R E P O R T R E S U M E S

ED 011 564 VT 002 320

REVIEW AND SYNTHESIS OF RESEARCH IN INDUSTRIAL ARTS EDUCATION.

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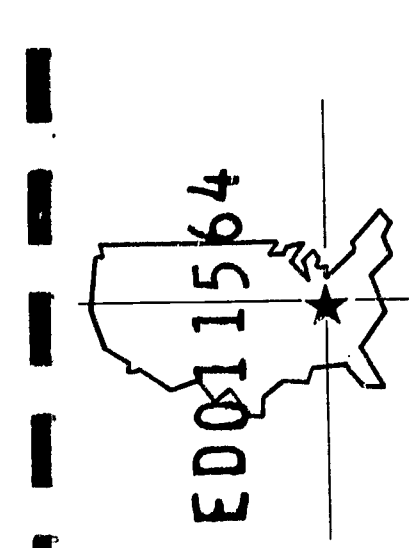
PUB DATE AUG 66

EDRS PRICE MF-$0.18 HC-$4.08 102P.

DESCRIPTORS- *INDUSTRIAL ARTS, *REVIEW (REEXAMINATION), *BIBLIOGRAPHIES, LEARNING PROCESSES, EDUCATIONAL PHILOSOPHY, CURRICULUM DEVELOPMENT, TEACHING METHODS, INSTRUCTIONAL MATERIALS, STUDENT PERSONNEL SERVICES, EDUCATIONAL FACILITIES, EDUCATIONAL EQUIPMENT, TEACHER EDUCATION, EDUCATIONAL ADMINISTRATION, PROGRAM EVALUATION, *EDUCATIONAL RESEARCH, EDUCATIONAL NEEDS, EDUCATIONAL PLANNING, EDUCATIONAL OBJECTIVES, EDUCATIONAL PROGRAMS, COLUMBUS, ERIC CLEARINGHOUSE

DISSERTATIONS, THESES, STAFF STUDIES, PERSONAL RESEARCH, PERIODICAL ARTICLES, YEARBOOKS, AND SPEECHES FROM 1960 TO 1966 ARE REVIEWED. TOPICS DISCUSSED ARE (1) PHILOSOPHY AND OBJECTIVES, (2) CURRICULUM DEVELOPMENT, (3) INSTRUCTIONAL MATERIALS AND DEVICES, (4) LEARNING PROCESSES AND TEACHING METHODS, (5) STUDENT PERSONNEL SERVICES, (6) FACILITIES AND EQUIPMENT, (7) TEACHER EDUCATION, (8) ADMINISTRATION AND SUPERVISION, (9) EVALUATION, AND (10) RESEARCH. THE AUTHOR CONCLUDED THAT EXCELLENT EXAMPLES OF RESEARCH EXIST IN EXPERIMENTAL WORK, IN FOLLOWUP RESEARCH EMPLOYING CAUSAL-COMPARATIVE METHODS, AND IN SOME PHILOSOPHICAL STUDIES. HOWEVER, MUCH OF THE RESEARCH DONE BECAUSE OF DEGREE REQUIREMENTS WAS THOUGHT TO BE OF EXTREMELY POOR QUALITY. BY ACCEPTING LOW QUALITY STANDARDS, INSTITUTIONS MAY BE PRODUCING INDIVIDUALS WHO ERRONEOUSLY CONCEIVE THEMSELVES ABLE AND ACCOMPLISHED RESEARCHERS. MAJOR QUESTIONS CONCERN INDUSTRIAL ARTS OBJECTIVES AND TEACHING METHODOLOGY. RESEARCH EFFORTS, IN THE NEAR FUTURE AT LEAST, WILL BE DIRECTED TO THE CONCERNS RAISED BY THE MAJOR CURRICULUM PROJECTS. (EM)



Review and Synthesis of Research in

INDUSTRIAL ARTS

THE CENTER FOR VOCATIONAL AND TECHNICAL EDUCATION
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The Center for Vocational and Technical Education has been established as an independent unit on The Ohio State University campus with a grant from the Division of Adult and Vocational Research, U. S. Office of Education. It serves a catalytic role in establishing a consortium to focus on relevant problems in vocational and technical education. The Center is comprehensive in its commitment and responsibility, multidisciplinary in its approach, and interinstitutional in its program.

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5. To upgrade vocational education leadership (state supervisors, teacher educators, research specialists, and others) through an advanced study and in-service education program;

6. To provide a national information retrieval, storage, and dissemination system for vocational and technical education linked with the Educational Research Information Center located in the U. S. Office of Education;

7. To provide educational opportunities for individuals contemplating foreign assignments and for leaders from other countries responsible for leadership in vocational and technical education.

REVIEW AