the past of giving “lip service” to their major objectives, of not clearly identifying how these objectives fit with the objectives of the school, and of once preparing these objectives quickly forgetting them. Until there are precise clear statements of the objectives for industrial arts, it will be extremely difficult for researchers to study and test the attainment of these objectives.

The writers of this chapter would like to propose several considerations which might serve as guidelines in the preparation of objectives for industrial arts. These considerations grow from the work of many others and are not necessarily unique or new to education. It was felt, however, that these are considerations which are far too often overlooked in the preparation of a statement of objectives.

Consideration No. 1

The objectives of industrial arts must grow from and contribute to the objectives of education.

These are times when the specific objectives of each of the institutions in our society have become more and more confused

and overlapping. This confusion has caused the school to assume many responsibilities which were formerly considered the objectives of other institutions in our society. The schools have attempted to undertake the rectification of any and all inequities that exist in our society. It is recognized that the school must be concerned with all of these factors but there has been a growing concern that the primary mission of the school has become obscured. Educators have witnessed, in this century, several statements dealing with the purpose of education. These statements vary from the early statements of objectives by the Commission on the Reorganization of Secondary Education in which they establish seven cardinal principles. Perhaps the most recent statement is the statement of purpose by the Education Policies Commission (1961) in which they isolated the central purpose of education as the development of the rational powers of men. These statements of purpose have been accepted by some educators and ignored by others. There is, however, lack of consensus as to the specific objective of the school.

It would, therefore, seem essential that a strategy be developed whereby the contributions of education are identified and used as a guide in the development of the schools. Once such a statement has been developed it is then essential that each discipline develop its objectives so that they in some way contribute to the total objectives of the school.

Consideration No. 2

A hierarchy of objectives should be developed.

It is essential to have a precise understanding as to the relative position of each of the objectives in our school. This hierarchy should range from the overall objectives of our democratic society down through and including individual objectives of each structured activity that is utilized in the school. The objectives in the hierarchy may also be ranked as to their specificity. The objectives for the school are usually stated in rather general, broad terms. The objectives in the lower levels of the hierarchy become narrow and are stated in more specific terms. It is recommended that if the researcher wishes to conduct research on the achievement of objectives that he *start* by evaluating his success in meeting the objectives that have been stated for each specific activity used in the classroom.

Consideration No. 3

The two types of evaluation must be considered when studying the objectives of industrial arts.

There are two major types of evaluation that are possible in any research study concerning educational objectives: (1) An internal evaluation in which it is determined if the objective has been accomplished as stated, and (2) an external evaluation in which it is determined if there is any significant difference between the students enrolled in our classes and those students who have not been involved in the instructional process which is under study. Both types of evaluation are essential if the results of this research are to be of assistance in determining classroom effectiveness.

Consideration No. 4

Educational objectives should be stated in terms of the types of change expected in a learner at the conclusion of instruction.

By the very nature of our work the teacher must be aware of what changes are taking place in the learner due to his efforts. A meaningful objective should communicate the teacher's instructional intent. As Mager (1962) states:

. . . A statement of an objective describes a desired state in the learner. We also know that we have successfully achieved our objective when the learner can demonstrate his arrival at this state . . .

A statement of objective is useful to the extent that it specifies what the learner must be able to do or perform when he is demonstrating his mastery of the objective. (Mager, 1962, p. 10).

Mager (1962) also recommends:

Since we cannot see into another's mind to determine what he knows, we can only determine the state of his intellect or skill by observing some aspects of his behavior or performance. (They are using the term "behavior" to mean "overt action.") (Mager, 1962, p. 13).

Consideration No. 5

The researcher should be aware that objectives may be classified as to the different levels of expectations that are possible during the instructional process.

It is strongly recommended that the researcher interested in studying the objectives of industrial arts should become familiar with the work that has been done in developing a taxonomy of educational objectives. The taxonomy is an attempt

to classify the intended behavior of students—the way in which individuals are to act, think, or feel as the result of participating in some unit of instruction. In preparing the taxonomy of educational objectives the writers give the following reason for the use of the taxonomy :

Some research workers have found the categories of use of a framework for viewing the educational process and for analyzing its workings. For instance, the AERA Committee on Criteria of Teacher Effectiveness suggests its use in analyzing the teacher success in classroom teaching. Bloom used them in analyzing the kinds of learning that take place in class discussion. Equally important, psychological relationships employed by the classification scheme are suggestive of psychological investigations which could further our understanding of the educational process and provide insight into the meanings by which the learner changes in a specified direction. (Bloom, 1956, p. 3).

Consideration No. 6

The educational objective must give a precise indication of how well the learner is expected to meet the specified objective.

Describing the criteria of accepted performance, in the statement of objective, can best do this. (Mager, 1962)

Not only must the teacher identify and name the overall behavioral act, he must also define the conditions under which the behavior is to occur. Mager (1962) states :

If we can specify at least the minimum accepted for each objective we will have a performance standard against which to test our instruction progress; we will have a means for determining whether our programs are successful in achieving our instructional intent. (Mager, 1956, p. 44).

Other considerations might be suggested but it is the feeling of the writers of this chapter that if the researcher has given thought to the above listed considerations that he will then have developed a series of objective statements which are ordered as to their relative importance, which vary from broad general statements to narrow specific statements, which are written in terms of expected overt behavior, which are classified as to the type of understandings required, and which precisely and clearly state the criteria of accepted performance. Educational objectives which have been stated in this way can then be subjected to rigorous examination and, assuming that the appropriate experimental methods are utilized, should result in findings which will be useful to us as guidelines in evaluating our existing program and in developing new programs for industrial arts.

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CHAPTER THREE

Research Related to Evaluation in Industrial Arts

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Introduction

With the ever increasing complexity and comprehensiveness of our educational system, the need for reliable methods of determining its effectiveness has also increased. Wrightstone says:

"No longer do tests of intelligence and subject matter achievement alone meet the needs for appraisal of the aims of a comprehensive educational program. Such newer techniques as anecdotal records, observational methods, questionnaires, inventories, interviews, checklists, rating scales, personal reports, projective methods, sociometric methods, case studies and cumulative records are required to assess such objectives as knowledge and understandings, skills, interests, aptitudes, personal-social adjustment, critical thinking, and health and physical development."¹

The procedures used to appraise the various aspects of the educational program include both *measurement* and *evaluation*. Quite often these terms have been used interchangeably and to many people their meanings are synonymous. While there is no desire to include a lengthy discussion on semantics, it is felt that these two terms are important enough to justify clarification of their meanings. Good defines *evaluation* as, "the process of ascertaining or judging the value or amount of something by careful appraisal."²

¹J. Wayne Wrightstone, Joseph Justman, and Irving Robbins, *Evaluations in Modern Education*, (New York: American Book Co., 1956) p. iii.

²Carter W. Good, *Dictionary of Education*, (New York: McGraw-Hill Book Co., 1959), Second Edition.

He then defines *measurement* as, "a broad term for the general study and practice of testing, scaling and appraisal of aspects of the educational process for which measures are available and of the individuals undergoing the educational process."³

According to Burton,

"The term measurement usually refers to the use of objective tests or instruments of precision which yield quantitative data. Their precise, quantitative data are direct measures of the pupil's achievement in fact and skill learnings or in rote mastery of subject matter. And the term evaluation usually refers to the use of behavior records, inventories, scales, or check lists which yield descriptive, qualitative data. These qualitative data form the basis for judgments about the pupil's acquisition of the more general, more subtle, and more important outcomes."⁴

Micheels and Karnes state that, "measurement implies a precise quantitative value which can be placed on a physical property or an outcome of instruction, while evaluation . . . is more comprehensive in nature and includes values which result from the exercise of judgment and more subjective appraisals."⁵ Dressel and Mayhew agree that, "Evaluation as contrasted with measurement, embraces a wider range of technique and evidence."⁶

The consensus of the foregoing definitions and statements is that measurement is quantitative in nature, more objective, and narrower in scope while evaluation is qualitative in nature, more subjective, and broader in scope. Both have a definite role to play in the educational process, but can only reach their ultimate potential when all persons concerned understand their functions and utilize them in the way they were intended. Without this basic understanding, "testing has frequently done more than measure outcomes; it has shaped them."⁷ Educationally, this is a case of the tail wagging the dog and cannot be defended. Correspondingly, the lack of comprehension of the functions of evaluation results in ineffective utilization of their vast potential. These main functions are: "to make provisions for guiding

³Ibid.

⁴William H. Burton, *The Guidance of Learning Activities*, (New York: Appleton-Century Crofts, 1952) p. 579.

⁵William J. Micheels and M. Ray Karnes, *Measuring Educational Achievement*, (New York: McGraw-Hill Book Co., 1950) p. 22.

⁶Paul L. Dressel and Lewis B. Mayhew, *General Education: Explorations in Evaluation*, (Washington: American Council on Education, 1954) p. 21.

⁷William H. Burton, Roland B. Kimball, and Richard L. Wing, *Education for Effective Thinking*, (New York: Appleton-Century Crofts, 1960) p. 435.

the growth of individual pupils, to diagnose their weaknesses and strengths, to point out areas where remedial measures may be desirable, and to provide a basis for the modification of the curriculum or for the introduction of experiences to meet the needs of individuals and groups of pupils.”⁸

The area of testing and measurement is much like the weather; everyone talks about it, but no one does anything about it. Burton, Kimball and Wing state that, “our difficulty is sheer ignorance of sound methods of measurement and evaluation. Even when teachers identify their basic educational objectives, oftentimes they lack the technical skill to devise ways to measure just how well a student has achieved these objectives.”⁹ A search of the research studies reveals that little has been done in the area of research in measurement or evaluation techniques. The majority of research projects have used these techniques but few have researched any phase of them.

Research Summaries

In the following sections, research projects concerned with the appraisal of learning or learning environment influences in industrial arts are included.

Content or Related Information

Author: March, Bryce D.

Title: Assessment of Informational Achievement in Industrial Arts

School: Southern Illinois University

Date: 1961

Purpose of Study:

To assess informational and problem-solving achievement in selected areas of industrial arts instruction.

Findings:

Based on an informational test administered to sample and pilot groups, it was found that:

1. Students whose teachers had master's degrees had learned more than students whose teachers had bachelor's degrees.

⁸Wrightstone, Justman, and Robbins, *op cit*, p. 16.

⁹Burton, Kimball, and Wing, *op cit*, p. 435.

2. The students of experienced teachers scored higher than those whose teachers were inexperienced.
3. Students in the ninth grade, who had industrial arts previously, obtained higher scores than students that did not.
4. Students in districts other than large city systems obtained the highest scores.

Author: Mudget, Albert G.

Title: The Effects of Periodic Testing on Learning and Retention in Engineering

School: University of Minnesota

Date: 1958

Purpose of Study:

To determine the differential effects of daily, weekly, and monthly testing on learning of the materials studied in a beginning course in engineering drawing.

Findings:

1. At the end of four weeks of freehand drawing instruction, no effects of the testing program were found.
2. During the ninth week, significant differences (.01 level) were found favoring the daily tested groups.
3. At the end of the experiment, differences between groups were significant at the 5 percent level in favor of instructors A and B.
4. On a performance test, significant differences (.01 level) were found: daily testing was found to be superior to weekly and monthly testing, and instructional outcomes for instructor D surpassed those of instructor C.

Evaluation of Course Content

Author: Sellon, William A.

Title: A Study of Methods of Evaluation and Their Application to Industrial Arts with Suggestions for the Content of a Course in Techniques of Evaluation

School: Bradley University

Date: 1950

Purpose of Study:

To compile and analyze certain evaluative techniques in the fields of education and industry in an effort to find techniques and factors which will be helpful to industrial arts

teachers in meeting their evaluative problems, with a suggested content for a course on Techniques of Evaluation to be offered on the undergraduate level in industrial arts education.

The techniques of evaluation were found through the documentary study of books, articles, and studies on various phases of the problems of evaluation in the industrial arts area, and by a questionnaire distributed to what were postulated as being better-than-average teachers of industrial education.

Conclusions:

1. The evaluative process is necessary to a dynamic education as a whole as well as to its specific subject of learning areas.
2. The evaluative process has gone from a highly subjective state to a more objective state. Evaluation is returning to a subjective state with the attempt to formulate a pattern or framework which uses the favorable points of both the subjective and the objective types of evaluation.
3. Evaluative techniques and interpretation are highly subjective and are subject to disagreement between "authorities" as well as laymen.
4. Evaluation in industrial arts is a comprehensive process which should give consideration to many facets of the individual's behavioral changes.
5. Evaluation in industrial arts should be a continuous process, calling for the selection and use of several instruments.
6. Evaluation should be made in terms of the behavioral changes resulting from work toward the realization of the objectives of each course or area in question.
7. The industrial arts student should be notified of, and advised in light of, the continuing results of his or her evaluation.
8. Standardized tests in industrial arts have not yet reached a high degree of usefulness.
9. Industrial arts teacher education majors may profit most by a Techniques or Evaluation course offered specifically in the field of industrial arts.

10. Every industrial arts teacher education student should be familiarized with suitable evaluative factors in his area of work and the techniques for recognizing, gathering and appraising these factors for use, as well as the actual construction of these evaluative instruments.

Author: Wilber, Gordon O.

Title: Evaluation in Industrial Arts Teacher Education

School: Ohio State University

Date: 1941

Purpose of Study:

To develop techniques and methods for appraising a program of industrial arts teacher education to determine the extent to which the graduates have been given the number and kind of experiences which will best fit them to become successful teachers.

Conclusions:

Final results not available. Fourteen tests were developed or adapted. Where tests could be found, which applied, they were used in their original form or altered to fit the situation. For the most part, tests had to be developed. These were:

1. *Confidential Report Blank* for rating cadet teacher.
2. *Solving Industrial Arts Problems Through the Application of Facts and Principles*
3. *Interpretation of Data*
4. *Technical Vocabulary Tests*
5. *Sources of Industrial Arts Supplies and Equipment*
6. *Sources of Information*
7. *Recognition and Properties of Industrial Arts Materials*
8. *Application of Scientific Principles*
9. *Skill in the Use and Care of Tools*
10. *Social Distance Scales*
11. *Interest Index*

Attitude

Author: Fuzak, John A.

Title: Evaluation of Cooperative Attitudes in Industrial Arts Classes

School: University of Illinois

Date: 1948

Purpose of Study:

To devise an instrument which industrial arts teachers can use to evaluate the development of the attitude of cooperation in their classes.

Findings:

As an index to attitude, pupil behavior was considered preferable to the usual endorsement of opinions.

Limitations of the use of behavior as an index to attitude are: external pressures may cause the behavior to reflect a distortion of the true attitude, and the fact that it is impossible to determine the motive for an act through an observation of behavior.

The Thurstone technique of scale construction was adopted as offering promise for development of a scale in which specific behavioral actions are given numerical values.

Items of behavior relating to cooperativeness were collected. Two groups of twenty-five judges — industrial arts teachers and non industrial arts teachers — scaled sixty items into twelve equal appearing intervals. The median of the group for each item was accepted as the scale value of that item. A coefficient of correlation of .98 was found between the indexes derived by each of the groups of judges. The two groups of judges combined to form a final group of judges for derivation of scale values and "Q" scores.

A number of items were eliminated. Thirty-eight items were retained and these were split into two approximately equal forms of the scale.

Observational procedure was tested by using two independent observers, one for each form, to check against the observations of the investigator. The correlation coefficients were .98 and .97.

Non-discriminatory items were eliminated and thirty-two items were retained. These items were rearranged to comprise two approximately equal forms of the scale.

The coefficient of reliability for the indexes of sixty-four pupils, grades 9 through 12, in four industrial arts classes

of the Champaign, Illinois high school on Forms A and B was .88.

Author: Campbell, Robert A.

Title: Student Attitude Toward Mandatory Industrial Arts Compared With Selected Variables in the Teaching Situation

School: The Pennsylvania State University

Date: 1962

Purpose of Study:

To ascertain student's attitude toward industrial arts and determine the extent to which selected variables in the teaching situation are associated with this attitude.

Findings:

1. An attitude scale was constructed and used to determine student's attitude towards mandatory industrial arts. The validity of the scale was determined by using three approaches, including an outside criterion group; the reliability was found to be .922.
2. Student attitude towards mandatory industrial arts is not significantly correlated with the:
 - a. physical conditions of the laboratory
 - b. instructional program
 - c. methods and management used in the laboratory
 - d. professional rating of the teacher
 - e. teacher's philosophy of education
 - f. student's experience or time in industrial arts
 - g. teacher's estimation of the school administration's attitude toward industrial arts

Manipulative Skill

Author: Coover, Shriver L.

Title: The Nature and Measurement of Certain Mechanical Abilities

School: University of Pittsburgh

Date: 1941

Purpose of Study:

To develop a test battery in order to obtain a valid measure of certain mechanical abilities for collegiate level students. A test of mechanical literacy, accuracy of visualization, and muscular coordination was developed.

Findings:

The test battery was administered to college freshmen enrolled in an industrial arts teacher education program. Special devices for evaluating the accuracy of each subject's performance were developed. The test results were compared with each individual's work produced during a course taken subsequent to the administration of the test battery. The correlation between the tests in the battery was low (.29, .25, .03), and the reliability for the Mechanical Literacy Test was .86 and for the Accuracy of Visualization Test .82.

Author: Crawford, John E.

Title: Measurement of Some Factors Upon Which Is Based Achievement in Elementary Machine Detail Drafting

School: University of Pittsburgh

Date: 1941

Purpose of Study:

To develop a battery of tests which would discriminate aptitude for machine detail and design, a phase of mechanical drawing. Included in the group studied were 80 male high school graduates who had not had any post high school training; the age range was 17-26 years with a mean of 21.98 years of age. All were enrolled in a special engineering defense course at Carnegie Institute of Technology; the course was twenty-four weeks duration.

Findings:

Determiners or basic requisites of success in machine detail and design were submitted to three juries for content validation. Tests were selected that were indicative of the determiners: The Carnegie Mental Ability Test, Minnesota Paper Form Board Test (Form AA), Crawford-Bennett Point-Motion Test, Crawford Spatial Relations Test.

The criterion used to determine the validity of the test battery was the student's scores in the course. The validity of the battery, which requires about two hours to administer, was .24.

Author: Worthington, Robert M.

Title: Factors Affecting the Delayed Imitation of a Demonstrated Psychomotor Skill

School: University of Minnesota

Date: 1958

Purpose of Study:

To test experimentally certain factors affecting learning from demonstration.

Findings:

1. The demonstration reduced the time required to learn a simple assembly task.
2. The demonstration reduced the time required to learn a complex assembly task and to a greater extent than a simple task.
3. Length of delay in imitating a demonstrated task or verbalization of key elements during a demonstration did not reduce the time required to learn the task.
4. The demonstration equalized the effects of I.Q., mechanical ability, and chronological age.

Author: Lockette, Rutherford E.

Title: The Effect of Aspiration Upon the Learning of Skills

School: University of Illinois

Date: 1956

Purpose of Study:

To determine the effects of realistic or unrealistic levels of aspiration on the learning of manipulative skills.

Findings:

1. Subjects treated realistically set lower goals, experienced greater satisfaction, performed more efficiently in terms of performance scores and improvement made and were more conscious of their needs for improvement.
2. Generally, methods which induce students to set realistic levels of aspiration are superior to those which induce students to set unrealistic levels of aspiration.

Author: Welburn, Wayne

Title: Project Evaluation for General Metal and General Woodworking in Industrial Arts

School: Utah State University

Date: 1959

Purpose of Study:

To determine if the use of a project rating scale would aid in the evaluation of student's manipulatively oriented work; to ascertain the variation in grades assigned by various teachers to student work.

Findings:

1. The use of a rating scale resulted in more consistent evaluation by the teachers.
2. Teachers consider some factors of greater importance than others in evaluating projects. These factors include design, quality of workmanship, and quality of finish.

Industrial Arts Facilities

Author: Byrom, John M.

Title: The Development of a Scale of Photographs for the Appraisal of Learning Influences in Industrial Arts Shops

School: The Pennsylvania State University

Date: 1957

Purpose of Study:

To develop a series of photographs depicting certain learning factors and instructional influences to be used in appraising industrial arts programs.

Findings:

1. A scale of photographs and set of written evaluative criteria were developed.
2. Mean ratings by a jury for the photographs were used to determine the validity of the scale. Data indicated the reliability of the scale to be .75.

Needed Research

This area of the educational process is so nearly void of conclusive research that it is impossible to identify gaps, simply because there are not gaps but wide open panoramas. Grote and Hackler¹⁰ discuss the need for research in the area of evaluation. They concentrate their attention on the theoretical question of whether we base our grades upon a measure of "progress,"

¹⁰C. Nelson Grote and Clyde M. Hackler, *Classroom Research in Industrial Arts*, (American Council on Industrial Arts Teacher Education, Thirteenth Yearbook, 1964), Chapter 5.

“achievement,” or a combination of these and/or other factors. Ketchum¹¹ lists several areas of evaluation.

In addition to the above mentioned needs, some other desperately needed research is in the following areas:

Industrial arts needs a complete battery of standardized tests to measure such items as attitude, interest, achievement and aptitude.

Our profession needs efficient instruments to measure the changes effected in human and cultural values by industrial arts.

Efficient methods and procedures of measuring the degree that each purpose and objective of industrial arts is being accomplished need to be developed.

Finally, we need to develop reliable measures of the effectiveness of such motivational factors as the project, instructional aids, methods of instruction, mass production, and experimentation.

¹¹G. Wesley Ketchum, *Research in Industrial Arts Education*, (American Council on Industrial Arts Teacher Education, Ninth Yearbook, 1960), Chapter 7.

CHAPTER FOUR

Research and Experimentation as a Teaching Method in Industrial Arts

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Historical Perspective

The scientific method of research has been known and used in its nascent form for many centuries. It was originally an outgrowth of man's common sense assumptions and judgments which, for many generations, were based on his empirical observations. It was, therefore, essentially a derivative of the problem-solving approach which craftsmen and artisans had *inherently* employed for many centuries as they sought to improve their materials and techniques.

One of the first to grapple with the problems of considering inductive logic (philosophy of science) as an abstraction was Francis Bacon. It was the educational historian, R. Freeman Butts, who noted that as a Sense Realist, Bacon advocated that the study of science and of the scientific method be a part of the formal education of children. He wrote that

Many of the doctrines of sense realism stemmed from the empirical philosophy as it was stated by Francis Bacon, who insisted that education should cultivate the habit of suspending judgment until the facts were in, and should foster a critical attitude that would free the individual from the shackles of preconceived prejudices and fixed ideas. (Butts, p. 236).

Later, many other educators (among them Herbert Spencer, Karl Pearson, Edward Thorndike) urged the use of the scientific attitude and method in the development of the social sci-

ences. They, like Bacon, considered this attitude and method a necessary and important part of the formal, educational sequence of children.

The infusion of this problem-solving technique as a primary goal of formal education reached its fruition in the work of the American philosopher, John Dewey. It was he who not only identified the procedural steps an individual *inherently* passes through in trying to solve a problem but also systematized these steps as a complete act of thought. He listed these steps in his book *How We Think*. J. Francis Rummel, in his book *An Introduction to Research Procedures in Education*, clarified and elaborated on these five steps.

A felt need. This may be considered as the occurrence of some felt difficulty in the lack of adaptation of means to an end, in identifying the character of an object, or in explaining an unexpected event.

The problem. Once one is aware of some question or problem or difficulty the next step is to define it in terms of a problem statement.

The hypothesis. The third step is that of stating a possible solution for the problem or the occurrence of a suggested explanation. It might be based upon a hunch, a guess, an inference, a theory, or any other basis that has not as yet been determined conclusively.

Collection of data as evidence. This involves the rational elaboration of an idea through the development of its implications by means of the collection of data, or information or evidence.

Concluding belief. On the basis of the evidence there is corroboration or rejection of the idea and formation of a concluding belief through the experimental analysis of the hypothesis. (pp. 12, 13).

Dewey considered his method of problem solving as synonymous with the method used by the scientist. In his most famous book, *Democracy and Education*, he envisioned the study of science, through the scientific method, as the third and final level of his theory of curriculum. Science, in Dewey's educational analysis, would not be taught in the customary, traditional manner where the logic and structure of the discipline is authoritatively presented to the student; that is, where the rules, principles, laws and theories discovered throughout history are presented by the instructor to the student in the logical, symbolic and concise form which is the language of the expert or specialist. Rather, Dewey would teach the *method* of science or the systematic procedures necessary to carry a problem to a successful conclusion. He wrote that "it is much more important that they should . . . get some insight into what scientific method

means than that they should copy at long range and second hand the results which scientific men have reached." (p. 258).

The student would learn about science with its laws, theories and numerous applications *by applying the formalized steps in the scientific method* to educational projects of personal interest with the help and guidance of the teacher. Dewey further envisioned that ultimately this formalized method of science would be used to find possible solutions to the myriad, complex social problems confronting the world.

In the Thirty-Third Yearbook of the National Society for the Study of Education, it was noted that the educational form developed by Dewey and his contemporaries to teach the problem-solving concept became generally known as the project method:

The project method rests upon Dewey's complete act of thought which proceeds from the effort to solve a problem. The project method is an attempt to inject purposive thinking into learning—to substitute thinking for memorizing. (p. 41).

In many educational circles, however, this concept has also been referred to as the activity curriculum.

Industrial Arts

Through the work of Frederick Bonser and others, many of the educational concepts advocated by Dewey have permeated industrial arts for many years. It is evident, therefore, that the nature of industrial arts, with its unique programs and laboratory facilities, has always been concerned to some extent with the problem-solving approach. Miller wrote that:

For many years this approach has been followed incidentally and accidentally in varying amounts in many industrial arts programs across the nation. However, since "sputnik" and the increased effort to improve all educational programs, an increasing emphasis has been placed on "problem solving" as a significant function of the experience provided through the industrial arts program. (p. 13).

As early as the turn of the twentieth century, Charles Bennett, in his book *The Manual Arts*, advocated three methods of teaching: (1) the imitative, (2) the discovery, and (3) the inventive. Although like Dewey, he did recommend the use of the discovery and inventive methods of teaching, Bennett limited the use of these methods to the bright students. And unlike

Dewey, he considered the imitative method as the most important and effective.

Dewey's work, therefore, suggests that the unprecedented rate at which new knowledge accumulates and old knowledge becomes obsolete makes it imperative that a student is made aware of the method of acquiring knowledge—as well as the knowledge itself. This awareness of a means of acquiring knowledge is especially evident in industry where research is becoming more and more a vital and necessary function. It is obvious, therefore, that industrial arts must concern itself with teaching one of the primary means of acquiring knowledge: that of problem solving.

Lux believed the teaching of problem solving so important that he considered it a valid justification for the requirement of industrial arts as part of general education. He stated that:

... greater recognition still needs to be given to the fact that the teaching of problem solving with contemporary materials, tools, and processes of industry, rather than with imaginary academic problems, is one of the valid justifications for the requirement of industrial arts as general education. (p. 147).

The contemporary research and experimentation movement within industrial arts has also centered its program around the tenets of the activity form of curriculum. This movement is consistent with the educational program developed by Dewey where the problem-solving approach is the key element. The objective of this approach is to instill in the student the method used in industrial research to test and evaluate new and emerging material as well as those already on the commercial market. The format used in industrial research is primarily a refinement of Dewey's analysis of the problem solving method. The format includes:

1. formulating problems and hypotheses
2. planning and designing the investigation
3. conducting the investigation
4. interpreting research results
5. preparing reports
6. administering research projects
7. accepting organizational responsibility, and
8. accepting personal responsibility. (Hertz, p. 168).

Professor Donald Maley, the leading exponent of the research and development program, described the program in an

unpublished paper as “an individual-centered approach, with the scientific method of problem solving being the principal element.” (p. 3). Elaborating on this point, he further stated:

The pursuit of the problem by the student involves the development of a scientific approach to the object of his curiosity. He learns and practices the techniques of research. He uses the language of research—statements of problems, hypotheses, assumptions, variables, findings, and conclusions (p. 3).

Therefore, the research and experimentation program is primarily concerned with “how to learn,” rather than with “what to learn”—the latter being the format of the traditional educational program. The emphasis is not on learning subject matter *per se* but on learning research procedures. The individual student is solely responsible for the selection of subject matter; while the amount of study is based on the type and form of the research project selected for investigation.

In an article co-authored by Professor Maley and Alan Keeny, an instructor of the research and experimentation program in the Montgomery Hills Junior High School at Silver Spring, Maryland, the two men listed the following goals for the program:

1. To develop an appreciation of the scientific approach to problem solving.
2. To develop a fuller understanding in the area of industrial research.
3. To offer a meaningful program to teach tools, processes, and materials.
4. To stimulate pupil interest in high-level laboratory activities.
5. To provide exploratory experiences of value for the student in his selection of avocational as well as vocational or professional pursuits.
6. To develop the student with respect to satisfying his own curiosity and developing self-reliance and the ability to do critical and analytical thinking.
7. To increase the individual's understanding and abilities in the area of consumer activities.
8. To develop in the student a feeling of creativity and satisfaction. (p. 88).

Livingston, in an article describing his ninth-grade research and experimentation program, stated the main purpose of the course was to produce the thinking student. This primary goal was accomplished by correlating the many academic subjects and industrial arts in a practical learning situation, the research project.

The purpose of the course is to produce the thinking student, through the correlation of such subjects as mathematics, science, English and industrial arts into a practical learning situation. The student does actual research. In this lies the secret of success of the program. In doing work that satisfies and interests him, the student eagerly learns all the processes necessary to accomplish his goal.

Any research project that is safe and creates a challenge is encouraged. The course is designed to produce the thinking student, not projects.

This is the way the correlation of subjects takes place:

1. *English*: The library is used extensively to obtain ideas and background information.
2. *English*: Businesslike correspondence is carried on between students, industry, government organizations, etc.
3. *Mathematics*: In most projects practical mathematics is involved, whether mathematical, electrical, or chemical research is done.
4. *Science*: All projects involve one or more of the sciences, such as physics, chemistry, biology, and botany.
5. *Industrial Arts*: All research projects require planning, correlation, and construction of working models, full-sized projects, and test equipment. All are handled by the industrial arts department.
6. *English*: The recordings of processes, progress, and findings of the research projects. (p. 20).

Professor Arthur W. Earl also recommended that the research and experimentation approach be adopted by industrial arts as a regular part of its program. He felt that it would improve the offerings in industrial arts and contribute to the advancement of general education. He believed that the research and experimentation approach has six unique features which would contribute to the growth of industrial arts.

1. Research challenges the student to explore the unknown.
2. The research method of investigation parallels the methods and procedures used in industry.
3. It encourages students to examine references and to contact industry.
4. It requires students to examine many different materials and products.
5. The creative nature of the program with its freedom helps the development of each student's individual ability.
6. The analytical nature of the program helps to develop an awareness on the part of the student. (p. 24).

But unlike pure science, modern industry is not concerned only with research. It is interested rather in the practical application of research in science and mathematics and the possible commercial value this research may afford. This applied experimentation with the findings of the scientist is known as

industrial research. The research and experimentation program in industrial arts is primarily concerned with studying and duplicating this important aspect of industry. Such a program necessarily involves the integration of science and mathematics in the industrial arts program. The industrial arts laboratory thereby becomes a center where the student can analyze, test, and evaluate the many products, materials, and processes of industry through the application of scientific procedures and theories. Here the student observes the abstract mathematical or scientific principles in a realistic or practical setting. Herein lies the obvious contrast of the two programs. The uniqueness of the research and experimentation program is the study of the techniques of industrial research, while the traditional industrial arts program has as its primary function the acquisition of technical knowledge and tool skill. Because of the abstract knowledge required in all phases of the research and experimentation program, the program tends to be best suited for and geared to the intellectually superior student. Maley and Keeny wrote:

The program was developed to meet the needs and interests of the future engineer, scientist, researcher, analyst, medical doctor, physicist and others. It is an attempt to provide a form of industrial arts that is compatible with the aspirations and talents of such students. (p. 86).

In a separate article describing his program at Montgomery Hills Junior High School, Keeny stated:

It is obvious that the industrial arts research laboratory is not to be recommended for all students. It is for those individuals who are somewhat gifted, who are intellectually curious, and who have generally gone beyond the offerings of a general industrial arts program. (p. 11).

Many of the research activities carried on by the students in various research and experimentation programs throughout the country attest to the student's superior ability. Such problems as the effects of heat and cold on radio efficiency, tests on wood fasteners, induction heating experiments, algae growth control, structural beam tests, wind tunnel experiments, flow tank problems, distillation of various oils, effects of color on mice, strength and flexibility of wood, heat reflection and transmission properties of materials, explosive metal forming and numerous others have been reported (Earl, Keeny, Livingston, Maley, Mortimer, Mehrens).

Laboratory Facilities

The research and experimentation program can be developed and carried out effectively in any type of industrial arts laboratory. The unit shop would be very applicable for in-depth research projects structured around the materials and equipment studied and taught in that specific laboratory. The general shop, with its diversity of tools, machines and equipment would be more suitable for a program conducting a wide variety of research projects. The ideal situation might be a special laboratory designed especially for the research and experimentation program.

In addition to the traditional equipment found in the average industrial arts laboratory, other forms of test apparatus should be included for the research phase. Such equipment as hardness testers, high- and low-temperature equipment, impact testers, microscopes, universal testers, chemistry facilities and other similar apparatus should be acquired. The laboratory should also have physical facilities for lectures, seminars, a library, planning center and storage area.

Special test equipment which is needed for many experimental projects can be designed and built by the students. Here is where they learn about the use of tools, materials and equipment. Many suggestions for the building of test equipment can be found in Professor Earl's book, *Experiments with Materials and Products of Industry*.

Seminars

During the entire duration of the course, a series of seminars are held to disseminate information on the selection of research topics and to give progress reports on the research projects already in operation. In the early phases of the course, seminars help develop the team approach which is so vital in industrial research, especially in the early planning stages of a research project. The nature of the proposed research project, with all its possible ramifications and variations, is thoroughly discussed and evaluated in terms of its operational feasibility. Such factors as the time limitation imposed by the nature of the classroom and school systems, the available laboratory facilities, the problems involved with obtaining or building appropriate test equipment, possible sources and type of information

needed, and the interest and capacity of the student must also be considered.

The research team considers each research project within the limitations imposed by the procedural steps used in industrial research. These analytical steps (previously listed) are evaluated very carefully to insure proper direction and objectivity in the conduct of each research project. Upon the completion of the project, the student prepares a written report based on his findings. He defends his entire project orally before the seminar. Here again, the same evaluation criteria are used to determine if the student has successfully learned and applied the step-by-step procedure of the problem-solving method.

Mehrens reported using two types of seminars: formal and informal. The formal seminars were organized for the purpose of giving each student an opportunity to report progress on his research project and to share the new knowledge he gained with his classmates. These seminars, which were moderated by a student, were open to the public; many interested outsiders attended the sessions.

The informal seminars were moderated by the instructor and were organized to accomplish three primary purposes: (1) the student presentations made during formal seminars were evaluated, (2) students with problems enlisted the advice of other students, and (3) questions raised by students concerning procedural steps were answered by the instructor." (p. 23).

The seminar approach results in well-informed students and in a greater accuracy with which each student executes, tabulates, and reports the results from his research project. It further provides each student with the environment for improvement in personal-social group relations, communication skills, and leadership development. It also gives the instructor the opportunity to observe and evaluate each student in a group situation.

Role of the Teacher

The function of an instructor in the research and experimentation program is not cast in the traditional, single role of one who chiefly disseminates knowledge about a specific subject. Rather, it is marked by a diversity of roles and functions. As

it would be impossible for the instructor to be completely informed in all the areas of knowledge with which his students are working, his chief role becomes that of giving direction and guidance to his class as each student pursues his specific research project. The instructor becomes an expert in the method of research and acts as the behind-the-scenes leader to see that a high level of quality performance is maintained by his students in all phases of the many research projects being carried out under his direction. On certain projects (when he is knowledgeable in these areas), he may act as a resource person. As the industrial arts teacher, he teaches the students about tools and materials as they build test apparatus. He can also assist the students in contacting various industries, libraries, other resource people or any other agency in the community which might provide assistance on the research projects. Other activities performed by the instructor are arranging for field trips, guest speakers, and the students' attendance at outside conferences and lectures.

In terms of his professional and academic preparation and background, therefore, Livingston concluded that the teacher in any research and experimentation program should be competent in many areas:

The instructor for such a course should be well qualified in industrial arts areas such as wood, metal, plastics, ceramics, and electronics. He should also have a background in the fields of chemistry, physics, mathematics; finally he should be trained to teach research at the student's level. (p. 21).

Evaluation

The grade the student receives is determined through an individual conference with the instructor and self-evaluation. The standards for evaluation are the results of teacher-pupil planning early in the semester. Keeny reported using the following criteria for the final determination of a grade:

- (1) Reasons for selection of problem;
- (2) Organization of the problem into (a) outline of experimental procedure, (b) procurement of materials, (c) effective use of time;
- (3) Recording of experimental results as to (a) method used, (b) accuracy of procedures, (c) completeness of project, (d) neatness of prepared results;

- (4) Conclusions from the study;
- (5) Use and care of tools and equipment;
- (6) Individual growth as evidenced by personal qualities such as (a) self-reliance, (b) initiative, (c) creativity, (d) problem solving, (e) resourcefulness. (pp. 12-13).

College Programs

Many industrial arts departments at the college level have started to prepare teachers in the research and experimentation approach. The Department of Industrial Education at the Utah State University has developed a course, "Industrial Education Experimental Lab," for selected seniors and graduate students. The stated purpose of the course is to give the class "the opportunity for experimental work with new tools, equipment, materials, and processes for improved program development and teaching techniques." (Mortimer, p. 32).

The specific objectives of the course are:

1. To gain an appreciation of the need for experimental work in industrial education programs.
2. To develop an understanding of the importance of research and development activities in modern industry.
3. To develop, through the experimental approach, a better interpretation of industry in school programs of industrial education.
4. To develop facility in using the experimental approach in teaching industrial education subjects.
5. To devise ways and means of improving industrial education courses through greater use of experimentation.
6. To provide opportunity for industrial and technical education students and teachers to improve their manipulative skills and technical knowledge.

Several criteria were developed in the course which the college student must use in evaluating his specific experimental problem. These same criteria could also be applied by the college student in any junior or senior high school industrial arts research and experimentation program he might later conduct.

The experiment must tie in with and contribute to the basic fundamental purpose of the course.

It must be within the maturity level and intellectual capacities of the experimenter.

It must be challenging and interesting to the student.

It should contribute to the knowledge and experiences of the student in a manner which is superior to other means.

It should involve reading and study of a worthwhile nature which go beyond the mere mechanics of the experiments.

It must not involve any safety hazards that cannot be controlled adequately.

Materials, supplies, equipment, and testing devices should be on hand or readily available. (Many of the testing devices can be constructed by the students and this may be as challenging as the experiment itself. This phase of the work should not be overlooked.)

The teacher must be well enough informed to assist students when the need arises or he must be able to obtain the necessary information or assistance and still maintain proper relationships with the students.

The cost must be reasonable and proper.

The time required to conduct the experiment must be such that the experimenter can complete it satisfactorily and still maintain interest in it. (pp. 33-34).

As a part of his program at the University of Maryland, Professor Donald Maley has initiated a course for prospective teachers entitled, "Research and Experimentation in Industrial Arts." The course has the following objectives:

1. To develop in the student an understanding of the role of research and experimentation in modern industry.
2. To develop an understanding of the concepts and bases behind the research and experimentation method.
3. To develop a level of understanding and competence in handling the research and experimentation program.
4. To broaden the student's perspective regarding the nature of industry and the forms of industrial aids.
5. To stimulate interest in programs that involve the problem solving approach.

Some of the requirements of the course include the study of the research sequence, the development of two research projects, the making of test apparatus, the participation in research seminars, the study of high school research and experimentation programs, and methods of teaching. In order to provide the students with a more meaningful understanding of industrial research, a selected series of movies and tapes on industrial research is presented during the semester. Where applicable guest speakers are also invited as an additional part of the course program.

Critique

The theoretical criticism of the activity program and its primary method of instruction, problem solving, has generally followed two main streams of questioning thought.

The primary criticism concerns itself with the nature of the activity program and its center of focus: a form of problem or project. The student draws information or knowledge from a variety of disciplines or other knowledgeable sources in an attempt to find solutions or tentative answers to his particular problem or project. This "raiding" of subject matter without systematically studying it can impose a difficult problem on the student. One can pick out facts from texts in the natural and social sciences; but the generalizations and concepts that enable him to understand the factual data within the logic of a discipline and to interpret it within the context of the logic, cannot be done without systematically studying the discipline.

Broudy, in reference to this problem of the activity program, wrote:

If they have never studied chemistry or physics, the chances that they can "raid" a textbook on these subjects are slim. It is almost impossible to raid the natural sciences without a prior conquest of them; the case is not much better with the social sciences.

The problem approach to the curriculum is therefore faced with a dilemma. If the problems used do not require the knowledge of the organized disciplines, then the school is superfluous. If such knowledge is required, it cannot be secured except by systematically studying the subject. We conclude, therefore, that the study of organized subject matter is indispensable if the school is not to be dispensable.

The problem-centered curriculum has equally lofty objectives and realized a number of them, particularly certain attitudes desirable for group living. Its chief drawback is that unless it can secure systematic mastery of organized subject matter somehow, the problems with which it can deal in the school are not the sort to which schooling is essential. (pp. 291-292).

The second point of controversy deals with the teaching of scientific method as a separate educational objective as well as with the validity of the logical step-by-step procedure as developed by Dewey and others. This step-by-step approach or procedure concerns itself only with the logical aspects of experimentation, thereby negating the psychological aspects. This

procedure is, therefore, considered to be a gross oversimplification of the scientific method. It fails to take into account the theoretical nature of science and leaves the impression that the ultimate goal of the scientific method is the solution of practical problems rather than the further development of theoretical models. It is this building of theoretical models that separates science from the practical arts which are mostly empirical in nature. The logical approach is a systemized analysis of the "common sense" thinking of the skilled worker. This logical approach is not, however, the method used by the scientist. Conant wrote:

To be sure, it is relatively easy to deride any definition of scientific activity as being oversimplified, and it is relatively hard to find a better substitute. But on one point I believe almost all modern historians of the natural sciences would agree and be in opposition to Karl Pearson. There is no such thing as the scientific method. If there were, chemistry and biology would reveal it. For as I have already pointed out, few would deny that it is the progress in physics, chemistry, and experimental biology which gives everyone confidence in the procedures of the scientist. Yet, a careful examination of these subjects fails to reveal any one method by means of which the masters in these fields broke new ground. (p. 45).

J. A. Easley, in reviewing this controversy between the teaching of the scientific method as a separate, educational objective on the one hand; and, on the other, the validity of the step-by-step procedure, concluded that:

First, the step analysis of scientific method is, as we have seen, a gross oversimplification of the available methodological principles. Second, no experimental evidence is available to indicate that these abilities really are psychologically separate ones. (pp. 178-179).

As the research and experimentation program in industrial arts is an applied program, it deals with established, scientific principles and facts, similar to those programs followed in industrial research. The method of empiricism or problem solving, therefore, is used. The research and experimentation program is not concerned with pure research or with the building of theoretical models (as is the case within the pure sciences). Thus, the procedural steps developed by Dewey and others seem applicable to the research and experimentation program.

Before any conclusions as to the effectiveness of the research and experimentation program can be drawn, however, further experimental study is needed to evaluate both the

stated weaknesses within the project method and those weaknesses in the psychological aspects of problem solving.

Most of the disadvantages or criticisms (of the research and experimentation program) reported by industrial arts teachers are of a practical nature. Mortimer reported the following:

1. All students do not have interest in experimentation.
2. Teachers may not have sufficient background or knowledge to carry on the program.
3. Not all of the experiments selected by students will contain good teaching content.
4. Adequate facilities for performing the experiment may not be available.
5. Some students do not have creative minds—they have little or no imagination and see no real problem to tackle.
6. Frustrations may result from a poorly conducted experiment.
7. Experiments may be too time-consuming and students become discouraged when they cannot complete the experiment for lack of time.
8. Teachers may permit students to tackle something which may be too difficult for their ability.
9. It is difficult to test students because of the great variety of work that may be carried on.
10. Some skills and techniques are taught more advantageously in the traditional type of program. (p. 34).

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CHAPTER FIVE

Research Related to Industrial Arts Teacher Education

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Introduction

The purpose of this chapter is to reveal the nature of research related to industrial arts teacher education since the year 1961. The inquiry was directed toward all centers of higher education having industrial arts teacher education in the United States. While the intent of this inquiry was to limit the investigation to research related to teacher education, other research was reported and is transmitted here in as much as it was felt that some research efforts reported did have a relationship to teacher education. The chapter includes a brief summary of the research reported; a table of the research reported identifying the author, setting, title and school where the research was completed; and a summary of observations related to research including some possible areas of concern for future research.

Characteristics of the Survey

Respondents included 201 institutions throughout the country reporting 278 pieces of research of which 235 are reported here. The responses represented five areas of effort: doctorate, masters, personal, field, and staff types of research. Research on the doctoral level provided the greatest number of responses, that of 69. Staff studies reported had the lowest frequency with

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2 only. Personal studies accounted for 12. There were 123 respondents who failed to specify the type of research effort, whether in the context of a degree program, funded and so on. Of the 45 states that have industrial arts teacher education at the baccalaureate level or higher, or programs related to this field, 27 states had institutions that responded.

The research reported reflects the efforts of teacher education faculty doing graduate work themselves as well as graduate students doing research in the context of a program of graduate studies.

Research reported was either completed or "in process" with a large number in the latter category. In-process research was deemed desirable in this reporting in order that a more accurate contemporary image of the state of research in industrial arts teacher education could be identified. It was also deemed desirable to not only request research directly related to teacher education but also research that is peripheral and indirectly related to teacher education in industrial arts.

After the responses were received, it was discovered that there were many different types of research reported. Consequently, an arbitrary decision for classification was required. Also, there were research efforts that cut across more than one classification. Titles occasionally varied from the description content. While titles are reported, the description of the research effort was the final determining factor for classification.

Summary of Research Findings

In the sections that follow selected findings are reported and grouped by research categories. The purpose is to present a sampling of the results of studies that bear some relationship to industrial arts teacher education.

Achievement

Personal factors of industry, willingness to follow instructions, perseverance, and similar traits in some cases are more reliable indices than intelligence as causal factors in achievement.

Achievement in drafting showed significant relationship between intelligence and gain in test scores. There appears to be a close relationship of personality to industrial arts and achievement.

Little or no relationship appears to exist between the number of units taken in high school industrial arts and achievement in industrial arts teacher education.

Success in technical drawing is not related entirely to courses taken previously in mechanical drawing and advanced mathematics, but in combination they tend to exert a positive influence.

Beginning Teachers' Problems

Many teachers encounter the difficulty of having students plan well and properly. Other beginning problems were developing and maintaining student interest, ordering and obtaining equipment and supplies, and a tendency to not cover the content of a course within the time allotted. Some new teachers felt their greatest problem was that of maintaining discipline.

Content and Curriculum

It was identified that there is no close relationship existing between industrial practices and the material being taught in high schools. A modest effort to up-date content appears to be developing in higher education.

It is a general view held that increased emphasis on physics, chemistry, algebra, geometry, trigonometry should be more closely correlated and integrated into the industrial arts program. The relationship between science and industry is well established.

Beginning technical draftsmen were found to be weak in basic technique. Instructor-made high school courses of study varied from school to school and proved to be a handicap to the student upon entering an engineering college. In general, there appears to be a recognized need for greater program and course uniformity.

Additional concern for curriculum development is needed and urged in the areas of adult education, aviation technology and in vocational instruction using cooperative work-study methodology as a means of training retarded youth.

Programs in industrial education should provide increased emphasis on occupational and vocational guidance and actual industrial-related experiences should be stressed.

There is an urgent need to depart from traditional project method as the sole learning experience provided the student.

Greater attention toward technological content, is needed in areas of industrial methods and overall cultural concepts.

Teacher preparation in the area of design is inadequate. Only a small percentage of the resource materials available enjoy wide usage in design instruction.

A very small percentage of industrial arts teachers had what they believed was an adequate preparation in the area of plastics.

Evaluation

The teacher-pupil method of evaluation was found to be superior to that of teacher-evaluation method, and more beneficial to the student. Also, oral face-to-face evaluation, replacing the traditional written test, is being identified as an improved method of evaluation.

It was found that the self-scoring method proved more favorable than the conventional method used in self instruction of descriptive geometry. The 1962 Revised Mann-Dynamicube Test was found to have validity for predicting final grades in college drafting.

There appears to be little or no relationship between training and certain personal factors to later success in industrial arts teacher education.

Teaching Materials

The classroom teacher with a minimum of technical skill can successfully construct many of the teaching aids needed.

Many devices, easily constructed, in the field of electricity were found to be important aids in achieving the more difficult goals of a course. By using projecturals to teach basic electricity, lecture-discussion time can be reduced, a method for review facilitated, and initial learning and overall retention can be increased.

Achievement by students was significantly improved through the use of overhead transparencies.

Technical

There has been a modest amount of research in applying technological and industrial processes in the classroom. Some of the technological research and industrial processes that are of current concern are:

1. Experimental metal cutting (including chemical) and tool performance.

2. The effects of additives upon batteries.
3. Plastic injection molding.
4. Testing automotive ignition systems.
5. Explosive metal forming.
6. Material analysis.
7. Printed circuits.
8. Solid-state circuitry and controls.
9. Numerical machine tool programming.
10. Photography as an automation study tool.

Multiple-area shop laboratories were found to provide a better creative learning environment.

Certification

State certification for industrial arts teachers varies greatly from state to state as do program requirements of colleges and universities offering industrial arts teacher education, the former having the greatest amount of uniformity.

Major requirements:

1. From 24 to 66 semester hours in the field of industrial arts.
2. Courses in: graphic arts, woods and construction, metals, electricity, crafts and power mechanics.
3. Increase in mathematics and the physical sciences.
4. State department of education approval is becoming a prerequisite for employment.

A fifth year of college is being considered as a requirement by some states.

Guidance

One of our greatest concerns in education today is that we are graduating millions of young people into unemployment. The large majority of all of our schools provide little education and orientation for work in industry. The preparation for and placement of young men in the industrial world of work appears to be of little concern by educators in general.

Reported also is that the mentally retarded have a higher degree of trainability than was originally thought in the past. The mentally retarded are capable of undertaking employment provided they have been adequately trained and guided.

The drop-out problem is of serious proportions in education today. In general, the median intelligence quotient of the drop-out is an average (100); however, the reading level is slightly

less than fourth grade. The potentially meaningful content and appropriate methods of learning possible in industrial arts provides one educational resource for the drop-out.

Shop Organization

There is a need for information on how to improve industrial arts shops and laboratories; also there is a need to know how to keep pace with and be able to relate the "shop-laboratory" to modern technology in the learning situation.

Substantial differences of opinion exist on size and location of equipment.

Status

It is felt there should be closer cooperation between industrial arts high school faculty and guidance personnel. Recruitment for industrial arts teacher education requires continued serious study. High school industrial arts programs are becoming less a source of recruits. Increased effective communication between the high school (counselors, teachers and administration) and the teacher education programs of our colleges is urgently needed.

Industrial arts graduates appear to be obtaining the necessary background materials for entrance into industry. Industrial arts graduates in industry indicated that industrial arts training was helpful but not essential in their present positions. Industry places emphasis on industrial education in that the worker was better prepared to use safety devices and achieve occupational objectives. There is increased pressure requiring schools to build up their industrial arts programs to meet the demands of the industrial world of work. Increased concern by industry over mathematics, English and a knowledge of the business world is being demonstrated.

Methods

Colored mock-ups proved to be increasingly successful in auto-mechanics. Also, in the area of auto-mechanics a workbook proved valuable in supplementing the demonstration.

Teaching method researched in the context of the subject of electricity produced the following results:

1. When a class is heterogeneously organized with reference to intelligence, it makes little difference which is taught first, theory or laboratory activity.

2. When a class is homogeneously organized with students of above average intelligence, they do best when theory is taught first, followed by laboratory activity.
3. When a class is homogeneously organized with students of below average intelligence, they do best when laboratory activity is the basic vehicle for learning.

It was found that in teaching electricity-electronics, both the lecture-demonstration method and an electricity-electronics teaching system approach appeared to provide the same learning result. The electricity-electronics teaching system, however, often provided for the instructor's lack of experience.

Audio-Visual

Two of the more recent teaching aids appearing on the audio-visual scene are increasing in popularity, that of microfilm and closed-circuit television. The latter provides improved demonstration visibility and safety within the classroom where space is limited (viewing an enlargement on a television screen of the relationship of tool geometry to material removal on a machine) or dangerous potentials that exist in a demonstration (explosion of a foundry mold).

Some technical recommendations for closed-circuit television are:

1. Transistorized vidicon camera.
2. Viewfinder very helpful.
3. Zoom potential of lens very desirable.
4. Mobile monitor stands with 25" screens, mounted 50" above floor for ease of viewing.

The validity for continued use of the overhead projector is strongly supported by findings that included demonstration time reduced, practical laboratory time increased and test scores improved.

Creativity

Regardless of what the teaching levels may be, the degrees held or the number of years of experience a teacher has, these factors have no effect or provide no support toward being creative or non-creative.

Safety

Factors which cause the greatest number of accidents:

1. Unsafe equipment.

2. Using hands where mechanical devices or other equipment were provided.
3. Using equipment in an unsafe manner.

It was found that many instructors admittedly wear jewelry, permit themselves loose clothing and use the circular saw without a guard. A large percentage of shops lack nonslip treatment of floors in the operational area of machines. Use of eye-protection devices presented problems of sanitation and impaired vision due to perspiration.

Recruitment

Attraction and selection of students appear to be the main recruitment concerns currently being studied. Attracting students to industrial arts teacher education has been largely by means of regional project exhibits, open house, school publications, staff visitations to public schools, staff lectures and industrial arts students encouraging others on career days. Some concern for selection has been researched, using interest inventories and interest analysis. The total research effort is small in terms of the magnitude of the need.

The average freshman student in industrial arts teacher education is 18 years of age. Fathers of these freshmen are equally distributed between a background of an elementary and a high school education. One-third of these students belong to some type of leadership organization. Also, one-third have varying amounts of skilled work experience.

History

Writing has been limited primarily to a smaller number of well known national, educational, and industrial personalities. Historical profiles are also limited and primarily of local programs.

Objectives

Students with industrial arts woodworking experience are better able to purchase and use wisely wood and related materials as a result of preparation than those without the preparation.

Industrial arts education does have a positive relationship with home leisure-time activities, and can influence the thinking of students as how to use this time. Those conclusions were as follows:

1. Fathers of technical students enjoyed the use of a home workshop more than the fathers of students with no technical training.
2. Leisure-time home activity continues to be a valid industrial arts objective.

Prominent industrial arts teachers (college and public) chose as their number-one objective "Habits of Orderly Performance," this objective also being appropriate to other subject areas. This was seen as a reason for industrial arts being classified as a part of general education for girls and boys.

Survey

Most printing industries were of the opinion that the vocational schools were doing a good job preparing the student for the printing industry. The printing industry prefers that schools give the student a broad training, that printing courses should include the fundamental knowledge and skills of letterpress and offset printing.

A student with a vocational printing background will have an advantage over a student with no such training. However, the vocational student will lose priority if his general educational grades are lower than the nonvocational student.

Miscellaneous

General vocabulary rather than technical terms seemed to be the greatest obstacle to the drafting student in reading his text. It was also ascertained that reading levels vary considerably throughout the textbooks.

Qualities that make educators "outstanding" are: authorship and position, as well as participation on state and national committees, conventions, and laboratory utilization studies.

The physically handicapped can and do learn drafting techniques without special equipment.

In relation to consumable supplies it was recommended that students should not be assessed for what they do not consume. It was also recommended that instructors are not viewed as cashiers and keepers of monies.

There is a great diversity of views as to which textbooks are most valuable at the graduate level. It was found that "old stand-bys" are still used and are considered excellent and worthy of continued emphasis.

Listing of Studies Reported

Achievement

Author	Setting*	Title	School
Hillman, R. C.		A Comparison of the Multiple Factors of Intelligence to Success in Freshman General Shop; 1961.	Chicago Teachers College
Jaris, Charles Frank		An Analysis of the Effect of a Semester of Drafting One on the Score of the <i>Spatial Relations Sub-Test of the Science Research Associates Test Battery, Form AH</i> ; 1962.	Chicago Teachers College
Kohut, B. LeRoy		A Study of the Relationship of School Achievement and School Attendance; 1964.	Chicago Teachers College
Manahan, Donald I.		The Relationship of Personality to Industrial Arts Achievement; 1961.	Chicago Teachers College
March, Bryce D.	(D)	Assessment of Informational Achievement in Industrial Arts; 1962.	Southern Illinois University
Maxey, Tyrice Edward	(M)	Relation of Units Taken and Marks Earned in High School Industrial Arts Courses to Achievement in the Industrial Arts Curriculum at Northwestern State College; 1961.	Northwestern State College, Natchitoches, Louisiana
Ryan, Robert D.	(D)	A Study of Student Performance in First Year Technical Drawing at St. Cloud State College as Related to Certain High School Courses and ACT Scores; 1964.	Colorado State College
Sheldrup, Arthur	(M)	The Gifted Child in Industrial Arts; 1961.	Northern Illinois University
Sommer, John		The Development of the Ability to Visualize Spatial Relationships in Mechanical Drawing and the Effects of Mental Ability on such Ability.	Chicago Teachers College

* (D) Refers to the Research Completed in a Doctoral Degree Program.

(M) Refers to the Research Completed in a Master's Degree Program.

(P) Refers to the Research Completed as a Personal Effort, Nondegree Program.

(F) Refers to the Research Completed as Being Funded.

(S) Refers to the Research Completed as a Staff Effort.

Beginning Teachers' Problems

<i>Author</i>	<i>Title</i>	<i>School</i>
Kirby, Jack (D)	Problems of Beginning Industrial Arts Teachers in Missouri with Implications for Preparatory and In-Service Teacher Education; 1965.	University of Missouri
Van Dorn, (M) Jack Albert	A Survey of Beginning Industrial Arts Teaching Problems in San Diego County; 1962.	San Diego State College

Content and Curriculum

Allen, (D) Willard A.	A Study of Present Practices and Trends in Industrial Arts Teacher Education Undergraduate Laboratory Courses in Transportation, Power, and Power Mechanics; 1963.	Indiana University
Boaz, (D) Holland Earl	Degree-Level Technology Programs Offered in Industrial Education Departments; Their Status, Accreditation and Acceptance; 1965.	University of Missouri
Bohatch, (M) John Richard	Evaluation of the Automotive Course Offerings at Long Beach State College; 1964.	Long Beach State College
Bowman, (D) James E.	A Study of the Basic Mathematical Skills Needed to Teach Industrial Arts in the Public Schools; 1958.	Central Michigan University
Bray, (M) Bruce A.	A Proposed Summer Curriculum for Industrial Arts Teachers at Kansas State College of Pittsburg; 1961.	Kansas State College of Pittsburg
Brousseau, (M) James Eugene	A Survey of University Engineering Departments in the State of Washington to Determine Engineering Drawing Requirements for High School; 1962.	Central Washington State College
Bumgardner, (M) Billy Max	Significant Aspects of the Industrial Arts Programs in the Junior High Schools of the Four-State Region; 1965.	Kansas State College of Pittsburg
Burkart, (M) Eugene	Industrial Arts Electricity-Electronics Programs in the Junior High Schools of Northwestern Illinois; 1965.	Northern Illinois University

<i>Author</i>	<i>Title</i>	<i>School</i>
Carrigan, Carl E. (M)	An Interpretation of the Evolution of Education for the Purpose of Ascertaining the Relationship Between Vocational and Non-Vocational Education; 1963.	Northwestern State College, Natchitoches, Louisiana
Ciancone, Elmer Samuel	A Comparative Analysis of Industrial Arts Teacher Education Masters Degree Programs: With Suggestions for Revision of Those in the State of Indiana; 1962.	Indiana University
Christopherson, Dale W. (M)	The Education of the Slow Learner in Industrial Arts; 1962.	Northern Illinois University
Collins, Charlie (D)	A Study of Industrial Arts in the Southern Appalachian Region; 1966.	West Virginia University
Courtney, Charles Robert	A Course of Study for Aviation Powerplants; 1965.	Chicago Vocational High School
Crawford, Bryant, Jr. (D)	Industrial Arts Programs for Adults: A Study to Develop Procedures and Practices with Reference to Industrial Arts Programs With Implications for Adult Living; 1961.	The Ohio State University
Cummings, John William	The Effect of Commercial Jet Aircraft Upon Vocational Mechanics Training Schools; 1965.	Chicago Teachers College
Dispensa, Joseph, Jr. (M)	An Elementary Ind. Arts Program at the University of Chicago Laboratory School; 1964.	Northern Illinois University
Drew, Alfred S. (F)	A Study of the Need for Educational and Training Adjustments in Apprenticeship Programs for Selected Craft Occupations; 1967.	Purdue University
Ecker, Louis Gene (D)	The Status and Projection of a Teacher Education Program in Power Technology; 1965.	The Ohio State University
Eddy, Max	A Cooperative Job Training Program for Retarded Youth; 1966.	Purdue University
Engelbrektson, Sune (D)	A Resource Unit in Astronomy for the Industrial Arts Curriculum in the Junior High Schools of New York State; 1961.	New York University

<i>Author</i>		<i>Title</i>	<i>School</i>
Face, Wesley L. and Flug, Eugene R. F.	(FS)	The Establishment of American Industry as a Transitional Subject Between General and Vocational Education; 1970.	Stout State University
Fealey, James F.		An Assessment of the Interests of Educable Mentally Handicapped Children in Handcraft in the Chicago Public Schools; 1965.	Chicago Teachers College
Gerber, Russell L.	(D)	Materials and Processes of the Furniture-Manufacturing Industry with Implications for Woodworking Courses in Teacher Education Institutions; 1966.	University of Missouri
Ginter, Richard E.	(D)	An Analysis of, and Opinions Concerning, Graduate Programs in Industrial Education; 1964.	University of Missouri
Gysler, Louis R.	(M)	An Evaluative Survey of Industrial Arts Graduate Education; 1965.	Kent State University
Hastings, James R.		A Directed Field Study in Industry as a Professional Laboratory Experience for the Preparation of Undergraduate Industrial Arts Majors; 1967.	State University of New York College at Oswego
Herder, Gordon C.	(M)	Proposed Course of Study for Industrial Arts Auto Mechanics in Des Moines, Iowa; 1961.	Kansas State College of Pittsburg
Holzrichter, Richard D.	(M)	A Comparative Study of the Technical and Academic Preparation and Actual Teaching Assignment of Industrial Arts Teachers; 1963.	Kansas State College of Pittsburg
Hoots, William R., Jr.	(D)	A Study of Graphic Arts Education: Concerned with Industrial Arts Programs in the Public Secondary Schools of North Carolina with Implications for Teacher Education; 1965.	The Ohio State University
Jacobsen, Eckhart A.	(PF)	A Survey of the Technical Needs of Industry and Implications for Curriculum Development in Higher Education; 1966.	Northern Illinois University
Jones, Benjamin H.	(M)	The Industrial Arts Curriculum of the 6-2-2-2 Systems in the U.S.A.; 1963.	Kansas State College of Pittsburg

<i>Author</i>	<i>Title</i>	<i>School</i>
Jordan, (M) Thomas Earl	A Comparative Study of Electronic Programs of Selected States with Louisiana Industrial Arts Education Curriculum; 1963.	Northwestern State College, Natchitoches, Louisiana
Kasprzyk, (D) Stanley F.	An Inquiry into the Place of Industrial Arts in General Education With a View to Re-Evaluating and Clarifying its Purpose and Aims; 1965 or 1966.	Michigan State University
Kenneke, Larry Jon	Instruction Unit on Printed Circuits for the Senior High School Electronics Laboratory;	Northern Illinois University
Lindbeck, (P) John R.	Elements of Industry Course; 1966.	Western Michigan University
Livingston, (M) Ralph T.	A Comparison of Current Lettering Requirements with Arthur L. Ferry's; 1961.	Kansas State College of Pittsburg
Lyons, (M) James C.	Study Guide in General Shop for Junior High School; 1961.	Kansas State College of Pittsburg
Oliver, (M) Daniel R.	The Point of View of Industry on the Modernization of Content and the Upgrading of Technical Drafting Instruction; 1965.	Kansas State College of Pittsburg
Poleszak, (D) Leonard J.	A Study of Student Teacher's Expected and Actual Outcomes and the Student Teaching Program of the Industrial Arts Education Division at the State University of New York College at Buffalo; 1964.	Michigan State University
Powers, Francis F.	Evaluation of Teacher Training Curricula to Meet the Changing Social, Economic and Industrial Conditions; 1965.	University of Washington
Robinson, (D) Orin R.	Non-Teaching Graduates of the Four-Year State College: Programs of Preparation, Placement, Job Success, and Job Satisfaction; 1965.	University of Missouri

<i>Author</i>	<i>Title</i>	<i>School</i>
Sexton, William E. (D)	Design Instruction in Industrial Arts Teacher Education: A Curriculum Analysis With Opinions of Educators, Instruction Specialists, and Industrial Designers Regarding Content and Instructional Practices; 1965.	University of Missouri
Shrader, Robert F. (D)	College-level Technical Training in Factory Schools for Industrial Teachers; 1966.	Miami University, Oxford, Ohio
Silvius, Harold and Ford, Andrew F. (F)	The Michigan Study of Industrial Teacher Competance; 1965.	Wayne State University
Steedley, Jimmie C. (M)	Teaching Applied Science in Industrial Arts Classes; 1963.	Louisiana State University
Swanson, Wendell L. (D)	A Study of Superior Practices in Graduate Industrial Education at the Master's Level Degree; 1964.	University of Maryland
Trapanese, Menna G. (D)	A Study of the Facilities of the Crafts Programs Conducted in Selected Elementary Schools in the State of New Jersey; 1964.	New York University
Towers, Edward R., <i>et al.</i> (FS)	The Industrial Arts Curriculum Project.	The Ohio State University, with University of Illinois
Wailles, Julian Kenneth (M)	Educational and Job Requirements of Technicians used in Industry in Calcasieu Parish; With Implications for Curriculum Building in Louisiana Technical Schools and Colleges; 1963.	Northwestern State College, Natchitoches, Louisiana
Webster, Jay (M)	Follow-up Study Industrial Arts Graduate Program; 1965.	Long Beach State College
Wiggins, James C. (M)	Factors Influencing an Expanding Industrial Arts Program; 1962.	Louisiana State University
Wilber, Charles L. (M)	Industrial Arts Student Teaching Procedures at Long Beach State College; 1965.	Long Beach State College
Willems, Jonathan Delmer (M)	Summer Employment of Industrial Arts Teachers in Industry; 1962.	Long Beach State College
Wolfe, Wade H. (M)	The Plastics Industry and Education; 1965.	Walla Walla College

Evaluation

<i>Author</i>		<i>Title</i>	<i>School</i>
Cozzens, Charles R.	(D)	A Comparison of Two Techniques of Teaching Engineering Descriptive Geometry; 1965.	Texas A & M University
Lombardi, C. L.	(D)	A Revision and Validation of the Mann Dynamicube Test as a Predictor of Grades in College Drafting Classes; 1965.	Northwestern State College, Natchitoches, Louisiana
Reams, Jake W.	(D)	The Relationship of Selected Factors to the Scholarship of Industrial Arts Teacher Education Students at Ball State Teachers College; 1963.	Ball State University
Renehan, Beverly		An Analysis of the Effectiveness of Teacher-Pupil Evaluation of Projects as Opposed to Teacher Evaluation of Projects in Home Mechanics; 1961.	Chicago Teachers College
Shafer, Carl I.	(D)	A Study of the Evaluative Practices in Management Education and Development Programs in Selected United States Companies; 1961.	Michigan State University

Teaching Materials

Boland, Donald W.		The Use and Construction of Teaching Aids for the Educable Mentally Handicapped Pupil; 1965.	Chicago Teachers College
Brooks, Weston T.	(D)	An Experimental Analysis of the Effectiveness of Overhead Transparencies on Learning and Retention (in Selected Units) in Beginning Woodworking; 1964.	Texas A & M University
Grobe, David John		The Development of Teaching Aids for Use in the High School Machine Shop; 1962.	Chicago Teachers College
Jones, George William		Teaching Aids for Improving a Graphic Arts Course in the Secondary School.	Chicago Teachers College
Kindel, Ersal Winton	(M)	Demonstration Techniques Useful in Teaching High School Electricity; 1961.	Kansas State College of Pittsburg
Koepnick, Ross Tamblын		Teaching Aids for Beginning Woodworking; 1963.	Chicago Teachers College

<i>Author</i>		<i>Title</i>	<i>School</i>
Poray, Richard Ted		A Survey of Projects, Teaching Aids and Devices Presented in the <i>Industrial Arts and Vocational Education Magazine</i> from 1948 to 1958; 1964.	Chicago Teachers College
Say, Willis G.	(M)	Teaching Aids and Resource Materials From Industry for Metal-working Courses; 1962.	Northern Illinois University
Yeager, Lowery Dayle	(D)	An Experimental Determination of the Value of Projectuals in Presenting Selected Units of Basic Electricity; 1963.	Texas A & M University
Technical			
Allen, Dell K.	(P)	Laboratory Manual for Experimental Metal Cutting and Machine-Tool Performance; 1965.	Brigham Young University
Burk, Karl W.		Classroom Effects of Battery Additives; 1963.	Arizona State University
Cary, Jere Murphy	(M)	Laminating Wood Components of Varying Individual Thickness; 1965.	Central Washington State College
Georgas, Alexander T.	(M)	The Wood Lamination Process and Its Application to the High School Industrial Arts Program; 1963.	Northern Illinois University
Greer, William	(P)	Semi-Conductor Theory as it Relates to Transistor Circuits; 1964.	Northern Illinois University
Greer, William	(P)	Principles of F-M Transmission and Reception; 1964.	Northern Illinois University
Greer, William	(M)	The Characteristics of a Solid State Electronic Variable-Speed Control for A.C. Motors; 1966.	Northern Illinois University
Gutenson, Joseph A.		A Study of Plastic Injection Molding Techniques for Use in Industrial Arts Plastics Courses; 1963.	Chicago Teachers College
Hawks, Ronald W.	(M)	A Follow-up Study of Non-Teaching Industrial Arts Majors Who Graduated From N.I.U., Jan. 1955 through Aug. 1960; 1961.	Northern Illinois University
Huss, William E.	(P)	A Study of Technical Photography Content in Automated Mass-Production Systems Using Photographic Instrumentation of Engineering Phenomena for Supplementing the Eye in Overcoming Limitations; 1965.	State University of New York College at Oswego

<i>Author</i>		<i>Title</i>	<i>School</i>
Jackson, Wendell		The Construction and Application of Automotive Testing Devices in the High School Auto Shop; 1963.	Chicago Teachers College
LaMaster, Charles A.	(M)	The History and Development of the American Automobile Ignition System; 1965.	Kansas State College of Pittsburg
Leitch, John	(M)	Centrifugal Casting of Jewelry; A Technique with Implications for I. A.; 1965.	Northern Illinois University
Liska, Edward		A Follow-up Study of Northern Illinois University Teaching Graduates with a Major in I. A. During August, 1961.	Northern Illinois University
Lundal, Frank	(M)	The Chemical Milling of Aluminum and Its Adaptation to the Industrial Arts; 1964.	Northern Illinois University
Mayes, Edward	(M)	The Explosive Metal Forming Process and Its Application to Industrial Arts; 1965	Northern Illinois University
Molla, Rafiqul Karim		Improving Halftones with Magenta Contact Screen; 1965.	South Dakota State University
Murphy, Kenneth	(M)	An Instructional Unit in Deep-Etch Lithography Platemaking for Use in the Proviso East H. S. Lithography Shop; 1962.	Northern Illinois University
Rebhorn, Eldon A.	(M)	Woodturning Project Design and Development; 1963.	Northern Illinois University
Ross, Robert L.	(M)	An Investigation of the Area of Leather Tanning; 1961.	Kansas State College of Pittsburg
Silhan, William John		Product Research Applied to the Development and Redesign of the Woodworkers Hand Plane; 1964.	Chicago Teachers College
Sims, Donald L.	(M)	Factors Affecting the Durability of Commonly Used Furniture Finishes; 1965.	Iowa State University
Springmire, Leslie E.	(M)	A Study to Determine the Applicability of the Shell Mold Casting Process in the High School Industrial Arts Program; 1965.	Northern Illinois University
Thompson, Leland R.	(M)	A Study of Gas Shielded Tungsten-Arc Welding; 1962.	Northern Illinois University
Van Roy, William H.	(M)	Explosive Forming in the Industrial Arts Shop; 1965.	Southern Illinois University

<i>Author</i>	<i>Title</i>	<i>School</i>
Vequist, (M) David E., Jr.	A Comparison of Testing Methods of Water and Oil Absorption of Two Printing Papers; 1965.	Kansas State College of Pittsburg

Certification

Scholten, Herman	Drafting Teacher Certification Requirements and Salary Schedules for Each State and Its Largest City; 1963.	Chicago Teachers College
Turlington, (M) Drew M.	A Comparative Study of State Certification Requirements and College Curricula Offerings for Industrial Arts Teacher Education in the Southeast Region of the U.S.; 1964.	University of Tennessee

Guidance

Blum, (D) Robert E.	Development and Standardization of an Achievement Test for Placing College Students in General Drafting Courses; 1965.	Texas A & M University
Loneragan, Frances R.	The Role of Federal Aid in the Vocational Guidance of Handicapped Civilians in Illinois; 1963.	Chicago Teachers College
Newton, Willard H.	The Shop Instructor-Coordinator as a Guidance Agent in the Work-Experience Program for the Schools in Illinois.	Chicago Teachers College
Roebuck, Lovell	An Investigation of Vocational Guidance Needs of High School Adolescents; 1963.	Chicago Teachers College
Scheid, Roy M.	The Value of Vocational Guidance for the Mentally Retarded; 1964.	Chicago Teachers College
Scheid, Roy M.	A Classroom Unit in Industrial Arts for Mentally Retarded Children.	Chicago Teachers College
Skunicki, Loris Z.	An Analysis of Vocational Guidance Factors Affecting Study Introducing Classified Home Mechanics Students; 1964.	Chicago Teachers College
Watson, Norman Earle	An Analysis of the Role of Plastics in Vocational Guidance; 1963.	Chicago Teachers College
Wessels, Philip L.	Factors Influencing Enrollment in Industrial Education in the Rockford Public Schools; 1965.	Northern Illinois University

Shop Organization

<i>Author</i>	<i>Title</i>	<i>School</i>
Crombie, Peter Blyth	A Survey of Storage and Distribution Problems in the Industrial Arts Shops of Selected Public Schools in South Cook County; 1963.	Chicago Teachers College
Gillies, Richard A.	An Analysis of the Factors Involved in Planning a Comprehensive Shop; 1964.	Chicago Teachers College

Status

Crump, (M) Danny Loy	A Follow-up Study of Graduates of Northwestern State College With an Industrial Arts Major in Applied Arts and Sciences.	Northwestern State College Natchitoches, Louisiana
Grice, (M) William Arthur	A Study to Determine the Effects of Industrial Arts Courses; 1965.	Northwestern State College Natchitoches, Louisiana
Grist, Robert W.	A Study of Reimbursable Vocational Trade and Industrial Education in Chicago from 1944 to 1959; 1961.	Chicago Teachers College
Harrison, (P) O. S.	Status of Industrial Arts in the Public Schools of Georgia; 1965.	University of Georgia
Henry, John Wesley	Genesis and Growth of Manual Arts Therapy in the Veterans Administration; 1965.	Chicago Teachers College
Hoff, John Alan	Survey of Attitudes and Expectations of Industrial Personnel in Relationship to Their Appraisal of the Value of Secondary Industrial Education Courses.	Chicago Teachers College
McGinley, (M) Mike	A Follow-up Study of Industrial Arts Graduates from Northwestern State College, Alva, Oklahoma; 1964.	Kansas State College of Pittsburg
McKenzie, (M) Charles Ray	A Comparative Study of Industrial Arts Programs in Selected States with Louisiana; 1965.	Northwestern State College Natchitoches, Louisiana
Sepulvado, (M) Paul Hurbert	Status and Need of Technical Teacher Training Programs; 1965.	Northwestern State College Natchitoches, Louisiana

<i>Author</i>		<i>Title</i>	<i>School</i>
Wahtera, K. A.	(D)	Industrial Arts in Michigan's Upper Peninsula; 1965.	University of Michigan
Wallis, Donald E.	(D)	Status of and Direction for Industrial Arts in the Public Schools of Missouri with Implications for Teacher Education; 1965.	University of Missouri
Methods			
Aguirre, Edward		An Experimental Study of Two Methods of Teaching Engine Lathe Principles and Procedures; 1965.	San Diego State College
Beal, Richard William	(M)	An Experimental Comparison of Two Methods of Teaching Below-Average Students in Industrial Arts; 1964.	Kansas State College of Pittsburg
Bergman, Kenneth H.	(D)	Comparisons of Three Teaching Methods in Introductory College Electricity; 1963.	Colorado State College
Bertrand, Clint A.		An Experimental Development of Programmed Instructional Material for the Vocational Education Department of the Texas Department of Corrections; 1964.	Texas A & M University
Bjorkquist, David C.	(D)	Discrimination Transfer from Scale Models and Pictorial Drawings in Learning Orthographic Projection; 1965.	University of Minnesota
Boettner, Hugh Eugene		The Development of a Teaching Device for the Study of the Binary System; 1961.	Chicago Teachers College
Brandon, G. L. and Mitzel, H. E.	(F)	Assessment of Experimental Teaching Strategies in Computer-Assisted Instruction Core Courses for Technical Education; 1969.	Pennsylvania State University
Burnett, Gilbert	(M)	A Study Comparing Two Methods of Teaching Basic Electronics; 1965.	Kansas State College of Pittsburg
Cornwell, Raymond L.	(D)	Written Instructional Materials: An Experimental Comparison of Problem-Centered and Traditional Assignment Sheets; 1961.	University of Minnesota
Crosby, Edmund D.	(D)	Some Results from the Use of Creative Problem Solving Techniques in Industrial Education; In Process.	University of Michigan

<i>Author</i>		<i>Title</i>	<i>School</i>
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Ferns, George William	(D)	Principles for Designing and Conducting Learning Experiences for Improving Problem-Solving Abilities as Applied to Industrial Arts Teaching; 1962.	Michigan State University
Fowler, Richard J.	(D)	An Experimental Comparison of Two Laboratory Methods for Teaching College-Level Introductory Electricity in Industrial Education; 1965.	Texas A & M University
Freeman, Kenneth R.	(M)	A Comparison of Teaching Techniques in Electricity; 1965.	Ohio University, Athens
Herold, R. D.	(P)	A Study to Determine the Best Method of Teaching Shop Safety, Negative or Positive Approach; 1962.	South Dakota State University
Hinckley, Edwin and Piersall, Arnold	(SS)	A Pilot Study in Programmed Learning in Laboratory Technical Courses; 1962.	Stout State University
Hofer, Armand G.	(D)	An Experimental Comparison of Self-Instructional Materials and Demonstrations in the Teaching of Manipulative Operations in Industrial Arts; 1963.	University of Missouri
Horning, Robert Bond	(M)	An Evaluation of Closed-Circuit Television as a Media in Teaching an Operation in Electronics by Use of the Demonstration Procedure; 1964.	Kansas State College of Pittsburg
Horton, Bolin E.	(M)	Order of Presenting Orthographic Projection and Isometric Projection and its Effect on Achievement in Mechanical Drawing; 1964.	Kansas State College of Pittsburg
Hughes, Ronald E.	(M)	Development of Projects and Production Assistance Outlines for an Introductory Woodworking Course; 1964.	Northern Illinois University
Hull, Thomas Franklin		An Experimental Study of the Effect of Practice on the Performance of Task Analyzed Operations; 1964.	University of Illinois

<i>Author</i>		<i>Title</i>	<i>School</i>
Kafka, Francis J.	(D)	A Study of the Industrial Arts Teaching Methodology Used at Millersville State College, as Reflected in the Teaching Methodology of Recent Graduates; 1965	New York University
Lease, Alfred Arnold	(D)	An Experimental Comparison of Linear Program and Textbook in Learning Basic Electronics; 1964.	University of Minnesota
Marko, Edward		Current Practices in Teaching Electricity; 1961.	Chicago Teachers College
McMurry, James G.	(D)	An Experimental Comparison of Self-Instructional Materials Versus Traditional Methods in Teaching Related Information in the Comprehensive General Shop; 1964.	University of Missouri
Mullikin, William		A Study of Occupational Therapy at Kankakee State Hospital; Manteno State Hospital; 1963.	Northern Illinois University
O'Shea, James P.		1. Creative Thinking Techniques for Basic Design; 1965. 2. Industrial Methods of Laminating Wood and Evaluation of Their Potential Use in H. S. Industrial Arts Laboratories; 1962.	Rhode Island College
Piersall, Arnold C.	(D)	An Experiment in the Use of Three Different Methods to Teach a Technical Information Unit in Industrial Arts Woodworking; 1964.	Colorado State College
Prust, Z. A.	(D)	Changes in Student Attitudes Toward Safety Education in the Graphic Arts Laboratory; 1964.	Colorado State College
Roberts, John E.		A Comparative Study of Average and Gifted Students When Grouped Homogeneously in the Field of Woodworking.	Chicago Teachers College
Smalley, Lee H.	(D)	The Development and Feasibility of Mass Production as an Education Experience in Industrial Arts; 1962.	Michigan State University
Sullivan, Victor F.	(D)	An Experimental Study of the Effectiveness of Two Methods of Teaching Orthographic Projection in Terms of Retention and Transfer; 1964.	University of Illinois

<i>Author</i>		<i>Title</i>	<i>School</i>
Trautwein, C. L.	(D)	An Experimental Comparison of Three Methods Used to Identify Industrial Materials; 1962.	Colorado State College
Weffenstette, Walter E.	(D)	The Effect of Laboratory Experiences on the Learning of Basic Electronics When a Programmed Instructional System is Employed; 1965.	Southern Illinois University
Wiberg, Donald Edward		The Development of a Program for a Teaching Machine for the Teaching of Introductory Concepts in Drafting.	Chicago Teachers College
Wills, Vernon L.	(D)	Effect of Teaching Procedures Emphasizing Speed of Performance Upon Educational Achievement: An Experimental Investigation; 1964.	University of Missouri
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Gimbel, Armin F.	(P)	What Reading Materials Are We Using at Graduate Level? 1963.	Southwest Missouri State College
Herbert, Harry A.	(M)	Single Room Closed-Circuit Television in Industrial Education; 1964.	Stout State University
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Creativity			
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Mietus, Walter S.	(D)	An Experiment on the Development of Productive Thinking and the Effect on the Cognitive, Affective and Psychomotor Behavior of Students in the High School Industrial Arts; 1966.	Loyola University of Chicago
Tucker, Casey A.	(D)	Creativity and its Relationship to Success in College as Measured by the Grade Point Average; 1965.	Colorado State College

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<i>Author</i>		<i>Title</i>	<i>School</i>
Paschke, Edward Ernest		An Analysis of the Shop Accidents and Their Causes Occurring at the Chicago Vocational High School From September, 1953, to June, 1958; 1962.	Chicago Teachers College
Pelikan, Robert	(M)	Recommended Standards for Safe Working and Safe Passing Space Around Selected Machines and Work Stations in the Industrial Education Woodworking Shop; 1963.	Northern Illinois University
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Wos, Michael Vincent		Eye Protection Programs Used in Junior and Senior High School Electric Shops in Illinois; 1964.	Chicago Teachers College

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Foley, Denis J., Jr.	(D)	Procedures for the Selection of Potential Industrial Arts Teachers; 1966.	New York University
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Martello, Norman John		Recruiting Practices Employed by Colleges and Universities in the Mississippi Valley Industrial Arts Conference.	Chicago Teachers College
Nelson, Howard F.		The Use of the Minnesota Vocational Interest Inventory in the Selection of Potential Industrial Teachers; 1964.	University of Minnesota

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Bennett, George V.	(M)	The History and Development of the Metalwork Shop in the Kansas High School; 1961.	Kansas State College of Pittsburg
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<i>Author</i>	<i>Title</i>	<i>School</i>
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Colbrese, Nick Peter	Verne C. Fryklund and his Contribution to Industrial Technical and Vocational Education; 1964.	Chicago Teachers College
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Hennessey, (M) Everett L.	Walter P. Chrysler and his Contributions to the Modern Automobile; 1961.	Kansas State College of Pittsburg
Hong, (M) Man Ho	An Analysis of Frank Lloyd Wright's Architectural Principles and Techniques with Emphasis on Applications on His Work; 1963.	Northern Illinois University
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Objectives		
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Jacobsen, (D) James Huffman	A Study of the Contribution of Industrial Arts Instruction to Consumer Knowledge; 1964.	Colorado State College
Miller, Rex (D)	An Examination of the Objectives of Industrial Arts with Respect to Selected Sociological Factors of Contemporary American Urban Society; 1961.	University of Buffalo
Roy, Wendell L.	A Study of Selected Objectives of Industrial Arts; 1963.	Texas A & M University

<i>Author</i>		<i>Title</i>	<i>School</i>
Woody, E. T., Jr.	(D)	Analysis of the Perceived Objectives Among Industrial Arts Teachers; 1963.	Colorado State College
Survey			
Kramer, Russell	(M)	An Investigation of the Use of Drafting Machines In Industry and the Public H. S. of Northern Illinois; 1964.	Northern Illinois University
Palendech, Michael		A Survey of the Printing Industry to Obtain Opinions on Vocational Printing in the High Schools; 1961.	Chicago Teachers College
Pufahl, Virgil	(M)	A Study of the Extensiveness of Electricity and Electronics Instruction in Senior High Schools of Southern Wisconsin Exclusive of Milwaukee County; 1965.	Northern Illinois University
Rathnau, Joseph N.		Research in Industrial Education at the Chicago Teachers College 1940-1960; 1961.	Chicago Teachers College
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Bell, H. T.	(P)	Industrial Arts Students in Occupations Other than Teaching; 1963.	Long Beach State College
Brownrigg, Jerry Roy	(P)	Reading Abilities of College Drafting Students Compared with Readability of Drafting Textbooks and with Informational Achievement in Drafting; 1962.	University of Missouri
Cecil, Stanley		A Comparative Study of the Requirements Leading to the Master's Degree in Industrial Education; 1963.	Chicago Teachers College
Collins, Kenneth L.	(M)	A Proposed List of Books Published Between 1950-1960, for the Industrial Arts Library with Suggested Criteria for Evaluation; 1961.	Kansas State College of Pittsburg
Detwiler, Wayne L., Sr.		Present Status and Preferred Practices in Industrial Supervisory Training Programs in Bethlehem, Pennsylvania; 1964.	Pennsylvania State University

<i>Author</i>	<i>Title</i>	<i>School</i>
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Grannis, (M) Gary E.	Graphic Arts Facilities and Curricula of Selected Teacher Training Institutions; 1963.	Northeast Missouri State College
Haskin, (M) Franklin L.	The Mobility of Public Senior High School Industrial Art Teachers in Kansas; 1963.	Kansas State College of Pittsburg
Hinckley, (SS) Edwin C. and Piersall, Arnold	An Analysis of the Utilization of the Laboratories of the Woodworking Department at Stout State University; 1962.	Stout State University
Hodges, Lewis H.	Experimental Program for the Identification, Selection, and Development of Persons for Leadership Roles in the Administration and Supervision of Vocational and Technical Education; 1965.	University of Michigan
Koerner, Ted	A Survey of Federal and State Aid to Education and its Relationship to Church and State, to Discover a Basis for a Philosophy in a Democratic Society.	Chicago Teachers College
Ledbetter, (D) James L.	Personality Variables of Intern and Public School Teachers; 1965.	University of Tulsa
Messman, (D) Warren B.	Interest Patterns of Freshman Industrial Arts Majors in Comparison with Personality Traits; 1963.	Colorado State College
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Nelson, (D) Hilding E.	Occupational Self Images of Teachers: A Study of the Occupational Involvements and Work-Role Orientations of Michigan Industrial Education Teachers; 1962.	Wisconsin State College, Platteville

<i>Author</i>	<i>Title</i>	<i>School</i>
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Ridendour, (M) William E.	Present Leaders in Industrial Arts Education; 1962.	Long Beach State College
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Schad, (FS) Joseph A.	Practices, Opinions, and Recommendations Dealing with Financing Consumable Supplies for Industrial Arts Classes in Virginia; 1962.	Cornell University
Sternard, Arthur E.	An Annotated Bibliography of Books, Pamphlets, and Articles for Industrial Arts in the Elementary School.	Northern Illinois University
Thomas, (D) Charles L.	The Relationship of Competence of Industrial Arts Student Teachers to Dogmatism as Revealed by the Rokeach Dogmatism Scale; 1964.	Colorado State College
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Observations Related to Research

It may be said that the ideal educational goal in the United States is one of seeking universal cultural literacy. If we view culture as the product of man's total genius, past as well as present, we find that there is substantial diversity rather than uniformity in achieving this goal. Since the substance of the technology found in this industrial setting is part of the total manifestation of the genius of man, it therefore becomes the concern of all education. The extent to which industrial arts becomes a part of this educational function is somewhat dependent upon the research in this area. It appears that the views of the role that industrial arts plays in the total educational picture are varied. Whether industrial arts will play a minority or a majority role in providing an adequate under-

standing of the industrial-technological facet of our culture is a question not yet fully answered—either by the educational community as a whole or by the professionals within the field of industrial arts.

Attitudes and Practices

The attitudes and practices of research in industrial education are not too difficult to assess. In recent years there has been more apprehension and less confidence in the profession's grasp of our contemporary image than there was two or three decades ago. Research is often stated as a solution to the problem of change. A modest amount of energy and enthusiasm has been projected toward more adequate content and methodological models.

Some of these views have been sound ones while others have reflected hunches, prejudicial positions and sometimes lacked built-in refinement. This is the result of the absence of related documentation and research. This has caused an undercurrent of confusion and doubt in the minds of many in our field who are essentially consumers rather than producers of vanguard thought. To a limited degree, research is now appearing on the industrial arts scene which could assist in resolving this dilemma of current confusion.

Another characterization, not without foundation, is our occasional unwillingness (and often inability) to communicate within our field, let alone with those in the peripheral disciplines or subject matter areas. These attitudes often are so strong as to perpetuate an exclusion of related disciplines from our field.

Also, there are presently, diverse efforts in many directions which have resulted in clouding our main stream of effort. Only a little thought has been given to the intrinsic value of research as one means, *and only one of many*, in attempting to resolve this problem. Utilizing the peripheral disciplines in an examination of our own needs has much to recommend it.

Understanding and Enthusiasm for the Research Approach

The enthusiasm for a problem-solving research approach to this concern for change is in question. This is perhaps due in large measure to the lack of understanding as well as poor communication within our own profession and with the public.

With all of our hunches, strong and weak views, as well as the minimal research representing our own investment in resolving our problems, is there not a need to understand one another in a research context that will ultimately bring an approach to industrial arts education that might find acceptance by the laity as well as the professionals? Some believe this is possible. It can be truthfully said that while the events of the past two decades should compel us to involve ourselves more scientifically and professionally, there are only a certain few who have approached this as a research activity. What so-called "break-throughs" we have achieved have rarely resulted from a well disciplined research approach. Often as an individual intuitive dream or departmental team effort, there is the perpetual hope that this time an important and insightful contribution will be made. Research proposals may be motivated by personal status rather than by the importance of the work and its contribution to the profession.

Until recently, monetary support for any worthy research effort has been seriously wanting in our field, and it could very well be that many a worthy and sincere research effort has fallen by the wayside as a result of this limitation. Research subsidy too often goes to the "in-group" research programs rather than to the operational level that we find in the classroom (whether at the high school, college or university level). There are limited exceptions to the previous observation, such as the funded studies taking place in American Industries at Stout State University, the study involving many different cultural institutions taking place at Ohio State University, and the study of technology as it relates to higher education at Northern Illinois University.

While selective subsidy may be justified on the basis of competency as well as a systematic development of inquiry under controlled conditions, inevitably it also means the research that is done may take place in what may be a sterile environment, lacking little or no relationship to the operational setting of the industrial arts classroom. Also, often in question, is the adequacy of procedural and methodological tools, and hence the approach is influenced by receptivity (often negative) to new possibilities. The Thirteenth Yearbook of the American Council on Industrial Arts Teacher Education has made a sig-

nificant contribution toward providing the tools for classroom research.

Producers and Consumers of Research

It has been observed by many that the industrial arts classroom educator is rarely a research consumer let alone a research producer. Without a doubt, there are potentially research-laden situations in many classrooms where the spirit is willing but is lacking the encouragement and the tools necessary to bring about significant research. It would be unrealistic to assume that all teachers are researchers, but not unrealistic to assume that they could be knowledgeable and effective *consumers* of research. Integrity in this approach can be had, but only through the provisions for proper training (in undergraduate and graduate professional preparation). Its acceptance, and a willingness on the part of the teacher to conduct a worthwhile, meaningful and disciplined research effort in his own situation are needed. Having accepted the responsibility to function in such a situation, we must likewise have the courage to evaluate ourselves and study carefully the evaluation of others in order that we may improve our own effort. Concurrent with the new cultural images, which significantly influence the philosophical posture of industrial arts education, is the need for adequate classroom research under realistic conditions. The importance of the classroom teacher in this view cannot be over emphasized. To this end, research should be one of the cornerstones of graduate work and hopefully a requirement for the future in undergraduate teacher education programs where the skills acquired are in the context of the classroom and shop-laboratory work. So often the educator has viewed research as the function of the educational elite. In most instances, classroom teachers will find colleges and universities and other educational resources willing to provide assistance for those anticipating research as a part of the regular school program. First efforts are usually difficult, but with repetition comes ease and with understanding comes challenge and anticipation.

Evaluation

If change is to take place, the research that begets change must be based upon valid and reliable means. To be specific, how many teachers in our field have assumed that they are

performing their professional responsibility satisfactorily? What evidence do they have to substantiate this fact? Few, perhaps, would respond in the negative. Let us then ask how many years have they been doing what they have deemed satisfactory or adequate? Would it be ten, twenty, thirty years or more? Also, in terms of the so-called objectives of their teaching and their program, what significant evaluation has been made as to whether those objectives had been truly adequate as well as achieved. Or has it been merely supposition. The limited research in this area would suggest that rare is the situation where a program achieves what the school and the teacher define as the objectives of the program. There is a need for a more sincere effort in eliminating guesswork and prejudicial opinion, replacing it with inspired and factual research.

Communication with the Present

The fabric of developments in the practices of our field during the last half century has been a rather complimentary philosophy and a comfortable rationale. Disturbed as many may be to the practices in our field, it is even more disturbing to note the many others who express approval by perpetuating the past as if it were approaching what some view as almost the ideal practice. This unnerving complacency can be traced to those who refuse to involve themselves in identifying the present realities of the changing culture and to similarly reflect this involvement in some form of research with reference to this change. The complacency of the status quo is a very comfortable one. It is a comfort born out of the past where once the practices have been successful they are perpetuated irrespective of the changing context of the present and the foreseeable future. Often the cultural signposts of the present are at variance with interpretive educational practice and it is here that one can appreciate the reasons for the tensions that sometimes exist in our field. To continually conjecture and theorize, based upon the past, can be a harmful preoccupation.

Content and Method

There are those who might hold that content and practice, especially that established through research is too much to expect as part of the general classroom practice. Some teachers

may hold that there is a certain intellectual enjoyment for some in dealing with theories but to implement them in the classroom is impractical. Also, quite often teachers in training view theories of learning in academic abstraction at the college level with little or no application to what might be termed the practical level of operation in the classroom. Hence research is seen as a scientific adventure rarely related to the classroom and without any sense of application to the field. Must we only theorize without providing application in the classroom? Common sense would truly suggest that implementation does not constitute a contradiction.

Concept

Industrial educators must exercise the prerogatives of inventiveness and curiosity. We must be creative in applying conceptual elements of theory to a wide spectrum of uses in the classroom. These can range from a philosophical statement to its manifestations in curricular patterns, course content, methods of teaching, structuring of learning experiences, and evaluation of not only the student but likewise the program in terms of the original goals and philosophical concepts. It would include the participation in a model of contemporary society which would necessarily include the technologies and the human involvement having research as part of the learning experience. We must be able to theorize, we must be able to define explicitly the concepts and the means and procedures of what has been identified and discovered, implementing these into the learning experiences which we structure for our classrooms. We must be able to implement experimentation in order to help us think through and work out what our responsibilities are and where our efforts should be directed. At the same time, we should recognize that these experimental procedures do not necessarily impose any fixed restrictions on our programs. While all cannot function with equal brilliance in this endeavor, each can function individually or in a group effort. Teachers should not lessen their efforts toward using the best of their abilities. Rather, they should with the greatest possible freedom, yet reflecting a professional and self-disciplined approach, pursue the unknown of the present culture. There is a *need for theory, substantiated by fact and implemented by practice.*

Philosophy and General Acceptability

One may question whether one should deal purely in thought speculation rather than rely upon research, observation and documentation. For decades we have built programs based upon our own speculations, and preferences rather than drawing upon a common body of knowledge and content peculiar to the total field. Many programs have become so personalized that they are completely identified with the individual teaching the subject rather than as a field. Consequently, the subject, because of this individuality, which at times has been viewed as a strength, has led to a more serious concern of weakness when viewed in relationship to total school curriculum. Therefore, it is necessary to be able to theorize within the structure of the field, drawing upon the peripheral disciplines related to the field rather than involving the preference of the teacher in an emotional approach to teaching. Often programs have been trivial where the teaching has ignored the infinite possibilities of the contemporary scientific and the technological applications.

In Summary

It is possible to identify where to begin on this problem—what shall be included or rejected, the methods used in teaching, the content needed, as well as the elements to be evaluated. A self-disciplined approach in terms of the profession is essential, rather than what might be termed the individual-preferential approach that is unique for each individual teacher and program. To conclude that a research approach is the complete and total answer without pitfalls would be ludicrous. We must guard against an insensible sanguine attitude which implies that all of the work done in a research approach is all wise, all knowledgeable, and all truth without question. It is acknowledged that research has its elements of chance. The chance is more likely in the possible human error of interpretation and implementation rather than the higher probabilities of a well disciplined research design. Successful operational research as well as theory drawn from the peripheral disciplines of our field need to be applied to our programming. We then will be able to go beyond our present knowledge and practice and venture outward with some assurance into a future that holds promise for *what* we teach as well as *who* we teach.

Only the future alone will determine what is important. Equally important is that we pursue the future as carefully, as is professionally and humanly possible.

Finally, one should guard against the trivial, recognizing that we can be our own worst enemy. Let the advances that are made include the elements of verification and documentation as well. Let not the objectivity of the present and the future ignore tradition and the past, but rather provide an area of synthesis where the two would be successfully combined. In a quest for objectivity let us not rule out the possibility of the accidental as characterized by Firestone's discovery of vulcanization. Let us recognize that our quest for objectivity is not peculiar to our field alone. Other curricular areas seek similar objectivity. In an effort to identify and to determine fundamental values reinforced by objectivity, there is the strong need for communication, *and* a sense of dedication to implement that which has been communicated.

The educational establishment may be viewed by many as being as stalwart as the proverbial oak tree. Yet, one day a cultural demand for examination may be as devastating as a bolt of lightning splitting complacency down the middle, exposing the decay of time, indifference and disinterest. As the heart of an oak may disintegrate with time, it leaves a healthy appearing but empty shell of what was once a sturdy establishment. In reality some of the old purpose, substance, and significance has deteriorated with time, leaving only the hollowness of its former self, often unable to sustain the light of critical examination that a modern world requires. For some, decay is meaningless. For others, decay is a betrayal of those to whom the educational establishment has its responsibilities. Some are unaware of what has happened while others proceed along a path of knowing indifference frozen in immaturity. Does today's educational program enable the student to reach high for the best that can possibly be offered from today's resources?

Guiding attitudes must be reexamined, recognizing that the will for change resides with the individual. The will for change is not enough—in addition to this, we must have commitment and action.

Some Areas of Needed Research

Content and Curriculum

1. New curricular structures and concepts that may more adequately characterize contemporary industrial arts content.
2. Teacher training institutions preparing teachers for the interplay of technology and industry and to orient students toward technological areas.
3. The appropriateness and possibilities of including technologically oriented research with the traditional professional research in undergraduate and graduate industrial arts teacher education.
4. The concern whether industrial arts teacher education should provide technical specificity or broad theoretical understandings.
5. The consideration of program characteristics and potential standards of industrial arts teacher graduate programs at the fifth- and sixth-year levels.
6. Educational legislation and other means by which industrial arts teacher education may find assistance and funds for institute programs at the graduate level.
7. Curricular trends and new shop-laboratory equipment implementation.
8. A study of "concept" as a basis of curricular structure in industrial arts programming.
9. A study of the extent to which industrial arts teacher education can utilize the opportunities provided by the peripheral educational disciplines in advancing its own graduate and professional content.
10. Replication of research and implementation of findings of other educational and social research efforts.

Philosophy

1. The relationships that may be developed between industrial arts education and the exceptional child.
2. Identify possible philosophical thought structure that will provide guideposts for the emerging industrial arts of the future.
3. The developing cultural profile and the future role of industrial arts in general education.

Recruitment

1. Recruitment of various kinds for industrial arts teacher education at the baccalaureate level.
2. Recruitment of qualified personnel for teacher education faculties. Sources to include not only graduate schools of colleges and universities but science and industry as well.

Methodology

1. The identification, experimentation and evaluation of different types of learning experiences possible in the "new" industrial arts programs.
2. A study of the current literature in the broad field of methodology and the new roles the teacher and pupil can play in industrial arts learning experiences.

Evaluation

1. Approaches to periodic programmed evaluation of different curricula at different levels.

Work Experience

1. A study of coordinated technological/industrial work experience and possible professional credit at the undergraduate and graduate levels of industrial arts teacher preparation.

Non-Industrial Arts Involvement

1. A study of the involvement of industrial arts personnel in non-industrial arts professional organizations and the resulting potential to the individual teacher and profession by such involvement.

Staff Studies and Other Nondegree Research in Industrial Arts Education

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Introduction

The extension, conservation and diffusion of knowledge are purposes typically accepted by institutions of higher learning and they would surely be accepted by most of the professionals in industrial arts teacher education.

Attention is directed in this chapter to the first of the aforementioned purposes, namely the extension of the boundaries of knowledge. The teacher education facet of our profession undoubtedly must assume a major portion of the responsibility for the fulfillment of this significant purpose through research. To what extent is this responsibility being met? The answer to this question as reported in the Ninth ACIATE Yearbook by Fuzak¹ in 1960 was discouraging and disheartening. The conclusion of Chapter III relates quite well the status of the profession's attention to the extension of the boundaries of knowledge as Fuzak relates,

"The situation with regard to research work as a continuing activity by industrial arts teacher educators is a shocking one. It represents one of the darkest blots on the reputation of the profession. If research in industrial arts education is to ever develop beyond the stage of an information gathering activity, it must develop its own body of concepts, theories, and principles which are adapted to its own field. This cannot be done by

¹Fuzak, J. A., "Research by Industrial Arts Teacher Education," (American Council on Industrial Arts Teacher Education, Ninth Yearbook, 1960), Chapter 3.

depending upon graduate students for the major share of research. Mature industrial arts teacher educators have no choice but to develop and carry on programs of research as a regular part of their professional responsibility."²

This chapter of this, the fifteenth, yearbook discloses a somewhat brighter picture than that related in 1960; however, in view of the tremendous need there is still considerable reason for dissatisfaction with the profession's development and extension of knowledge.

Identification of Professional Research

To identify the nondegree research activities of individual professionals as well as staff studies, continues to be a difficult task as it was when last attempted in 1960.

The investigation was immediately hampered by the fact that there is no single source where one might expect to find reports of nondegree research in industrial education. This situation made it necessary to explore a number of *potential* sources which might contain reports of this type of professional activity. Since this rather broad-gauge review of literature seemed necessary, it was decided to limit the search to the five-year period from January, 1960, to January, 1965. The review of literature was further limited to consideration of research reports which gave evidence of a systematic structure, a description of purpose and procedures, an indication of findings as well as a statement of conclusions or generalizations resulting from the project.

Some of the sources reviewed in the research identification process were: *The Education Index*, *The Review of Educational Research*, *The Journal of Educational Research*, *The Phi Delta Kappa Directory of Educational Research Agencies and Studies*, *The Phi Delta Kappa Research Studies Index*, *The Journal of Industrial Teacher Education*, *The National Association of Industrial Teacher Educators Bibliography of Research Studies in Industrial Education*, *The Journal of Industrial Arts Education* (formerly *The Industrial Arts Teacher*), *The Industrial Arts and Vocational Education Magazine*, *The School Shop Magazine*, and *ACIATE Yearbooks X-XIV*.

²Ibid, p. 48.

The reviewing process identified twelve research studies meeting the criteria for inclusion. The most promising source for future reviews of research activities in the profession appears to be the *Journal of Industrial Teacher Education* which has devoted the majority of its space to research reporting in its first years of publication. As a result of this disappointing, although not unexpected yield, it was decided to go directly to the professionals engaged in industrial arts teacher education. Recognizing the limitations and difficulties involved in interpretation and classification reported by Fuzak in the Ninth Yearbook,³ the investigator developed a simple instrument designed to encourage professionals to submit an abstract, a summary, or a copy of the report resulting from a completed study. An information form was designed to secure descriptive information regarding the purpose, procedure, findings and conclusions of studies for which formal reports had not been prepared. In addition, the survey instrument sought information relative to nondegree research *in process* as well as research activity in the *planning* stage. The survey requested information about research completed between 1950 and 1965.

Of the approximately 200 institutions listed in the *Industrial Teacher Education Directory*⁴ nearly one-fourth had staff members who reported nondegree research activity in one or more of the three categories (that is, completed, in process, or planned).

The majority of the nondegree research reviewed in this chapter results from the data gathered through the direct survey. Unfortunately, much of the data submitted for review was rather sketchy thus requiring interpretation by the investigator. The survey gathered information regarding a number of research activities which are not reported since they were judged to have little or no direct relationship to industrial arts education even though they were submitted by professionals having a degree of responsibility for industrial arts teacher education. The majority of the activities excluded were in the major areas of vocational-industrial education, driver education and safety education.

³Ibid, p. 40.

⁴Wall, G. S. (compiler), *Industrial Teacher Education Directory*, (Stout State University, Menomonie, Wisconsin, 1963).

Nondegree Research Since 1950

The completed studies identified through the combination of procedures previously described vary considerably with regard to topic studied as well as the rigor of the investigating and reporting procedure followed. The topic variance is herein reported, but no detailed evaluation has been attempted.

Some of the studies are rather obvious extensions of former degree research activities which gives evidence of continued interest and perhaps a desire to continue the extension of the boundaries of knowledge in a specific area which would imply a quite desirable outcome of degree research. Another group of studies was somewhat exploratory or "pilot" in nature and has been extended into degree research by graduate students under the direction of the original researcher. Still others have provided a single piece of evidence for application, problem solution, or further research. The program development and improvement area of industrial arts teacher education provided the largest number of completed studies (a total of fourteen).

Many of the studies were staff or team efforts; however, complete data regarding all participants were not provided. Therefore, while one or two individuals may be cited with the study for identification purposes, several others may have contributed materially to the study.

Industrial Arts Teacher Education

Research which had as its purpose the consideration of the development and/or improvement of the program or practice of industrial arts teacher education is herein identified. Except where noted otherwise, the best source for further information regarding the research study would be the principal investigator cited.

1. Carpenter, Joseph E.: Massachusetts State College, Fitchburg, Massachusetts

An investigation designed to ascertain the competencies possessed by graduate students in industrial education relative to library usage (1964).

2. Dean, C. Thomas and Lathrop, Irvin: Long Beach State College, Long Beach, California

A survey designed to identify and describe the nature of programs of graduate study in industrial arts teacher education (1960). Reported in the Tenth Yearbook of the ACIATE.

3. Erickson, K. J.: Stout State University, Menomonie, Wisconsin
An experimental comparison of two approaches to the supervision of laboratory activities. One approach utilized an open laboratory with teaching assistants while the other employed assigned laboratory periods with regular instructor (1961). Reported in the Fourteenth Yearbook of the ACIATE.
4. Erickson, K. J.: Stout State University, Menomonie, Wisconsin
A study to ascertain the effect of an advanced placement program in basic college drafting upon achievement by students enrolling in subsequent drafting courses (1964). Reported in the Fourteenth Yearbook of the ACIATE.
5. Hornbake, R. L. and Maley, D.: University of Maryland, College Park, Maryland
A nationwide survey of industrial arts teacher education programs with emphasis upon the identification of superior practices (1955). Reported in the Fourth Yearbook of the ACIATE.
6. Micheels, W. J. and Sommers, W. S.: Stout State University, Menomonie, Wisconsin
A staff study designed to give careful consideration to the organization of a new structure of experiences for industrial arts teacher education at the University of Minnesota (1958). Published as *The Minnesota Plan for Industrial Arts Teacher Education* by McKnight & McKnight Publishing Company.
7. Nelson, Howard: University of Minnesota, Minneapolis, Minnesota
An investigation designed to provide better criteria by which students might be selected or admitted to programs of industrial arts teacher education. Using the Minnesota Vocational Interest Inventory as a base, the study sought to develop special "keys" which would have predictive value for student selection (1961). This is a continuing research project although a tentative report was presented in the Eleventh Yearbook of the ACIATE.
8. Piersall, A. C. and Hinckley, Edwin: Stout State University, Menomonie, Wisconsin
A study to ascertain instructor activities in college woodworking courses in categories, i.e., demonstration, supervised laboratory work, classroom type activities (1962).
9. Robinson, Walter J.: Northwestern State College of Louisiana, Natchitoches, Louisiana
A nationwide survey of departments of industrial arts teacher education programs to assess trends as well as expected program modifications (1959).
10. Sampson, J. B. and Sommers, W. S.: Stout State University, Menomonie, Wisconsin
An investigation designed to apply the industrial technique of "work sampling" to the process of analyzing laboratory teaching activities in industrial teacher education (1963).

11. Schmitt, Marshall: U. S. Office of Education, Washington, D. C.
A study of the trends in graduate study for the field of industrial arts during the period 1951 to 1959 (1960). Reported in the Tenth Yearbook of the ACIATE.
12. Silvius, G. Harold: Wayne State University, Detroit, Michigan
An interview study designed to assess the program goals, teacher competencies, in-service opportunities, recruitment practices, and the nature of other selected factors which contribute to the effectiveness of industrial education programs in Michigan (1965).
13. Wagner, Willis: State College of Iowa, Cedar Falls, Iowa
A study designed to secure the structured reactions of students and instructors to the use of "graduate assistants" for the supervision of laboratory activities carried out in conjunction with college woodworking classes (1959).
14. Wright, L. S.: State College of Iowa, Cedar Falls, Iowa
A study to experimentally compare the relative effectiveness of the "instructor supervised" and the "graduate assistant" laboratory phase of college drafting (1959).

Teaching Methods and Media

The studies identified in this category had as their purpose the improvement of teaching-learning efficiency through the investigation of instructional practices or materials.

1. Barnard, David P.: Stout State University, Menomonie, Wisconsin
Pilot investigation designed to implement single-room closed circuit television for purposes of presenting technical demonstrations (1963). Further research effort has been extended in this area through a master's degree study at the same institution.
2. Gimbel, A. F.: Southwest Missouri State College, Springfield, Missouri
Survey of college industrial education programs to ascertain the nature and extent of published materials used in industrial teacher education courses at the graduate level (1963).
3. Gunderson, Harry: Northern State College, Aberdeen, South Dakota
Developmental research to develop a device for facilitating the presentation of technical information relative to threads in the field of metalworking (1964).
4. Irang, Frank J.: San Diego State College, San Diego, California
Survey of nationwide sample of industrial arts teachers, teacher educators, and supervisors to ascertain the current status of published materials and the anticipated textbook need for the future (1964). Research was supported by a grant from a publishing firm.
5. Jacobsen, E. A.: Northern Illinois University, DeKalb, Illinois
An experimental comparison of the attitudes held by students toward instruction by closed-circuit television and instruction in the conventional classroom (1960). Research reported in *Liberal Education*, December, 1961.

6. Miller, W. R.: University of Missouri, Columbia, Missouri
An experimental comparison of the achievement of equated groups of learners exposed to technical informational content written at the sixth grade level and the eleventh grade level (1964).
7. Piersall, A. C. and Hinckley, Edwin: Stout State University, Menomonie, Wisconsin
An experimental comparison of two teacher-directed approaches to the presentation of informational content relative to wood identification with two student-directed approaches including programmed instruction (1962).
8. Piersall, A. C.: Stout State University, Menomonie, Wisconsin
An experimental comparison of the lecture-chalkboard method, the information sheet method and lecture supplemented by closed circuit television in the teaching of a technical information unit in wood-working (1963).
9. Rowlett, John D.: Eastern Kentucky State College, Richmond, Kentucky
An experimental comparison of direct-detailed and directed-discovery methods of presenting content related to orthographic projection. Initial learning, retention and transfer were outcomes tested. A tape-recorded scheme of providing instructions was used. (1961). Financial assistance provided through Title VII of NDEA.
10. Suess, Alan R. and Householder, D. L.: Ohio State University, Columbus, Ohio and Purdue University, Lafayette, Indiana
A study to investigate the effects of group discussion as well as teacher influence upon opinion change (1964). Reported in the *Journal of Industrial Teacher Education*, Vol. 2, No. 2, 1965.

Status and Need

Investigations categorized in this section have attempted to ascertain certain conditions, not for purposes of comparison, but to provide a knowledge base upon which to plan future activities.

1. Logue, Jay: East Texas State College, Commerce, Texas
Study of the factors leading 510 industrial arts graduates to originally enroll, the conditions of their present status and opinions of the graduates regarding teacher education program experienced (1960).
2. London, H. H.: University of Missouri, Columbia, Missouri
Survey of bachelor's, master's and doctor's degree graduates to ascertain current status, professional plans, as well as a curricular evaluation (1955 and 1961).
3. Miller, W. R.: University of Missouri, Columbia, Missouri
Follow-up of graduates of a "professional semester" program in industrial arts education at Purdue University in an effort to secure structural reaction from graduates during their first two years of teaching (1962).

4. Ray, Willis: Ohio State University, Columbus, Ohio
Survey resulting in a report that describes the industrial arts teachers and programs within the State of Ohio (1959).
5. Rudiger, Robert: Stout State University, Menomonie, Wisconsin
Survey designed to ascertain the status of industrial arts in the State of Wisconsin (1961).
6. Tierney, W. F.: University of Maryland, College Park, Maryland
Study through survey and interview of the certification status, in-service programs, and personnel needs in the field of industrial arts for the State of Maryland (1958).

Relationship Between Industrial Arts and Other Aspects of School Program

1. Brennan, Thomas J.: University of West Virginia, Morgantown, West Virginia
A survey of the research and literature associated with the school dropout problem with implications drawn for the program of industrial arts (1963). Report published in the *Journal of Industrial Teacher Education*, Spring, 1964.
2. Drennan, Jerry and Nichols, Phillip: Abilene Christian College, Abilene, Texas
A pilot investigation to identify and define both potential and existing relationships between Industrial Arts and Special Education (1964).
3. Tinkham, Robert A.: University of Illinois, Urbana, Illinois
A research effort designed to develop and demonstrate the effectiveness of instructional materials prepared for the use of blind students in the technical area of woodworking (1962).

Changing Nature of Industrial Arts Education

1. Barnhart, E. L.: Kansas State Teachers College, Emporia, Kansas
A survey of the college and university departments of industrial arts in the Mississippi Valley region of the United States to ascertain the extent to which programs of Industrial Technology were being incorporated (1963).
2. Bernard, Charles: University of Southwestern Louisiana, Lafayette, Louisiana
A survey of the college and university departments of industrial arts in the Mississippi Valley region offering programs for non-teaching majors (technologists) to ascertain the nature and scope of such programs (1954).
3. Rowlett, John: Eastern Kentucky State College, Richmond, Kentucky
An exploratory project designed to identify broadened roles for college and secondary school programs of industrial arts as well as to plan demonstration programs to carry out the roles identified (1964). Financial assistance provided through a grant from the Cooperative Research Branch of the United States Office of Education.

Miscellaneous Studies

This category of studies should imply no more than the fact that each research cited represents an area of investigation which had no studies of a similar nature reported; therefore, they have been grouped together for convenience.

1. Fuzak, John A.: Michigan State University, East Lansing, Michigan
An investigation designed to ascertain the role which physical maturity plays in the ability of junior high school boys to perform manipulative processes and to find a criterion for physical maturity that would have practical value for the classroom teacher (1958). Report published by the American Technical Society.
2. Morical, Edward: Stout State University, Menomonie, Wisconsin
An exploratory investigation to develop an objective means of evaluating service activities in auto mechanics (1964).
3. Peterson, Goodwin G.: Northern Illinois University, DeKalb, Illinois
A technical research to ascertain the extent to which a single modularized strain-gage amplifier can be increased in scope to a total of twelve and/or twenty-four channels with a common power source (1950). Financial assistance provided through a grant from the Hathaway Instrument Co.
4. Porter, Samuel: Western Washington State College, Bellingham, Washington
A survey of industrial arts awards programs conducted in various states (1965)
5. Warner, James: Northern Illinois University, DeKalb, Illinois
An analysis of the results of the regional and state industrial arts exhibit programs held in the state of Illinois — 1961 through 1963 (1964).

Unless noted otherwise, the research studies reported in the preceding categories were financed by individual or state funds through the departments or colleges where the majority of the studies emanated.

A number of scholarly works based on evidence secured through a wide range of reading and synthesis were noted by the author; however, these were excluded as not meeting the original criteria established for the survey of research.

Nondegree Research in Process

In addition to the preceding studies which were reported as completed, a number of studies were indicated as being "in process." Even though these investigations were reported in a variety of stages, it was decided that their inclusion would be beneficial to the profession.

The area of instructional media appears to be receiving the greatest amount of attention as eight studies were indicated as being *in process* with the majority scheduled for completion by June, 1966.

Instructional Devices and Media

1. Bernard, Charles: University of Southwestern Louisiana, Lafayette, Louisiana
An investigation to ascertain the effectiveness of the programmed instruction method in teaching 16mm motion picture projection
2. Biggam, W. R.: University of Idaho, Moscow, Idaho
An investigation to ascertain the effectiveness of the programmed instruction method in teaching of skills and knowledge associated with measuring and reading a micrometer. A companion investigation in the area of building materials is also underway.
3. Botsford, Jon: Eastern Kentucky State College, Richmond, Kentucky
A technical research designed to create a one-fourth inch tape video recorder.
4. Campbell, Robert: University of Illinois, Urbana, Illinois
A study to investigate the use of technical media for simulating environment to be utilized in the provision of individualized instruction. Financial support being provided through the Cooperative Research Branch of the United States Office of Education.
5. Peterson, Goodwin: Northern Illinois University, DeKalb, Illinois
An experimental investigation of the relative effectiveness of classroom instruction with electronic feedback and conventional classroom instruction.
6. Schwalm, Ray: Western Washington State College, Bellingham, Washington
An investigation to develop and implement the concept of visual communication education. Financial support provided through the International Graphic Arts Education Association by the Ford Foundation.
7. Siegner, C. Vernon: Peru State College, Peru, Nebraska
A study designed to explore the potentialities of the half-frame camera for visual aids in industrial education.
8. Stern, Jacob: University of Illinois, Urbana, Illinois
An investigation of the auditory environment and its effects on teachers in the area of metal machining.

Status and Need for Industrial Arts

1. Brooks, Weston: East Tennessee State University, Johnson City, Tennessee
A survey of the present status of industrial arts programs in the public schools of Tennessee.

2. Brown, B. Wesley: Arizona State College, Flagstaff, Arizona
A follow-up study of the industrial education graduates of Arizona State College, 1959-1964.
3. Harrison, O. S.: University of Georgia, Athens, Georgia
A study designed to assess the status of industrial arts education in the state of Georgia.
4. Logue, J. L.: East Texas State College, Commerce, Texas
A study designed to assess the status of industrial arts education in the state of Texas.
5. Loveless, Austin: Utah State University, Logan, Utah
An investigation designed to ascertain the status and need for industrial arts in Utah.
6. Tierney, W. F.: University of Maryland, College Park, Maryland
A survey of the industrial arts personnel needs in the state of Maryland.

The Industrial Base for Industrial Arts

1. Cunningham, B. M.: Bradley University, Peoria, Illinois
A study to identify the applied sciences in industrial education and industry.
2. Face, W. R., Flug, E. R. and Swanson, R. S.: Stout State University, Menomonie, Wisconsin
A developmental study designed to identify and structure a body of knowledge interpretive of industry that is expressed in concepts rather than isolated elements of content. This is a continuing investigation; however, a progress report was issued in the Fourteenth Yearbook of the ACIATE. Financial assistance provided through a grant from the Cooperative Research Branch of the United States Office of Education and the Ford Foundation.
3. Hackett, D. F.: Georgia Southern College, Statesboro, Georgia
An analysis of the scientific technical knowledge associated with the area of woodworking.
4. Kleinbach, M. H.: Wayne State College, Wayne, Nebraska
An illustrated study of the operations, processes and products in selected Northeast Nebraska industries.
5. Melo, Louie: San Jose State College, San Jose, California
A study to identify and evaluate industrial materials in the secondary school industrial arts program.
6. Merrill, George R.: University of Maryland, College Park, Maryland
An evaluative study to ascertain the effectiveness of the "education for industry" programs.
7. Towers, Edward R., *et al.*: The Ohio State University, Columbus, Ohio, with the University of Illinois, Urbana Illinois
The Industrial Arts Curriculum Project — an investigation of possible approaches to structuring the body of knowledge in industrial technology using advisers representing various related disciplines and agencies. A continuing project funded by United

States Office of Education, aiming at developing and implementing a systematic curriculum for industrial arts at the various levels.

Miscellaneous Research

1. Moss, Jerome: University of Minnesota, Minneapolis, Minnesota
A study designed to estimate the validity of the "Minnesota Tests of Creative Thinking" as a device for measuring the creative abilities of eighth grade industrial arts students.
2. Moss, Jerome: University of Minnesota, Minneapolis, Minnesota
An investigation to ascertain the influence of industrial arts experience at the senior high school level upon grades earned in selected post-high school trade and technical curricula. Financial support being provided through the Cooperative Research Branch of the United States Office of Education.
3. Nothdurft, D. D.: Northeast Missouri State College, Kirksville, Missouri
A study to assess the relationship between industrial arts and other practical arts courses taken in high school and subsequent college success.
4. Smith, Brandon: Ellendale State Teachers College, Ellendale, North Dakota
A research effort to develop and implement a non-teaching degree program in a department of industrial arts teacher education.
5. Suess, Alan R.: The Ohio State University, Columbus, Ohio
An investigation of the characteristics of students who transfer into the industrial arts teacher education program.

Nondegree Research Planned

The survey of institutions having programs of industrial arts teacher education yielded information regarding research plans that had been formulated although the projects had not been initiated.

Due to the nature of planned activities, it was decided that no detailed description would be attempted. Only an indication of the principal areas in which research activities may be anticipated are herein reported.

Fewer studies were reported in the "planning stage" than in either the "completed" or the "in process" categories as only seventeen research studies were currently being planned. Of the planned projects, five were in the area of industrial arts for the elementary school; three were institutional follow-up studies of graduates; three studies were planned in the area of industrial arts curriculum structure and appraisal; two

studies were planned in the area of instructional methods and media; two studies were designed to investigate technical problems; and two investigators planned statewide studies of industrial arts education programs.

Conclusion

Considering the small amount of nondegree research activity reported in the Ninth Yearbook in 1960, the five-year period between 1960 and 1965 was a quite productive period as twenty-five of forty-one studies were reported as *completed* during the first half of the present decade.

As might be expected, over ninety percent of the researchers completing and planning studies in the area of industrial arts education possessed the doctor's degree. In spite of the fact that both private and public groups have been encouraging research, only about ten percent of the studies completed had been supported by agencies outside of colleges and universities where the researcher was employed. Of the twenty-five reported "in process," four have been financed by agencies outside of the researcher's employing institution.

Even though the quantity of research activities is considerably increased, the predominant emphasis has been upon the type of research method referred to as normative survey and a relatively smaller amount of attention has been given to studies of an experimental nature.

The evidence does provide some basis for professional optimism as it appears that professionals in industrial arts teacher education are becoming increasingly active in research activities. Only time will tell whether the professionals will fully accept the challenge expressed by Fuzak in the Ninth Yearbook of the ACIATE when he said,

"If research in industrial arts education is to ever develop beyond the stage of an information gathering activity, it must develop its own body of concepts, theories, and principles which are adapted to its own field."⁵

⁵Fuzak, *op. cit.*, p. 48.

Securing Funds for Research in Industrial Arts Teacher Education

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Essentially this chapter aims to provide suggestions, and hopefully, some motivation for the industrial arts teacher educator who is interested in pursuing contract or funded research. This task is complicated by the fact that our teacher education personnel vary widely in their research competencies as well as in their familiarity with existing sources of research funds and procedures for securing such funds. A further complication, albeit a welcome one, is the fact that many federal agencies are undergoing internal reorganizations as a consequence of recent legislation that has provided new funds for research. A precise description, then, of such agencies and their programs would likely be somewhat obsolete by the time this Yearbook is published.

In attempting to discharge the responsibilities of this chapter, the writer has organized materials in the following manner:

1. An examination of certain "myths" regarding research in industrial arts teacher education.
2. A description of typical sources of research funds.
3. A discussion of procedures employed in securing research funds.
4. Detailed summaries of two federally supported research projects that relate to industrial arts teacher education, that were financed by different agencies within the U. S. Office of Education, that are drastically different in purpose and design, and that were conducted at a state college

that is somewhat typical of institutions where the majority of industrial arts teacher education programs are located.

The Myths

There are several myths (or perhaps partial-myths) that some industrial arts teacher educators have used from time to time to explain their lack of activity in research:

The Large-School Myth

1. "Research grants usually go to the large universities rather than to smaller colleges and universities where the bulk of industrial arts teacher education programs are located."

This statement is true, but only to a point. While the greatest quantity of research money does go to the large universities, the acceptance rate of proposals from smaller institutions is about the same (at least with respect to projects that relate to education) as for larger institutions! To put it another way, staff members from smaller, "non-research oriented" institutions have met with reasonable success when proposals are developed and submitted. Unfortunately, these proposals have been few in number, and this has been particularly true with reference to industrial arts teacher education.

The No-Time Myth

2. "The teaching load is too heavy to provide time for research."

If one expects to teach a full load and then to attempt, in addition, a research project of any consequence, then it must be admitted that one is setting out on a difficult journey. Fortunately, this does not have to be the case. *A research proposal typically provides for some released time from teaching during the course of the research project with money earmarked in the request budget to pay for staff to teach the classes which would ordinarily have been taught by the researcher.* A proposal may provide for a fractional reduction in teaching load, or it may specify full time to be devoted to the research project. Administrative details, such as a staff replacement, must, of course, be worked out within the framework of each institution's policies.

The No-Experience Myth

3. "One must be an experienced researcher in order to successfully compete for research funds."

Obviously, some research experience on the part of the chief investigator adds to the strength of any proposal. However, there are specific programs, such as the "small contracts program" of the U. S. Office of Education, that afford excellent opportunities for the untried, but promising researcher. Such programs, then, permit one to move ahead with proposals without being in undue competition with the experienced and more sophisticated researcher who will more than likely submit his proposal under a program that does not place a limit on the amount of funds to be requested.

The Not-Our-Policy Myth

4. "Research is not encouraged at my institution."

While this may have been true in the past, the climate is rapidly changing. At a recent meeting of the Association of State Colleges and Universities in Washington, D. C., (member institutions have typically developed via the normal school-teachers college-state college-university route) college presidents and deans spent much of their time attending sessions at which a variety of federally supported research programs were outlined and discussed. It was obvious, that, as a group, these administrators were extremely interested in their faculties becoming more involved in these programs. It is also significant that the position, "Director of Research," is beginning to be established at institutions of this type. The individual who holds this position typically assists staff members in preparing research proposals and routing them to the proper agencies. In addition, he usually has the responsibility for coordinating staff research projects that are supported by institutional funds.

The Present Outlook

The whole point of exploring the "myths" has been to suggest that the climate has never been better for industrial arts teacher educators to move ahead with proposals that will provide staff time and other resources that are necessary to come to grips with the wide spectrum of problems that demand answers. It must be admitted that we are short on research talent, but the situation is beginning to improve as Rupert Evans has pointed out in Chapter I. Furthermore, Title IV of the Elementary and Secondary Education Act of 1965 offers a dramatic opportunity to get at this shortage through provisions for spe-

cial training programs for researchers, ranging from undergraduate research training programs through post-doctoral programs. There are many possibilities for special programs, including staff improvement projects (in terms of research skills) under this title. Hopefully, industrial arts teacher educators will be involved in some of these programs in the 1966 summer session, and in the ensuing years.

Sources of Funds

An internationally famous jurist, addressing the graduating class at a noted law school, remarked that success in the legal field, at least in terms of making a real contribution to social progress, was determined not only by one's scholarship in law, but also by one's understanding of the disciplines that are tangent and related to the legal profession. He was suggesting, among other things, that one's perspective should not be limited by the particular discipline that one has set out to master. In industrial arts teacher education it would appear that we have operated within unrealistic, self-imposed limitations with respect to the type of research problems we have selected and to the range of agencies to which proposals have been submitted for support. A more productive approach will enlarge the scope of possibilities to include agencies with interests of such breadth that many of the problems facing us may be attacked with their support.

Federal Agencies

Public laws enacted by our congress provide sums of money for research related to problems of consequence in the various segments of our national life. These funds are administered by agencies pursuant to the laws and interpretations thereof, and in keeping with appropriate guidelines. Recent legislation such as the Vocational Education Act of 1963, the Economic Opportunity Act, and the Elementary and Secondary Education Act of 1965 are examples of public laws that have research dimensions. Certainly the amendment to Title XI of the National Defense Education Act to include industrial arts as one of the fields for teacher institutes is of extreme importance to industrial arts teacher educators. At this writing, Congress authorized, but did not appropriate funds for such institutes for the

fiscal year 1966. When funds are appropriated industrial arts teacher educators will be faced with both the problem and the opportunity of drafting proposals for institutes, proposals which share many of the same features of a research proposal. In substance, industrial arts teacher educators would do well to familiarize themselves with past, newly-enacted, and proposed federal legislation that provide broad support for research, demonstration projects, and other activities.

The Bureau of Research, United States Office of Education, is an excellent starting point for the industrial arts teacher educator who is interested in becoming involved in contract or funded research. The U. S. Office of Education will provide materials describing a variety of programs, guidelines for each program, and proposal forms. In addition, the specific objectives of each program are outlined. This enables the researcher to evaluate the appropriateness of his research problem with the objectives of a particular program. The research studies that have been and are currently supported by the U. S. Office of Education relate to a very wide range of problems of an educational nature. Publications are available through the U. S. Office of Education that list the titles of completed and current projects. Such publications are of great value to the beginning researcher as they indicate the breadth of projects supported by this agency.

There are other federal agencies with research programs that the serious researcher will not ignore. These include the National Science Foundation, Atomic Energy Commission, Office of Economic Opportunity, National Aeronautics and Space Administration, National Institutes of Health, Department of Defense, Department of Commerce, Department of Interior, and Department of Labor. It requires only a modest amount of effort to keep one's files current on the major research programs and research interests of such agencies.

Foundations

In recent years several foundations have given substantial financial support to projects in industrial arts. An excellent index to foundations is:

The Foundation Directory, Second Edition, Russell Sage Foundation, New York, 1964, Ann D. Walton and Marianna O. Lewis, editors.

This *Directory* may be ordered from the Foundation Library Center, 444 Madison Avenue, New York. It lists in excess of 6,000 foundations, general purposes and activities of each foundation, and amount of support each foundation has been providing recently, per year.

College and University Research Programs

Many smaller colleges and universities have begun, in recent years, to establish research budgets to support studies that may range from projects of local interest to those that may, in mature form, require outside financial assistance. Such programs are usually characterized by flexibility and a minimum of paper work. At this writer's institution a substantial sum is budgeted each year for such research activities. This is an excellent source of support for pilot or short duration studies.

Other Sources of Support

State Departments of Education, local school boards, and industries of various types are representative of sources of support that should not be discounted. Imagination, aggressiveness, and concrete proposals are essential in securing support from such sources.

Procedures in Securing Research Funds

It is somewhat presumptuous for a writer to suggest that specific procedures may be outlined that will enhance one's position in securing funds for research, particularly from agencies outside of the institution where one is employed. Certainly one should work very closely with the research coordinator, if such a position exists at the institution, with experienced colleagues at the institution, irrespective of discipline, and with colleagues on other campuses who are active in research and who will take the time to critically evaluate a proposal. The procedures discussed in this section, then, are general rather than specific in nature.

Identifying the Problem

The researcher *should have clearly in mind what the problem really is* before making the initial step in preparing a proposal. This suggestion may appear trite, but it is a matter of record that many proposals have been rejected by review panels because the members of such panels could not determine, in the

case of a particular proposal, the specific nature of the problem to which the researcher planned to direct his efforts.

Selection of a Sponsoring Agency

An agency should be selected that has objectives to which the research problem will relate. It is for this reason that researchers should become familiar with the objectives of the research programs of various agencies. Without such a background a researcher may experience keen disappointment by submitting an excellent proposal to an agency that does not support research of the type indicated in the proposal. If such a mistake is made the researcher will have an opportunity to submit the proposal to another agency, but valuable time is lost in the process. Many agencies have specified "deadlines" for submission of proposals. Ordinarily there are three or four "deadlines" per year, although some programs are "open" and provide for frequent reviews of proposals.

Exploratory Procedures with an Agency

Some agencies encourage a researcher to submit a "draft proposal" for staff evaluation prior to the development of a full-blown proposal. This is ordinarily an informal procedure but one that is of particular value to the beginning researcher. The problem, objectives, and procedures must be sufficiently refined at this point to provide some basis for evaluation. It should be pointed out that other agencies accept only fully developed proposals. It is up to the researcher at any given time (and this may usually be done by correspondence) to identify the rules and procedures by which a given agency is operating.

Drafting the Proposal

Most agencies will provide the researcher with a manual that provides the format for the proposal. A typical proposal involves:

1. A statement of the problem and its relevance to education.
2. An enumeration of the specific objectives (hypotheses) of the project.
3. Detailed procedures (research design) of how the project will be conducted.
4. A brief review of the literature pertinent to the project.
5. A detailed budget.

Clarity of expression is extremely important in developing the various stages of the proposal. Review panels are not impressed with "flowery" language or oversize words. What is important, however, is for the researcher to convey to a review committee precisely what it is he proposes to do, why it is important, and how he intends to accomplish the task.

Examples of Contract Research in Industrial Arts

The research summaries that complete this chapter have been included for the following reasons:

1. The studies relate to industrial arts teacher education but are quite different in purpose.
2. The studies illustrate the range of research possibilities in industrial arts teacher education.
3. The studies suggest the diversity of research designs that are acceptable to various agencies; one involves an experimental design with formal hypotheses and statistical tests; the other incorporates the use of many consultants and specialists, with philosophy, logic, and value judgments weighing heavily on the conclusions and recommendations.
4. The studies were conducted at a state college that is typical of the majority of institutions where industrial arts teacher education personnel are employed. The investigator was primarily a classroom teacher at the time the proposals were initiated; released time from teaching (fractional) was provided after the proposals were funded. The suggestion is that a wide range of studies may and should be conducted by industrial arts teacher education personnel who find themselves in similar circumstances.

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AN EXPERIMENTAL COMPARISON OF DIRECT-DETAILED AND
DIRECTED-DISCOVERY METHODS OF PRESENTING
TAPE-RECORDED INSTRUCTION

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Introduction

Orientation to the Problem

The unprecedented increases in college and university enrollment forecast for the years ahead pose serious problems for those responsible for administering institutions of higher learning and for students who will seek instruction at such institutions. On the one hand the sheer number of students who are likely to pursue a higher education is almost overwhelming; on the other hand the probability of a proportionate increase in highly competent staff members to meet this demand is, at the present, not at all encouraging. Although many plans have been proposed, and in fact are in operation, to attract an increasingly larger number of capable people to careers in higher education, it seems feasible that colleges and universities might well assay the utilization of their present faculties to determine whether or not the knowledge and skills of well-trained staff members can be made available to larger numbers of students than is normally the case. The limitations of class sizes coupled with a reasonable teaching assignment restrict the contact of many outstanding professors to small groups of students, groups that may be unnecessarily small if new instructional media are employed.

A distinct possibility for more effective staff utilization involves the use of taped instruction. Not only does this procedure seem feasible from the standpoint of providing an opportunity for the employment of tapes, prepared by outstanding scholars for introductory and/or supplementary treatment of a given topic, it also seems appropriate in regard to the organization of key presentation, prepared by the individual instruc-

tor, and intended for his own classes. In addition, such instruction could be made available for repetition for those students who may have difficulty understanding an initial presentation. Furthermore, the use of taped instruction seems to have unusual possibilities for independent study in a wider range of subjects than those in which it is currently employed.

The educational applications of taped instruction enumerated above are by no means exhaustive. Similarly, no implication is intended in regard to the efficacy of taped instruction in contrast with other media that might be employed. However, if it is reasonable to assume that taped instruction has merit in a wide range of educational settings, then it follows that the unique features of the teaching-learning process inherent in this approach ought to be studied and evaluated.

One of the more obvious problems involved in preparing taped instruction relates to the technique of structuring the material to be learned. The methods employed in organizing and presenting taped instruction may determine to a large extent the quality of initial learning and the degree to which students retain and transfer the facts and principles they learn. Logically, such methods should be grounded in principles of learning that have been established in the psychological laboratory and that have been experimentally tested in the classroom. A number of research studies (1, 2, 3, 4, 6, 11, 12, 13, 14, 16, 27, 28, 29) have been designed to evaluate instructional methods in terms of initial learning, retention, and transfer. Instruction related to the learning task in each of these studies, however, was presented by the experimenter using media other than tape recordings.

Statement of the Problem

The purpose of this study is to provide formal research evidence as to the effectiveness of two selected methods of organizing tape-recorded instruction as measured by 1) initial learning, 2) retention, and 3) transfer in a learning situation involving problem solving with meaningful materials. The experiment is designed, in addition, to test for interaction between methods and the high-, average-, and low-ability levels. Orthographic projection principles and skills, a fundamental unit of work in mechanical and engineering drawing, will serve as the learning task. College women who have completed the first

semester of the freshman year at Eastern Kentucky State College will serve as subjects.

Theoretical Bases of Methods

Direct-Detailed. One may find theoretical support for a method of organization that involves highly direct and detailed instruction. This method has its basis in the learning theory of Edward Lee Thorndike (30, 31, 32, 33) and to a lesser extent in Guthrie's (8, 9, 10) system of contiguous conditioning. Explicit in both theories is the conviction that the responses to be practiced by learners should be those, and only those that are correct for a given pattern of stimuli. Otherwise, inappropriate responses may become associated with stimuli for which other responses would be correct. Organization based on these learning theories would seem to demand careful and detailed instruction to insure the formation of desired connections between stimuli and responses. It seems to follow that instruction relative to principles and generalizations would be presented in a detailed manner, and that these would be illustrated by showing their applications to the solution of problems. Provisions for students to discover the application of principles in problem solving would be unsound in view of the fact that incorrect applications might occur.

Directed-Discovery. A second method of organization has its theoretical basis in the learning theories and experiments of gestalt psychologists such as Kohler, (19, 20, 21) Koffka, (18), Katona, (16), Luchins, (22) and Wertheimer (35). Whether one considers the experiments of Kohler with sub-human subjects or those of the latter three psychologists whose studies involved school children and adults, one striking commonality exists: learning is regarded as a problem-solving process involving insight as a phase of the process, and, at least in terms of human subjects, understanding as the end result. The learning situation is such that if the subject responds to the problem, a degree of tension is produced that persists until the problem is solved, or until considerable time has elapsed. In terms of classroom instruction, principles should be presented to the students in a problem-solving context. Gestalt psychologists have emphasized that students develop a better understanding of principles if, through their own efforts, they share in the discovery of their meanings and applications. Ob-

viously, many principles are too difficult and complex to expect students to comprehend without assistance from the teacher. From the gestalt point of view, this assistance takes the form of questions and "hints" that guide the student's efforts, but do not reduce the level of tension deemed necessary for effective learning.

Related Research

At the time of the initial planning of this project only two research studies had been completed in industrial education that directly related to the current study. Ray's (24) comparison of a direct-and-detailed with a directed-discovery method of teaching micrometer principles and skills involved the use of taped instruction. Ray found that the two groups receiving differential treatments did not differ in terms of initial learning, nor did they differ in performance on a retention test administered one week after treatment. However, the directed-discovery group was superior on transfer tests administered one and six weeks after treatment, and on a six-weeks retention test.

The results of Rowlett's (25) study, employing orthographic projection principles and skills as the learning task, are largely in agreement with Ray's findings. In only one instance do the findings seem to differ, and in this case the testing intervals were not identical. Ray administered a retention test at one week and found no difference between the two methods. In Rowlett's study the first retention test was administered twelve days after treatment with the results favoring the directed-discovery method. The subjects used in both of these studies were ninth-grade students.

More recent studies by Grote (7) and Moss (23) at the University of Illinois have produced findings inconsistent with those of Ray and Rowlett. Additional research is continuing using similar research designs.

Definition of Terms

Direct-Detailed Instruction: Method A. Subjects are provided with nine small models illustrating the three major types of surfaces encountered in orthographic projection. In addition, subjects are provided with a workbook of problems which included 1) one-, two-, and three-view orthographic drawings of

the first model, 2) six-view orthographic drawings of eight models, (lines omitted in six of these and are to be added by the subject) 3) four orthographic drawings involving missing lines, and 4) eleven problems involving decisions relative to view relationships, methods of revolving an object, and the selection of a correct "third view" from among several alternatives.

The taped instruction provides a step-by-step procedure for superimposing each of the models over the various views of the appropriate drawing. In addition, the subjects are instructed in a detailed manner in regard to revolving the object to provide the six possible views of an orthographic drawing. The three types of surfaces considered are treated in a direct and specific manner with an emphasis on correct and positive identification of the surfaces, and with a frequent restatement of the principles relating to the surfaces. Types of lines and projection techniques are dealt with in a similar manner.

Subjects solve, or make decisions in regard to twenty-one problems with the direct assistance of the experimenter. Taped instruction relating to the correct solution of problems is explicit and detailed, and includes the rationale and principles involved in arriving at a given solution. Reinforcement is provided at the conclusion of each problem by the statement, "You have now completed problem . . ."

Directed-Discovery Instruction: Method B. Subjects are provided with the identical models and workbooks used in Method A. Except for a brief introduction, subjects are left to their own methods of developing an understanding of the technique of revolving an object to provide the six possible views of an orthographic drawing. They are, however, provided with leading questions which are intended to structure their personal approaches to a predetermined system. The three types of surfaces which are studied are defined, but the subjects are again placed on their own, along with questions from the experimenter, to identify the surfaces under consideration. Types of lines and projection techniques are dealt with by employing leading questions.

Subjects solve, or make decisions in regard to twenty-one problems without direct assistance from the experimenter. Taped instruction relating to the solution of a problem is

limited to questions which should direct the subjects' attention to the critical elements of the problem under consideration. Reinforcement is not utilized at the conclusion of each problem; instead, a question related to the problem is posed. Closure must be a product of the subjects' individual efforts.

Orthographic Projection Principles and Skills. Orthographic projection is a graphic method by means of which the precise shape of an object may be represented in one or more views on a flat plane. Each view has a specific location with reference to the other views. Line values representing visible and invisible elements are employed to clarify shape descriptions.

Problem Solving. A learning task involving problem solving opportunities is such that the problem under consideration is incomplete, and may be solved only by the application, either implicitly or explicitly, of the principles of orthographic projection. These principles may be related to the problem by the experimenter, and the problem solved by the subjects with the direct assistance of the experimenter, or the subjects may be guided by leading questions to arrive at their own solutions.

Ability levels. Three ability levels are considered in this study; high, average, and low. The high-ability group tests at or above 45 on the *Revised Minnesota Paper Form Board Test*, the average group between 38 and 44, and the below-average group at or below 37.

Initial Learning. Initial learning is defined as the extent to which subjects are able to apply the principles and skills of orthographic projection to the solution of multiview problems that are similar, but not identical, to those used during the instructional period and their capacity to respond to questions in regard to surface and line identification, and to view relationships. A multiple-choice objective test is used to measure the amount of initial learning immediately after treatment.

Retention. Retention is defined as the degree to which subjects are able to apply the principles and skills of orthographic projection to the solution of multiview problems that are similar, but not identical, to those used during the instructional period and their capacity to respond to questions in regard to surface and line identification, and to view relationships as measured by a multiple-choice objective test administered one and six weeks after treatment.

Transfer. Transfer occurs when the subject is able to generalize previous learning and apply it to a new problem situation and/or when common elements exist in both new and old problems and this commonality is recognized by the subject. The amount of transfer is measured by a multiple-choice objective test administered one and six weeks after treatment utilizing problems that test for diversified application of general projection principles.

Statement of Hypotheses

Directional two-sided t-tests will be employed in contrast to the traditional use of the null hypothesis with its non-directional alternative. While an explicit statement of the directional alternatives to each of the null hypotheses (H_{1B} - H_{5B}) is implied, the alternatives will be stated for illustrative purposes only in regard to H_1 .

1. H_{1A} : The subjects taught by Method A are superior in terms of initial learning.
 H_{1B} : There is no difference between the subjects taught by Method A and Method B in terms of initial learning.
 H_{1C} : The subjects taught by Method B are superior in terms of initial learning.
2. H_{2B} : There is no difference between the subjects taught by Method A and Method B in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured one week after treatment.
3. H_{3B} : There is no difference between the subjects taught by Method A and Method B in terms of transferring projection principles and skills to the solution of a wide range of problems as measured one week after treatment.
4. H_{4B} : There is no difference between the subjects taught by Method A and Method B in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured six weeks after treatment.

5. H_{5B} : There is no difference between the subjects taught by Method A and Method B in terms of transferring projection principles and skills to the solution of a wide range of problems as measured six weeks after treatment.

The above hypotheses are pertinent to the total subjects in the two treatment groups. It seems desirable, in addition, to contrast the two treatments in terms of specific ability levels. Much has been written in educational literature suggesting that highly detailed instruction coupled with frequent drills is the most effective instructional method for students of low ability. On the other hand, current educational writing points up the acute need for developing more efficient methods of instructing students of high ability. It is often implied, if not explicitly stated, that the high-ability students are most productive when provided with a minimum of guidance and allowed to "think for themselves" whereas their counterparts at the opposite end of the ability continuum require detailed guidance if instruction is to be effective. This suggests that the directed-discovery method may be superior for subjects of high ability and that the direct-detailed method may be the more effective instructional technique for subjects of low ability. Directional two-sided t-tests are employed to compare each ability level by treatment in regard to initial learning, retention after one and six weeks, and transfer after one and six weeks. If interaction is found to be present, it will be possible to identify both the ability levels and treatments possible.

The Research Experiment

Experimental Design

A treatments \times levels design is employed in this experimental study. Direct-detailed and directed-discovery instructional methods, and a single control comprise the three treatments. The independent variables are 1) instructional methods, and 2) ability levels. The dependent variables are 1) initial learning as measured by an objective test administered immediately after treatment, 2) retention as measured one and six weeks after treatment, and 3) transfer as measured one and six weeks after treatment. The controlled variables consist of 1) length of instruction, 2) three-dimensional aids, 3) workbook of problems,

TABLE 1

AVAILABLE SUBJECTS BY LEVEL
AND THE CUT-OFF POINTS BY
SCORES ON THE
"MINNESOTA PAPER FORM BOARD TEST"

<i>Level</i>	<i>Subjects</i>
High — 45 to 50	115
Average — 38 to 44	108
Low — 8 to 37	114
Total	N = 337

4) tests and testing conditions, and 5) content and instructional methods. It will be observed that instructional method has been included as both an independent and a controlled variable. The methods are controlled in the sense that all instruction is tape-recorded. In addition, for each of the two methods under consideration, an equal

amount of instructional time is allocated for each principle, fact, or problem included in the instruction.

Population and Sampling

The subjects used in this experiment were randomly selected from among the women at Eastern Kentucky State College who had completed the first semester of the freshman year, and who were enrolled in a required social science course. *The Revised Minnesota Paper Form Board Test* was administered in February, 1961, to all students who were enrolled in this required course. Table 1 shows the distribution of available subjects by levels.

A sampling procedure outlined by Walker and Lev (34, 173-174) was employed in assigning the subjects to ability levels. The procedure consists of dividing the population into strata, and then drawing random samples from each stratum. Table 2 shows the assignment of subjects to treatments and levels.

TABLE 2

ASSIGNMENT OF SUBJECTS TO TREATMENTS AND LEVELS

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>	<i>Total</i>
High — 45 to 59	21	21	7	49
Average — 38 to 44	21	21	7	49
Low — 8 to 37	21	21	7	49

TABLE 3
 MEANS AND STANDARD DEVIATIONS OF "MINNESOTA PAPER
 FORM BOARD TEST" SCORES AND NUMBER OF SUBJECTS BY
 CELL, TREATMENT, AND LEVEL*

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>	<i>Total</i>
High 45 to 59	$\bar{X} = 50.00$ s = 3.73 n = 21	$\bar{X} = 50.14$ s = 4.14 n = 21	$\bar{X} = 50.42$ s = 4.28 n = 7	$\bar{X} = 50.14$ s = 3.86 n = 49
Average 38 to 44	$\bar{X} = 41.28$ s = 2.15 n = 21	$\bar{X} = 41.24$ s = 2.17 n = 21	$\bar{X} = 41.71$ s = 1.60 n = 7	$\bar{X} = 41.32$ s = 2.05 n = 49
Low 8 to 37	$\bar{X} = 30.04$ s = 5.41 n = 21	$\bar{X} = 31.85$ s = 5.22 n = 21	$\bar{X} = 32.42$ s = 3.96 n = 7	$\bar{X} = 31.16$ s = 5.03 n = 49
Total	$\bar{X} = 40.44$ s = 9.07 n = 63	$\bar{X} = 41.08$ s = 8.51 n = 63	$\bar{X} = 41.57$ s = 8.28 n = 21	$\bar{X} = 40.88$ s = 8.67 n = 147

*For a discussion of research terms and simple tests of significance see the Thirteenth Yearbook of the ACIATE, *Classroom Research in Industrial Arts*. Bloomington, Illinois: McKnight & McKnight Publishing Co., 1964. Basic terms used here include the following:

\bar{X} , mean of a sample group	σ , standard deviation within the population
X , a score of an individual	r , correlation between sample groups
μ , mean of the theoretical population from which the sample was drawn	ρ , correlation between theoretical populations
s , standard deviation within a sample	n , number of cases in a sample
	N , total number of cases

Table 3 shows the means and standard deviations of *Minnesota Paper Form Board Test* scores by cell, treatment and level.

The means and variances of the *Minnesota Paper Form Board Test* scores of subjects assigned to Treatments A, B, and C do not differ significantly. An analysis of variance produced an insignificant F, thus permitting an acceptance of the hypothesis $\mu_A = \mu_B = \mu_C = \mu$. Furthermore, the means and variances of subjects within each ability level do not differ significantly.

The Learning Task

As previously defined, orthographic projection is a graphic method by means of which the precise shape of an object may be represented in one or more views on a flat plane. Subjects

were taught 1) the names and locations of the six possible views used in this system of projection, 2) the methods of revolving an object to produce these views, 3) the projection principles that enable one to transfer shapes and measurements from one view to another, 4) the representation of normal, inclined, and curved surfaces, and 5) line symbols representing projection lines and visible and invisible features. The taped instruction was keyed to a workbook of problems which the students solved as the instruction was presented.

Differential Treatments

The subjects in this experiment were randomly assigned by ability levels to Treatments A, B, and C. The subjects in Treatment C, the control group, received no instruction. They took the written examination to give the experimenter some indication of an uninstructed group's capacity to respond to the questions.

The subjects assigned to Treatments A and B received 43 minutes of instruction. The first 8 minutes of instruction was identical for both groups. It consisted of 1) a statement of the purpose of the research study, 2) an explanation of the practical applications of the principles of orthographic projection, 3) a brief introduction to the names and locations of the front, top, and right-side views, 4) an explanation of the methods of revolving an object to obtain the front, top, and right-side views, 5) a short introduction to projection principles and techniques, and 6) a brief explanation of the use of visible and projection lines. The remaining 35 minutes of instructional time was devoted to differential treatments. Treatment A, a direct-detailed method, and Treatment B, a method of directed discovery, have been previously defined.

The direct-detailed group received continuous instruction throughout the 35 minutes with the exception of normal pauses at the end of sentences and when it was necessary for subjects to turn the pages of the workbook. This method is analogous to that employed by the instructor who works through a number of problems on the chalk board for his students, gives careful and detailed instruction, but maintains a personal responsibility for both method employed and solution of the problem.

The subjects taught by the directed-discovery method were presented with the identical problems and then asked leading

TABLE 4
COMPOSITION OF EACH INSTRUCTIONAL GROUP

<i>Level</i>	<i>Subjects</i>
High — 45 to 59	8
Average — 38 to 44	8
Low — 8 to 37	8
Total	24

questions that suggested methods of attack and critical points in the problem solution. This instruction incorporated a number of pauses. Subjects were expected to use these intervals to think through the problems on their own, using whatever hints were provided by the instructor. It should be pointed out, however, that for a given problem, each group was allowed an identical amount of time.

Instructional Procedures

Instruction was presented to groups of 24 subjects randomly assigned in terms of ability levels. Table 4 illustrates the composition of each instructional group by treatment. Instructional and testing sessions began at 4:10 p.m. on a Monday, Tuesday, Wednesday, Thursday schedule. All instruction and testing were conducted in drafting rooms that were well-lighted and adequately equipped for the experiment. During the instructional period each subject was provided with 1) pencil, 2) a workbook of problems, and 3) 9 small blocks representing the first nine problems in the workbook. The blocks were of uniform size and painted with white lacquer. Each block was numbered with India ink to correspond to its orthographic drawing in the workbook.

In an experiment of this type the researcher is always faced with the probability that some subjects will be absent from their designated instructional or testing sessions. In anticipation of this, three additional subjects representing the three ability levels were assigned to each instructional session and were designated as replacements, although this fact was unknown to the subjects involved. Although this precaution was taken, illness necessitated reducing the total groups for Treatment A and B to 63 each, and the Treatment C group to 21. It was necessary to randomly eliminate several subjects in a manner to keep the Treatments A and B groups X ability levels at

TABLE 5
CRITERION TESTS

<i>Type of Test</i>	<i>Items</i>	<i>Possible Points</i>	<i>Time</i>
Initial Learning	65	65	50 minutes
Retention One Week	65	65	50 minutes
Transfer One Week	44	44	50 minutes
Retention Six Weeks	65	65	50 minutes
Transfer Six Weeks	44	44	50 minutes

an equal size, and the Treatment C group proportionately equivalent.

Workbook of Problems

The workbook and criterion tests were reproduced on a spirit duplicator. A seemingly innocuous feature of the workbook and the criterion tests is the usage of 1) *purple* object and hidden lines and 2) *red* projection lines. Although other reproduction processes would have been simpler, the researcher felt that a near maximum "figure-and-ground" effect was achieved with this technique. Subjects were not required to make decisions relative to line "weights," as is common in drafting. When one considers both the complexity and brevity of the instruction, the technique of employing multicolor lines would seem logically to provide treatment groups with opportunities for rapid discrimination and a minimum of confusion. A taped instructional reference to a *red* projection line, for example, seems to have a quality of directness and clarity, at least for the novice, that might have been lacking had conventional line representations been employed.

Written Tests

The examinations administered during the course of the experiment involved multiple-choice items. Table 5 illustrates the character of the tests employed in this study. All subjects were able to complete each of the criterion tests with time to spare.

The initial learning test was re-administered to measure retention one and six weeks after treatment. It was deemed unnecessary to disguise the test items due to the large number employed and their complexity. In addition, it should be pointed

TABLE 6
RELIABILITY COEFFICIENTS OF CRITERION TESTS

<i>Test</i>	<i>N = 126</i>
Initial Learning	.92
Transfer One Week	.91
Retention One Week	.86
Retention Six Weeks	.96
Transfer Six Weeks	.87

out that subjects were not permitted to examine any of their corrected tests during the course of the experiment.

The tests for transfer after one and six weeks were identical and attempted to measure the degree to which subjects were able to generalize previous learning and apply this to the solution of problems of a different nature from those used in the instructional period.

The reliability coefficients of the five criterion tests are included in Table 6. The reliability coefficients were computed by split-halves, corrected by the Spearman-Brown Prophecy Formula as explained in Edwards (5, 176-177).

Statistical Treatment of Data

The t-test is employed in testing the directional two-sided hypotheses. There seems to be a distinct logical advantage for using the directional two-sided test in contrast to the traditional nondirectional two-tailed test. An explicit statement of the hypotheses to be tested in the study if a nondirectional two-tailed test were used would take the following form: $H: \mu_A - \mu_B = 0$, and the alternative, $H': \mu_A - \mu_B \neq 0$. As Kaiser has pointed out (15), the researcher is faced with an extra statistical problem of identifying the direction of the obtained differences if the data warrant an acceptance of H' . An explicit acceptance of H' would enable the researcher to state logically nothing more than the fact that the means are different. In order to avoid this logical pitfall, the hypotheses tested in this study are stated in the following manner: $H_{1A}: \mu_A - \mu_B < 0$; $H_{1B}: \mu_A - \mu_B = 0$; and $H_{1C}: \mu_A - \mu_B > 0$. The possibility should be pointed out that the data may warrant an acceptance of H_{1A} when in fact H_{1C} is true. The probability of accepting a hypothesis which is in fact false (gamma or Type II error) is al-

ways less than one-half the probability of committing an alpha or Type I error (rejecting a hypothesis which is in fact true).

Hypothesis Testing and Results

The Control Group

The control group was included in the research design for two distinct purposes. First, it seemed pertinent to gain some indication of an uninstructed group's capacity to respond to the written examinations. Second, the researcher wished to investigate the possibility that the subjects in this group would learn as they took the various tests. The high-ability level of the control group scored progressively higher at each successive testing interval.

Learning Scores

Tables 7-11 present the means and standard deviations of the learning scores by treatment and level. All three ability levels receiving Treatment B show an increase in performance on the test for transfer after six weeks; while of the Treatment A levels, only the low-ability group shows a comparable gain.

The subjects taught by Treatments A and B proved superior to those in the control group on each of the five criterion tests. This evidence indicates that the 43 minutes of taped instruction, irrespective of method, was productive of a quality of learning, at all ability levels, and that it persisted and was usable six weeks after instruction. Tables 12-13 present comparisons of performance of Treatments A and B with Treatment C on the five criterion tests.

Hypothesis Testing

Tables 7-11 provide the framework for testing hypotheses 1-5. $N_A + N_B - 2$ degrees of freedom are available for each of the directional two-sided t-tests. The risks involved in committing the following errors are: 1) $\alpha = .05$, 2) $\beta = .10$, and 3) $\gamma =$ less than one-half the probability of committing an alpha error.

Interaction

There was no evidence to suggest interaction between ability levels and methods. Thirteen of the 15 t-tests that were made comparing the performance of each ability level \times treatment on the five criterion tests present evidence to support the

TABLE 7
 MEANS AND STANDARD DEVIATIONS OF LEARNING SCORES
 ON INITIAL LEARNING AND NUMBER OF SUBJECTS
 BY TREATMENT AND LEVEL

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>
High 45 to 59	$\bar{X} = 36.29$ $s = 10.069$ $n = 21$	$\bar{X} = 39.05$ $s = 9.303$ $n = 21$	$\bar{X} = 12.43$ $s = 2.758$ $n = 7$
Average 38 to 44	$\bar{X} = 32.62$ $s = 7.703$ $n = 21$	$\bar{X} = 35.72$ $s = 5.036$ $n = 21$	$\bar{X} = 11.71$ $s = 2.688$ $n = 7$
Low 8 to 37	$\bar{X} = 25.24$ $s = 8.999$ $n = 21$	$\bar{X} = 24.05$ $s = 8.052$ $n = 21$	$\bar{X} = 10.43$ $s = 3.358$ $n = 7$
<i>Total</i>	$\bar{X} = 31.38$ $s = 9.971$ $n = 63$	$\bar{X} = 32.94$ $s = 9.952$ $n = 63$	$\bar{X} = 11.52$ $s = 2.926$ $n = 21$
$t = +.877$			$F = 1.003$

hypothesis $\mu_{Ai} = \mu_{Bi}$. Two of the t-tests produced statistically significant t-values in favor of the low- and average-ability groups receiving directed-discovery treatments. The average-ability group was superior on the test for transfer after six weeks. In summary, of the 15 t-tests, 14 of the obtained values favored the directed-discovery method although in only two cases were the differences statistically significant. A comparison of the low-ability groups on the initial learning test produced a t-value of .45 in favor of the Treatment A group.

Test of Hypothesis H_1

H_{1A} : The subjects taught by Method A are superior in terms of initial learning.

H_{1B} : There is no difference between the subjects taught by Method A and Method B in terms of initial learning.

H_{1C} : The subjects taught by Method B are superior in terms of initial learning.

The t-test produced a value of +.877 in favor of the directed-discovery treatment. However, the obtained t-value is within

the acceptance region of H_{1B} ($-1.98 < t < 1.98$). Hypothesis H_{1B} is accepted in view of this evidence. In terms of initial learning, there was no significant difference between the subjects taught by direct-detailed and directed discovery teaching methods.

Test of Hypothesis H_2

H_{2A} : The subjects taught by Method A are superior in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured one week after treatment.

H_{2B} : There is no difference between the subjects taught by Method A and Method B in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured one week after treatment.

TABLE 8
MEANS AND STANDARD DEVIATIONS OF LEARNING SCORES
ON RETENTION
ONE WEEK TEST AND NUMBER OF SUBJECTS
BY TREATMENT AND LEVEL

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>
High 45 to 59	$\bar{X} = 38.43$ $s = 10.749$ $n = 21$	$\bar{X} = 43.38$ $s = 9.635$ $n = 21$	$\bar{X} = 14.43$ $s = 4.577$ $n = 7$
Average 38 to 44	$\bar{X} = 34.29$ $s = 9.928$ $n = 21$	$\bar{X} = 36.71$ $s = 10.583$ $n = 21$	$\bar{X} = 12.43$ $s = 3.154$ $n = 7$
Low 8 to 37	$\bar{X} = 24.19$ $s = 8.483$ $n = 21$	$\bar{X} = 26.86$ $s = 6.110$ $n = 21$	$\bar{X} = 10.14$ $s = 2.966$ $n = 7$
<i>Total</i>	$\bar{X} = 32.30$ $s = 11.349$ $n = 63$	$\bar{X} = 35.65$ $s = 11.180$ $n = 63$	$\bar{X} = 12.33$ $s = 3.889$ $n = 21$
$t = +1.67$			$F = 1.030$

TABLE 9
 MEANS AND STANDARD DEVIATIONS OF LEARNING SCORES
 ON TRANSFER
 ONE-WEEK TEST AND NUMBER OF SUBJECTS
 BY TREATMENT AND LEVEL

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>
High 45 to 59	$\bar{X} = 27.00$ $s = 7.315$ $n = 21$	$\bar{X} = 27.76$ $s = 7.641$ $n = 21$	$\bar{X} = 18.28$ $s = 5.047$ $n = 7$
Average 38 to 44	$\bar{X} = 23.33$ $s = 5.975$ $n = 21$	$\bar{X} = 25.43$ $s = 6.185$ $n = 21$	$\bar{X} = 16.86$ $s = 2.268$ $n = 7$
Low 8 to 37	$\bar{X} = 16.71$ $s = 6.615$ $n = 21$	$\bar{X} = 19.00$ $s = 5.568$ $n = 21$	$\bar{X} = 16.00$ $s = 2.000$ $n = 7$
<i>Total</i>	$\bar{X} = 22.35$ $s = 7.828$ $n = 63$	$\bar{X} = 24.06$ $s = 7.424$ $n = 63$	$\bar{X} = 17.05$ $s = 3.528$ $n = 21$
$t = +1.26$			$F = 1.112$

H_{2C} : The subjects taught by Method B are superior in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured one week after treatment.

The t -test produced a value of $+1.67$ in favor of the directed-discovery treatment. However, the obtained t -value is within the acceptance region of H_{2B} ($-1.98 < t < 1.98$). Hypothesis H_{2B} is accepted in view of this evidence. In terms of retention, there was no significant difference between the subjects taught by direct-detailed and directed-discovery teaching methods when contrasted one week after treatment.

Test of Hypothesis H_3

H_{3A} : The subjects taught by Method A are superior in terms of transferring projection principles and skills to the solution of a wide range of problems as measured one week after treatment.

H_{3B}: There is no difference between the subjects taught by Method A and Method B in terms of transferring projection principles and skills to the solution of a wide range of problems as measured one week after treatment.

H_{3C}: The subjects taught by Method B are superior in terms of transferring projection principles and skills to the solution of a wide range of problems as measured one week after treatment.

The t-test produced a value of +1.26 in favor of the directed-discovery treatment. However, the obtained t-value is within the acceptance region of H_{3B} ($-1.98 < t < 1.98$). Hypothesis H_{3B} is accepted in view of this evidence. There was no significant difference between the subjects receiving direct-detailed and directed-discovery instruction in terms of transferring projection principles and skills as measured one week after treatment.

Test of Hypothesis H₄

H_{4A}: The subjects taught by Method A are superior in terms of retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured six weeks after treatment.

H_{4B}: There is no difference between the subjects taught by Method A and Method B in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction period as measured six weeks after treatment.

H_{4C}: The subjects taught by Method B are superior in terms of the retention and application of the principles of orthographic projection to the solution of problems of the same general type used in the instruction as measured six weeks after treatment.

The t-test produced a value of +1.59 in favor of the directed-discovery treatment. However, the obtained t-value is within the acceptance region of H_{4B} ($-1.98 < t < 1.98$). Hypothesis H_{4B} is accepted in view of this evidence. In terms of retention, there was no significant difference between the subjects taught

TABLE 10
 MEANS AND STANDARD DEVIATIONS OF LEARNING SCORES
 ON RETENTION
 SIX-WEEKS TEST AND NUMBER OF SUBJECTS
 BY TREATMENT AND LEVEL

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>
High 45 to 59	$\bar{X} = 39.76$ $s = 11.908$ $n = 21$	$\bar{X} = 41.52$ $s = 11.347$ $n = 21$	$\bar{X} = 17.86$ $s = 7.426$ $n = 7$
Average 38 to 44	$\bar{X} = 32.33$ $s = 10.752$ $n = 21$	$\bar{X} = 38.95$ $s = 9.222$ $n = 21$	$\bar{X} = 11.43$ $s = 4.353$ $n = 7$
Low 8 to 37	$\bar{X} = 24.81$ $s = 8.992$ $n = 21$	$\bar{X} = 26.48$ $s = 7.653$ $n = 21$	$\bar{X} = 11.00$ $s = 3.558$ $n = 7$
<i>Total</i>	$\bar{X} = 32.30$ $s = 12.124$ $n = 63$	$\bar{X} = 35.65$ $s = 11.476$ $n = 63$	$\bar{X} = 13.43$ $s = 6.029$ $n = 21$
$t = +1.59$			$F = 1.116$

by direct-detailed and directed-discovery methods when contrasted six weeks after treatment.

Test of Hypothesis H_5

H_{5A} : The subjects taught by Method A are superior in terms of transferring projection principles and skills to the solution of a wide range of problems as measured six weeks after treatment.

H_{5B} : There is no difference between the subjects taught by Method A and Method B in terms of transferring projection principles and skills to the solution of a wide range of problems as measured six weeks after treatment.

H_{5C} : The subjects taught by Method B are superior in terms of transferring projection principles and skills to the solution of a wide range of problems as measured six weeks after treatment.

The t-test produced a value of +2.30 in favor of the directed-discovery treatment. The obtained t-value is within the critical

TABLE 11
 MEANS AND STANDARD DEVIATIONS OF LEARNING SCORES
 ON TRANSFER
 SIX-WEEKS TEST AND NUMBER OF SUBJECTS
 BY TREATMENT AND LEVEL

<i>Level</i>	<i>Treatment A</i>	<i>Treatment B</i>	<i>Treatment C</i>
High	$\bar{X} = 26.76$	$\bar{X} = 28.29$	$\bar{X} = 22.18$
45 to 59	$s = 7.661$	$s = 6.482$	$s = 4.181$
	$n = 21$	$n = 21$	$n = 7$
Average	$\bar{X} = 23.05$	$\bar{X} = 26.48$	$\bar{X} = 14.57$
38 to 44	$s = 6.054$	$s = 5.862$	$s = 3.409$
	$n = 21$	$n = 21$	$n = 7$
Low	$\bar{X} = 17.71$	$\bar{X} = 21.43$	$\bar{X} = 14.00$
8 to 37	$s = 5.574$	$s = 5.963$	$s = 5.099$
	$n = 21$	$n = 21$	$n = 7$
<i>Total</i>	$\bar{X} = 22.51$	$\bar{X} = 25.40$	$\bar{X} = 16.91$
	$s = 7.402$	$s = 6.683$	$s = 5.567$
	$n = 63$	$n = 63$	$n = 21$
$t = +2.30$			$F = 1.226$

region of H_{50} ($+1.98 < t < \infty$). Hypothesis H_{50} is accepted in view of this evidence. The subjects taught by the directed-discovery method were significantly superior in transferring projection principles and skills as measured six weeks after treatment.

General Discussion

The t -tests on the preceding pages produced values that favored the directed-discovery method, but in only one instance, H_5 , was a value statistically significant. In a previous study Rowlett (25) found that the directed-discovery method was superior to a statistically significant degree in regard to H_2 , H_3 , H_4 , and H_5 . In that study, the mean of the differences of the means of six matched groups provided a statistic, D , which was employed in testing the hypotheses.

A directional two-sided t -test with $N_A + N_B - 2$ degrees of freedom was employed in the present study. The *direction* of the differences between Treatments A and B is consistent

TABLE 12
A COMPARISON OF TREATMENTS A AND C ON THE FIVE
CRITERION TESTS

<i>Test</i>	<i>Treatment A</i>	<i>Treatment C</i>	<i>t-value*</i>
Initial Learning	$\bar{X} = 31.38$ s = 9.971 n = 63	$\bar{X} = 11.52$ s = 2.926 n = 21	14.10
Retention One Week	$\bar{X} = 32.30$ s = 11.349 n = 63	$\bar{X} = 12.33$ s = 3.889 n = 21	12.61
Transfer One Week	$\bar{X} = 22.35$ s = 7.828 n = 63	$\bar{X} = 17.05$ s = 3.528 n = 21	4.24
Retention Six Weeks	$\bar{X} = 32.30$ s = 12.124 n = 63	$\bar{X} = 13.43$ s = 6.029 n = 21	9.36
Transfer Six Weeks	$\bar{X} = 22.51$ s = 7.402 n = 63	$\bar{X} = 16.91$ s = 5.567 n = 21	4.83

* Walker and Lev (34, 157) state that this statistic, when it is unreasonable to assume equal variability and N is large, may be referred to a table of normal probability. A value of 1.96 is significant at the .05 level for directional two-sided tests. All such values entered in the column above greatly exceed this in favor of the Treatment A group. In regard to the above comparisons, it is reasonable to conclude that the direct-detailed method of organizing taped instruction was productive of learning that was usable immediately after instruction, and that persisted for at least six weeks after instruction in regard to the retention and transfer of orthographic projection principles and skills.

for both studies. The dissimilarities in the findings of the two studies may be attributed to a number of factors. Among these are differences in 1) populations, 2) sample size, 3) length of instructional time, 4) content and problems, 5) criterion tests, 6) intervals between initial learning and first retention and transfer tests, and 7) statistical treatment of data.

A posteriori reasoning suggests that an alternative statistical treatment would have enabled the researcher to state that the directed-discovery method is superior in regard to H_2 , H_4 , and H_5 . As a matter of general interest, H_1 - H_5 were tested using a matched-means technique described in Edwards (5). Inasmuch as the research design did not provide for this test, but in fact specified another, the researcher is not privileged to select the

TABLE 13
A COMPARISON OF TREATMENTS B AND C ON THE FIVE
CRITERION TESTS

<i>Test</i>	<i>Treatment B</i>	<i>Treatment C</i>	<i>t-value*</i>
Initial Learning	$\bar{X} = 32.94$ $s = 9.952$ $n = 63$	$\bar{X} = 11.52$ $s = 2.926$ $n = 21$	15.23
Retention One Week	$\bar{X} = 35.65$ $s = 11.180$ $n = 63$	$\bar{X} = 12.33$ $s = 3.889$ $n = 21$	14.18
Transfer One Week	$\bar{X} = 24.06$ $s = 7.424$ $n = 63$	$\bar{X} = 17.05$ $s = 3.528$ $n = 21$	5.79
Retention Six Weeks	$\bar{X} = 35.65$ $s = 11.476$ $n = 63$	$\bar{X} = 13.43$ $s = 6.029$ $n = 21$	11.37
Transfer Six Weeks	$\bar{X} = 25.40$ $s = 6.683$ $n = 63$	$\bar{X} = 16.91$ $s = 5.567$ $n = 21$	5.74

* Walker and Lev (34, 157) state that this statistic, when it is unreasonable to assume equal variability and N is large, may be referred to a table of normal probability. A value of 1.96 is significant at the .05 level for directional two-sided tests. All such values entered in the column above greatly exceed this in favor of the Treatment B group. In regard to the above comparisons, it is reasonable to conclude that the directed-discovery method of organizing taped instruction was productive of learning that was usable immediately after instruction, and that persisted for at least six weeks after instruction in regard to the retention and transfer of orthographic projection principles and skills.

test that produces the greatest number of significant differences after the data are in.

Intercorrelations

Intercorrelations of the total test scores of the five criterion tests ranged from .74 to .86. All correlations were sufficiently high to reject the hypothesis $\rho = 0$ at the .0005 level.

Efficiency of Equating Instrument

In using the *Revised Minnesota Paper Form Board Test* to establish ability levels for this experiment the assumption was made that a positive relationship exists between performance on this test and the mastery of the learning task as reflected in tests of initial learning, retention, and transfer. That this as-

sumption is tenable is evidenced by correlations ranging from .49 to .61 between scores on the equating instrument and the five criterion tests. On the basis of these relationships the hypothesis $\rho = 0$ may be rejected at the .0005 level.

Performance Gains on Retention Tests

An examination of the mean scores suggests that the Treatment A and Treatment B groups differ in regard to gains in performance. Tables 14-19 present data illustrating the increases in performance. A statistical test described in Walker and Lev (34, 54) is employed to test for significant increases in performances.

TABLE 14
COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT A GROUP
ON INITIAL LEARNING AND RETENTION ONE-WEEK TESTS

<i>Initial Learning</i>		<i>Retention One Week</i>	
$\bar{X} = 31.38$		$\bar{X} = 32.30$	
$s = 9.971$		$s = 11.349$	
$n = 63$		$n = 63$	
$D = .92$	$r = .95$	$t = 2.01^*$	

* $t_{.975} = 2.00$

On the basis of the above comparison one may conclude that the Treatment A group performed at a statistically significant higher level on the retention one-week test in contrast to performance on the initial learning test.

TABLE 15
COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT B GROUP
ON INITIAL LEARNING AND RETENTION ONE-WEEK TESTS

<i>Initial Learning</i>		<i>Retention One Week</i>	
$\bar{X} = 32.94$		$\bar{X} = 35.65$	
$s = 9.952$		$s = 11.180$	
$n = 63$		$n = 63$	
$D = 2.71$	$r = .89$	$t = 4.22^*$	

* $t_{.975} = 2.00$

The comparison in Table 15 indicates that the gain in performance of the Treatment B group on the retention one-week test is statistically significant.

TABLE 16

COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT A GROUP ON INITIAL LEARNING AND RETENTION SIX-WEEKS TESTS

<i>Initial Learning</i>	<i>Retention Six Weeks</i>
$\bar{X} = 31.38$	$\bar{X} = 32.30$
$s = 9.971$	$s = 12.124$
$n = 63$	$n = 63$
$D = .92$	$r = .85$
	$t = 1.14^*$

* $t_{.975} = 2.00$

On the basis of the above comparison one may conclude that the Treatment A group did not perform at a significantly higher level on the retention six-weeks test in contrast to performance on the initial learning test.

TABLE 17

COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT B GROUP ON INITIAL LEARNING AND RETENTION SIX-WEEKS TESTS

<i>Initial Learning</i>	<i>Retention Six Weeks</i>
$\bar{X} = 32.94$	$\bar{X} = 35.65$
$s = 9.952$	$s = 11.476$
$n = 63$	$n = 63$
$D = 2.71$	$r = .82$
	$t = 3.26^*$

* $t_{.975} = 2.00$

The above comparison indicates that the gain in performance of the Treatment B group on the retention six-weeks test is significant.

TABLE 18
COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT A GROUP
ON TRANSFER ONE- AND SIX-WEEKS TESTS

<i>Transfer One Week</i>	<i>Transfer Six Weeks</i>
$\bar{X} = 22.35$ $s = 7.828$ $n = 63$	$\bar{X} = 22.51$ $s = 7.402$ $n = 63$
D = .16	r = .88
	t = .34*

* $t_{.975} = 2.00$

A t-value of .34 indicates that the Treatment A group did not make a significant gain on the transfer six-weeks test.

TABLE 19
COMPARISON OF GAIN IN PERFORMANCE OF TREATMENT B GROUP
ON TRANSFER ONE- AND SIX-WEEKS TESTS

<i>Transfer One Week</i>	<i>Transfer Six Weeks</i>
$\bar{X} = 24.06$ $s = 7.424$ $n = 63$	$\bar{X} = 25.40$ $s = 6.683$ $n = 63$
D = 1.34	r = .83
	t = 2.54*

* $t_{.975} = 2.00$

One may conclude on the basis of the above comparison that the Treatment B group performed at a significantly higher level on the transfer six-weeks test in contrast to performance on the transfer one-week test.

Conclusions and Implications

Conclusions

1. The direct-detailed and directed-discovery methods are equally effective in regard to the initial learning of orthographic projection principles and skills and to the retention of this content as measured one and six weeks after instruction.
2. The direct-detailed and directed-discovery methods are equally effective in terms of transferring projection principles and skills as measured one week after treatment.

3. The directed-discovery method is superior with reference to transferring projection principles and skills as measured six weeks after instruction.
4. The direct-detailed and directed-discovery methods of organizing taped instruction are productive of learning that is usable immediately after instruction, and that persists for at least six weeks after instruction in regard to the retention and transfer of the projection principles and skills.
5. With reference to specific ability levels, the directed-discovery method is superior for low-ability subjects in terms of transferring projection principles and skills six weeks after instruction.
6. With reference to specific ability levels, the directed-discovery method is superior for average subjects in regard to the retention of orthographic projection principles and skills six weeks after instruction.
7. The directed-discovery method is productive of significant gains in performance on tests of retention administered one and six weeks after treatment in contrast with the subjects' performance on the identical test administered immediately after instruction.
8. The direct-detailed method is productive of a significant gain in performance on a retention one-week test in contrast with performance on the initial learning test; however, there is no significant gain between retention six weeks and initial learning.
9. The direct-detailed method is not productive of a statistically significant gain on the transfer six-weeks test in comparison with performance on the identical test administered one week after instruction.
10. The directed-discovery method is productive of a statistically significant increase in performance on the transfer six-weeks test in contrast with performance on the identical test administered one week after instruction.

Limitations

The formulation of generalizations applicable to the organization of taped instruction should be tempered and carefully weighed in view of the following limitations:

1. The learning task employed in this experiment was primarily cognitive. Manipulative tasks were incidental and

consisted of sketching lines to complete problems and revolving three-dimensional blocks. However, the fact that students were engaged in physical responses to the auditory stimuli should not be disregarded as unimportant.

2. The teaching-learning process was limited in that subjects were not informed concerning the accuracy of their responses to the problems in the workbook.
3. The subjects were not permitted to examine the corrected criterion tests. The omission of a feedback of information, although a procedure followed for control purposes, nevertheless denied the subjects information which might have been used as a basis for altering responses on the transfer six-weeks test and on the tests of retention that were administered one and six weeks after treatment.
4. The novelty effect of receiving instruction in a manner quite different from that to which the subjects had become accustomed may have influenced performance independent of the methods of organization employed.
5. The subjects were not held accountable for their performance in the sense that their efforts were translated into, and became a part of, a final grade in a college course. Had it been possible to couple the extrinsic motivation associated with the goal of achieving a "high" grade with the intrinsic motivation that was present, the scores, irrespective of methods may have been increased.
6. Communication between subjects during the course of the experiment almost certainly occurred since all subjects were enrolled at the same college. However, there is nothing to suggest that one treatment group was in a more advantageous position than another to profit from or be inhibited by information relative to the experiment that may have been transmitted by other subjects.

Implications for Further Research

1. While the control of extraneous variables may be more easily accomplished in a research design of the type employed in this study, there would be merit in a longitudinal study to compare the cumulative effects of the direct-detailed and directed-discovery methods of organizing taped instruction.
2. A modification of the type of research design employed in this study to facilitate a feedback of information to the sub-

jects could be accomplished by employing a tab-type criterion test.

3. It seems that there would be merit in replicating the present research design using subjects at several age levels. There is a possibility that older subjects may not respond as well initially to the directed-discovery method as those who are younger and more flexible.

Educational Implications

The historic role of the college professor has been one of guiding and directing the efforts of young people in such a manner that reasonable competence in the subjects being studied is the expected or desired end-product. If one were to trace the evolution of pedagogy at the college level from its primitive origins to the post World War II years, one would find a diversity of techniques that have been employed to promote learning. However divergent these techniques may have been, there was usually one commonality, a professor meeting with a group of students in a classroom or laboratory.

This research has demonstrated that effective and efficient learning can be accomplished in a classroom without the physical or visual presence of the professor. Previous research including recent work involving teaching machines supports this general finding. It should be emphasized that the subjects in this experiment, *irrespective of method of organization*, were superior to those in the uninstructed group when tested immediately after instruction and at later intervals of one and six weeks. Furthermore, subjects receiving directed-discovery instruction significantly improved their scores on tests administered one and six weeks after instruction when comparisons were made of their performance on the following tests: 1) initial learning and retention after one week, 2) initial learning and retention after six weeks, 3) transfer after one and six weeks. Although slight gains were made by the direct-detailed group at each of the testing intervals, a significant gain was noted only in regard to a comparison of performance on tests for initial learning and retention after one week.

If it is reasonable to assume that a student may learn, retain, and transfer skills and knowledge as a consequence of taped instruction, then it seems to follow that the resources at the disposal of a professor need not be restricted to the students

who come to his class for instruction nor to those who read his books and journal articles. The possibilities of using tapes prepared by recognized scholars to supplement regular classroom instruction is worthy of serious consideration.

There are undoubtedly units of work in many subjects that may be introduced, at least, if not rather fully treated, through the use of taped instruction supplemented by whatever educational aids and techniques seem psychologically sound in regard to the learning task. The scope of the possibilities of this instructional procedure will become apparent only as researchers and teachers direct their efforts to the task of 1) using and 2) evaluating the effectiveness of this medium in contrast with other media.

Taped instruction seems to hold genuine promise for independent study. Although much has already been accomplished in this area, particularly in foreign language instruction, there are many subjects to which little effort has been made in this direction.

The possibility of making available key presentations for remedial instruction should be exploited. Although the present study made no provisions for this procedure, it seems logical that many students might profit from such an opportunity.

Teachers in subject matter areas involving technical and manipulative skills have seemed reluctant to employ taped instruction. A careful study of the learning tasks involved may reveal that taped instruction may be an effective supplement to existing methods of presentation if not a replacement of some of them. In the area of technical drawing, for example, it seems plausible that many of the important lectures may be keyed to workbooks in a manner similar to the one prepared for this study or to slides, charts, or other illustrations.

In the quest for more efficient and effective methods of directing learning activities, teachers and researchers must be both flexible and perceptive as they employ new, and at the onset, seemingly radical instructional techniques. The implications of this and previous research (25) suggest that a method of organizing taped instruction that is inferred from gestalt learning theory is superior to a second method that has its basis in connectionist learning theory. It is axiomatic, in terms of most learning theories, that subjects must respond to stimuli

related to the task if learning is to take place. The learning task in this research required subjects to respond to auditory stimuli and relate this to the visual stimuli of three-dimensional objects and problems in the workbook. The directed-discovery method appears to be productive of a higher order of response, and consequently, of more effective learning.

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CONFERENCE TO IDENTIFY BROADENED ROLES FOR COLLEGE
AND SECONDARY SCHOOL INDUSTRIAL ARTS PROGRAMS IN
APPALACHIA AND TO PLAN PILOT EDUCATIONAL PROJECTS

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Background

The plight of Appalachia and more specifically of Eastern Kentucky is both well-known and of increasing national importance. That chronic unemployment, low per capita income, an alarming rate of functional illiteracy, and widespread poverty exist in this region is common knowledge. Within this depressed region, however, there are craftsmen who work either full or part-time in the production of craft items for sale in the tourist and other markets. Capital investment is by necessity low; the crafts are practiced in a tradition similar to the historic cottage industries. It would appear that the economy of Eastern Kentucky and other similar regions would be strengthened to the extent that 1) the quality of existing craft work be improved, 2) the quantity greatly increased, and 3) a large number of new people enter the crafts on a full or part-time basis.

The Kentucky Guild of Artists and Craftsmen and the Arts and Crafts Division of the Kentucky State Department of Com-

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merce have actively encouraged the development of craft activities. The magnitude of the problem demands, however, that additional agencies and institutions, with large numbers of technically competent personnel, join forces with these two groups to provide educational and training opportunities for current and prospective craftsmen.

Eastern Kentucky State College, Morehead State College, and Berea College are located in the eastern section of Kentucky. Each has an industrial arts department that provides technical and professional preparation for students who plan to become high school industrial arts teachers. The types of training offered in these departments are basic to many of the crafts.

The high school industrial arts teachers in Eastern Kentucky provide instruction, at present, to youngsters of secondary school age. Although their shops are adequately equipped (or could be equipped with modest additions) to offer programs for practicing and novice craftsmen, this function has never been accepted, largely because it has never been emphasized. It seems reasonable that the Industrial Arts Department at Eastern Kentucky State College, with its trained personnel and excellent facilities, (and departments in other interested colleges) and the high school industrial arts teachers in Eastern Kentucky should jointly provide some type of cooperative program of education, training, and assistance for the practicing as well as the novice craftsman.

Pilot programs involving 1) college industrial arts teachers and facilities, 2) high school industrial arts teachers and facilities, and 3) practicing and beginning craftsmen would seem to have strong implications for similar areas in Appalachia. The proposal to involve college and high school industrial arts teachers in educational and training programs related to craft-type, home industries is unique in that it does not fall within the scope of either vocational or industrial arts education as these two fields have been traditionally defined. The general implications of President Johnson's "war on poverty" suggest that traditional programs (such as industrial arts) be reevaluated, particularly in Appalachia, to identify new roles that relate to the educational and economic needs of the people who live in this geographic area.

Objectives

The scope of the problem suggested that diverse talents, including those of craft consultants, would need to be utilized if realistic plans were to be drafted to effectively involve industrial arts personnel in this atypical undertaking. It was felt that a highly structured, conference-type activity offered the best opportunity to attack the problem. Listed below are the specific objectives of the project:

1. To bring together at a conference a variety of people to look at industrial arts offerings in Eastern Kentucky and to discuss possible new directions and contributions such programs might make in more realistically meeting the needs of Appalachia. Included will be representatives 1) from the federal and state governments concerned with educational and economic dimensions of the problem, 2) from the Kentucky Guild of Artists and Craftsmen, 3) from the Council of the Southern Mountains, 4) practicing craftsmen from Eastern Kentucky, 5) practicing college and high school industrial arts teachers from Eastern Kentucky, 6) from related disciplines such as art and business, 7) county and city school superintendents from Eastern Kentucky, and 8) from specialized areas related to the crafts including consultants in marketing, finance, sources of raw materials, design, woodcraft, metalcraft and jewelry making, wooden musical instrument making, weaving, and ceramics.
2. To inform conference participants of the status of existing industrial arts programs in Eastern Kentucky. This description will include 1) the locations of industrial arts shops in Eastern Kentucky, 2) the size of each shop, 3) major equipment and tools, and 4) equipment and instructional strengths with respect to each of the craft areas.
3. To inform conference participants of the status of cottage-type industries in Eastern Kentucky, and of certain internationally outstanding programs. Data will be gathered from the Kentucky Guild of Artists and Craftsmen and the Arts and Crafts Division of Commerce to provide information as to 1) the number of practicing craftsmen in Eastern Kentucky, 2) the crafts pursued, 3) marketing techniques, and 4) the geographic locations of craftsmen with respect

to each of the existing industrial arts shops in Eastern Kentucky.

4. To plan a variety of imaginative pilot programs to be undertaken by college and high school industrial arts teachers, craftsmen, and local and state governments.

Procedures

The following specific procedures were developed as a means of achieving the objectives of the project:

1. To gather, duplicate, and distribute to conference participants materials descriptive of the status of 1) college and secondary industrial arts programs in Eastern Kentucky and 2) cottage-type industries in Eastern Kentucky as a foundation for listening, learning, discussing, and developing inventive new programs while at the conference.
2. To hold a three-day conference on the campus of Eastern Kentucky State College beginning Tuesday evening, July 14 and ending Friday noon, July 17, 1964.
3. To provide consultant, coordinating, and evaluative services for emerging follow-up activities.

After developing the conference agenda, potential conference participants were identified in keeping with the categories set forth in objective one and were extended invitations to attend the conference. The nature of the conference was described in the invitation and the kind of contribution which was expected of each individual was outlined.

Three separate mailings of pre-conference materials (in excess of 300 pages) were assembled and sent to participants prior to the conference. Materials were selected and/or developed that seemed best suited (in keeping with procedure one, above) to provide background information necessary for effective participation. These materials were brought to the conference by each participant and were used as resources throughout the duration of the meeting.

Fifty-eight individuals participated in the July 14-17 conference. The conference agenda was structured to provide for 1) the presentation of papers by consultants and other specialists, 2) tours of high school and college industrial arts facilities, and 3) intensive committee work directed at the development of proposals and pilot programs. See Fig. 1.

Formal papers were presented in the following order:

- Rowlett, John D., Director of Research and Professor of Industrial Arts, Eastern Kentucky State College, "The Task of the Conference."
- Whalin, Ralph W., Chairman, Industrial Arts Department, Eastern Kentucky State College, "Projected Contributions of Industrial Arts Teacher Education Programs in Developing and Upgrading Craftsmen in Eastern Kentucky."
- Black, Susan, Director, Division of Arts and Crafts, Department of Commerce, Commonwealth of Kentucky, "The Development and Current Status of the Craft Industries in Eastern Kentucky."
- Evans, Rupert N., Dean, College of Education, University of Illinois, "The Role of High School Industrial Arts Programs in Promoting the Development of Craftsmen."
- Osolnik, Rude, Chairman, Industrial Arts Department, Berea College, "The Teacher-Educator-Craftsman Views the Problem of Promoting the Craft Industries."
- Ireland, John W., Financial Specialist, Small Business Administration, "Financing the Small Business."
- Pasco, Henry H., The Pascos, (a gift shop) West Hartford, Conn., and Kennebunkport, Maine, "The Sale of Crafts in a Retail Shop."
- Eastmeade, Florence, The America House, New York City, "Marketing Craft Products."
- Tinkham, Robert A., Department of Industrial Education, University of Illinois, "Designing for Production."
- Frid, Tage, Rhode Island School of Design, "Woodcraft."
- Russum, Olin, Monkton, Maryland, "Cottage Industries."



Fig. 1. Speakers at Dinner Meeting Opening the Conference

(L. to R.) John Rowlett; Rupert N. Evans, Dean, College of Education, University of Illinois; Robert R. Martin, President, Eastern Kentucky State College; Harry Sparks, Sup't of Public Instruction, Commonwealth of Kentucky; and Merle Strong, U. S. Office of Education.

Pearson, Ronald Hayes, Victor, N. Y., "Jewelry and Metalcraft."

Ledford, Homer C., Winchester, Kentucky, "Design and Construction of Musical Instruments."

The initial phase of the conference was planned to provide an opportunity for specialists to share their experiences and ideas, through the presentation of papers, with all conference participants. Specified periods of time were set aside for questions and discussion. Since all participants were served their meals in a private dining room, additional opportunities existed for further questions and discussion. Formal papers were duplicated and distributed to participants shortly after each paper was presented. A number of the presentations were illustrated with slides and other visual media. In addition, craft consultants brought to the conference items illustrative of their respective crafts. These were exhibited with the products of the Kentucky craftsmen who participated in the conference.

The afternoon and evening of July 16, and the morning of July 17 were set aside for committee work. Five committees were organized with membership ranging from eight to ten. An attempt was made to structure each committee such that the composition would include 1) consultants, 2) high school industrial arts teachers, 3) college industrial arts teachers, 4) school administrators, 5) federal and/or state representatives, 6) representatives from related school disciplines, and 7) practicing craftsmen. These committees were provided with adequate quarters in which to work, and charged with the following tasks: 1) develop pilot programs in the crafts for adults who have left the "regular" school, 2) develop pilot programs for students who are in high school with interest (perhaps latent) and talent for cottage-type, craft industries, and 3) recommend curricular changes in industrial arts teacher education to better prepare teachers to function in the broadened, craft-oriented phase of industrial arts. A five-page statement was distributed to each committee to provide a framework for discussion and proposal developments. See Fig. 2.

Each committee developed highly specific recommendations relative to the assignment. These recommendations were presented at the final luncheon meeting on Friday, July 17. One of the most urgent recommendations related to the need for some type of action committee to meet, following the conference,

to pull together the various recommendations of the five committees, and to chart specific courses of action.

Results

The recommendations of the five committees at the July 14-17 conference, and the papers presented at the conference, suggested many points of departure in involving existing industrial arts programs, other school disciplines, and a host of various resources and agencies in developing, expanding, and promoting cottage-type, craft industries in Kentucky and Appalachia. Furthermore, the establishment of a new institution, the Kentucky School of Crafts, was strongly recommended.

An action committee met on the campus of Eastern Kentucky State College on October 26-27, 1964, to consider and evaluate the proceedings of the July 14-17 conference, and to make plans for selective implementation of the committee recommendation. Personnel involved in the October 26-27 conference included the staff of the Industrial Arts Department, Eastern Kentucky State College, and the following consultants: 1) Robert Gray, Director, Southern Highlands Handicraft Guild,



Fig. 2. Small Group Conference

(L. to R.) Rupert N. Evans, Dean, College of Education, University of Illinois; Olin Russum, (consultant in ceramics) Monkton, Maryland; Ronald Hayes Pearson, (consultant in jewelry design and construction) Victor, New York; John Rowlett; Florence Eastmeade, Director, Planning and Product Development, and Director, Limited Editions, Wholesale Division, The America House, (consultant in cooperative marketing) New York City; Henry Pasco, (consultant in private marketing) West Hartford, Conn.; and Tage Frid, (consultant in woodcraft) Providence, Rhode Island.

Asheville, North Carolina, 2) M. Ray Karnes, Chairman, Department of Vocational and Technical Education, University of Illinois, Urbana, Illinois, 3) H. H. London, Chairman, Industrial Education, University of Missouri, Columbia Missouri, 4) William J. Micheels, President, Stout State University, Menomonie, Wisconsin, 5) Howard Nelson, Chairman, Industrial Education, University of Minnesota, Minneapolis, Minnesota, and 6) G. Harold Silvius, Chairman, Industrial Education, Wayne State University, Detroit, Michigan. The members of this committee are shown in Fig. 3.

The action committee recognized that 1) all graduates of industrial arts teacher education programs in Appalachia will not be involved in the promotion and development of cottage-type, craft industries, and 2) high school industrial arts programs have multiple functions to perform for students with a wide range of talent, interests, and vocational aspirations. However, if college and secondary school industrial arts programs are to make a significant impact with respect to developing, expanding, promoting cottage-type, craft industries, the following recommendations, grouped into three categories, seem pertinent.



Fig. 3. Action Committee

(L. to R.) John Rowlett; Howard Nelson, University of Minnesota; M. Ray Karnes, University of Illinois; President Robert R. Martin, Eastern Kentucky State College; Harold Silvius, Wayne State University; President William J. Micheels, Stout State University; Robert Gray, Director, Southern Highlands Handicraft Guild, Asheville, North Carolina; H. H. London, University of Missouri; and Ralph W. Whalin, Eastern Kentucky State College.

College Industrial Arts Teacher Education Programs

The preparation of competent secondary school teachers has been the dominant objective of college industrial arts programs. Graduates ordinarily teach in programs that, historically, have been "nonvocational" in orientation. The rationale for the July 14-17 conference implied that college and secondary school industrial arts programs in Appalachia may have unique, as well as traditional functions. In preparing those teachers who plan to remain in Appalachia, and who may be involved in promoting the development of cottage-type, craft industries as a part of their professional activities, the following recommendations seem appropriate:

1. Industrial arts teacher education programs must be modified. An immediate and crucial change would provide for the addition of one or more artist-craftsmen to the college industrial arts faculty. Resident artist-craftsmen should serve as consultants to practicing craftsmen in addition to providing instruction on the campus.
2. Provisions need to be made for retraining the college industrial arts teachers who will have responsibilities in this new program. Such teachers might attend the School for American Craftsmen, in addition to acquiring first-hand experience with practicing craftsmen in their geographic area.
3. College industrial arts departments should utilize teams of craftsmen-teachers to work with potential and practicing craftsmen.
4. Strong summer workshop programs should be developed to provide retraining opportunities for high school industrial arts teachers.
5. Establish cooperative work-experience programs in existing cottage-type craft industries for experienced industrial arts teachers.
6. Study the possibility of developing an "itinerant crafts laboratory" to take shop facilities to the more remote areas.
7. Accept a responsibility for assisting in designing and perfecting craft projects of types suitable for production by people with a wide range of abilities.
8. A strong adult education emphasis should become a part of existing college industrial arts teacher education programs.

9. Provide for internship experiences as a part of the teacher education program; interested, prospective industrial arts teachers-in-training should acquire first-hand knowledge of cottage-type, craft industries.
10. Train industrial arts teachers in depth in specific craft areas without regard to the usual program of breadth in many areas.
11. A strong interdisciplinary curriculum involving business, marketing, art, and design is needed to prepare the industrial arts teacher for this new role.
12. Identify potential leaders in the student population majoring in industrial arts teacher education and encourage them to prepare for this broadened role.

Existing High School Industrial Arts Programs

The region of the United States identified as Appalachia contains several hundred industrial arts shops which are utilized, almost exclusively, for instructional programs for junior and senior high school students. It is suggested that these shops, with appropriate instructional programs, should also serve 1) the potential drop-out, 2) the high school student who will likely terminate his formal education upon graduation and for whom industrial arts instruction may be the most relevant "vocational" experience available to him (many high schools do not have vocational trade and industrial education programs), and 3) the adult novice craftsman who wishes to develop skills and understandings that will have economic value. In addition, it has been suggested that facilities and needed services should be made available in an orderly, systematic manner, to practicing craftsmen who reside in the area served by the school. In order to promote and sustain the growth of these new programs it is suggested:

1. Establish a "model" program for secondary school industrial arts, with the aforementioned broadened roles, at the Model Laboratory School at Eastern Kentucky State College.
2. Establish a master plan, administered by Eastern Kentucky State College, to utilize industrial arts facilities in the Appalachian region of Kentucky.
3. Identify schools in which pilot programs may be organized.

4. Establish a "model" program for secondary school industrial arts, with the aforementioned broadened roles, in a substantial public high school located in Eastern Kentucky.
5. Organize evening and Saturday classes for adults. Existing schools are accepted by the communities and have staff that may be utilized.
6. Identify local resources that are available — human, equipment, space, supplies, etc. Local leadership, including craftsmen, should be heavily involved.
7. The local industrial arts teacher should develop close cooperation with other schools and disciplines.
8. Industrial arts teachers in Kentucky should become more active in the Kentucky Guild of Artists and Craftsmen.
9. Utilize existing craftsmen in the community as resource personnel to stimulate the program.
10. Encourage experimentation with materials and processes.
11. Encourage experimentation in the industrial arts curriculum.
12. Restudy the goals of industrial arts at the high school level.
13. Capitalize on the "Hawthorne Effect" in order to recognize and stimulate those working in the program.
14. Emphasize quality and design techniques.
15. Encourage and stimulate the program through awards at the local level.
16. Develop a sound public relations program.

The Kentucky Crafts School

This proposed school represents one of the inventive, new programs developed at the July 14-17 conference. Under the leadership of Ronald Hayes Pearson, a craftsman in metal with an international reputation, Committee Number Four drafted an outline for this school including 1) organization, 2) functions, 3) staffing, and 4) relationships with other agencies and institutions. The action committee strongly endorsed the proposal developed by Mr. Pearson and his committee, and reemphasized and/or supplemented this proposal with the following suggestions:

1. The school should be staffed with artist-craftsmen and be adequately equipped.

2. The school should be independent; however, it may be housed on an existing campus. It is recommended that the school associate with Eastern Kentucky State College. It is further recommended that this affiliation be on the local campus in order that all campus facilities may be utilized.
3. Admission to the school should be determined on the basis of interest and ability to profit from the training.
4. Include a production shop as a part of the school. This would be an outlet for products, develop interest in the program, and provide a source of funds.
5. Investigate the role of high school industrial arts teachers in recognizing the potential student for the Kentucky School of Crafts.
6. Establish a Sales and Distribution Center as an outlet for goods produced in the Kentucky School of Crafts.
7. Utilize the school as a laboratory for leadership training and development.

Dr. H. H. London, in summarizing the work of the action committee, suggested that the ultimate effectiveness of the proposed programs developed at the July 14-17 conference should be evaluated in terms of 1) the number of people reached by the programs, 2) the extent to which those who are trained actually work at the craft for which they are trained, 3) the occupational success of those who receive training in contrast to those who have had no training, 4) the satisfaction of the students with their training, and 5) the contribution of the programs in the alleviation of poverty.

Conclusions and Implications

Conclusions

1. Secondary school industrial arts programs in Appalachia should accept, as one unique function, a shared responsibility for promoting the development of craft skills, appropriate for cottage industry enterprises, for in-school youth, out-of-school youth, and adults who are interested in, and have talent for this type of occupation. This responsibility should be shared with other school disciplines, particularly art and business, and with relevant private and public agencies.

2. Pilot programs should be developed for in-school youth, out-of-school youth, and adults. These programs should be carefully planned and subjected to rigorous evaluation, including longitudinal studies of the occupational patterns of those who participate in the pilot programs. The full expense of operating such pilot programs need not be an added burden to the local school system. Recent federal legislation provides support for experimental and demonstration programs directed at occupational preparation and the elimination of poverty.
3. High school industrial arts teachers need additional skill training in order to make a maximum contribution to these projected new programs. Such training may be conducted on the campuses of institutions of higher education in Appalachia and/or at specialized craft schools. Artist-craftsmen should be heavily involved in such instructional programs.
4. The industrial arts shop in Appalachia should become a service and instructional center, in the evenings, for novice and practicing craftsmen. Additional staff will be necessary to develop extensive evening programs.
5. Industrial arts teacher education departments in Appalachia must give vigorous support to these projected new programs at the secondary school level. Consultant services should be readily available, including those of artist-craftsmen.
6. An artist-craftsman should be added to the faculty of an industrial arts teacher education department if such a department is to make a significant contribution to the development of craft-oriented programs. The artist-craftsman should serve as a member of the instructional staff and provide consultant services to emerging high school programs and to practicing craftsmen.
7. The curricula of industrial arts teacher education programs in Appalachia should undergo a rigorous reexamination to determine the adequacy of the educational programs for teachers in relationship to the social, educational, and economic needs of the people, both young and old, in the communities of Appalachia, in which these teachers will serve.

8. The Kentucky School of Crafts should be established and in operation as soon as programs are developed and facilities made available.

Implications

The proposed broadening of industrial arts programs in Appalachia to provide a realistic contribution to a many-faceted effort to reduce poverty raises a fundamental philosophical issue in the field of industrial arts education. The suggestion that industrial arts facilities and staff be utilized to promote craft-oriented occupations will be viewed with alarm by many in the field, particularly those who are unfamiliar with Appalachia and who hold that the province of industrial arts is restricted to the broad realm of general education and that occupational training is the proper function of vocational education.

Such philosophical differences have little meaning to the potential and the practicing craftsmen in Appalachian communities who need instruction, guidance, and the use of industrial arts facilities. *What this type of broadened program is "named" is of little consequence; what it may do for the people it reaches is of supreme importance.* College and secondary industrial arts programs in Appalachia must take into account the growing interest in the crafts of a segment of the people who fully warrant and deserve assistance from the educational institutions designed to serve all of the people of Appalachia. In the judgment of this writer, industrial arts programs will make provisions for the educational needs of these people.

The numbers of in-school youth, out-of-school youth, and adults who may be involved in the projected craft-oriented phase of industrial arts programs will likely be small. Industrial arts programs in Appalachia, at both secondary and college levels, need not de-emphasize traditional functions and objectives as a consequence of accepting broadened roles. There is no evidence to suggest incompatibility between existing and projected broadened roles. It is significant that the high school administrators, high school industrial arts teachers, college industrial arts teachers, practicing craftsmen, consultants, and others, who attended the conference, demonstrated through discussions, papers, and recommendations a belief that industrial arts programs should accept the projected broadened roles.

The establishment of a Kentucky School of Crafts, with well-defined relationships with college and secondary industrial arts programs, and other appropriate institutions and agencies, should have a revolutionary impact on the development of crafts in Kentucky. Such a school might well serve as a model for similar schools in other areas of Appalachia.

The leadership of the college industrial arts programs in Appalachia will likely determine the next course of action. If the broadened roles with which this conference was concerned are accepted as both valid and necessary, then one may, with reasonable certainty, predict that attempts will be made to organize such programs. If model programs are developed on college campuses, and if pilot programs, through cooperation with the colleges, are organized in existing secondary schools, one may suggest that such programs will likely receive wide acceptance, and exert substantial influence in the shaping of additional programs. The personnel of college industrial arts programs in Appalachia must first decide if this venture is worthwhile, and if the decision is positive and followed with sustained action, industrial arts programs will likely assume a more realistic role in the multiple-pronged task of meeting both the economic and educational needs of people with latent or overt interests in the crafts that are appropriate for cottage-type industries.

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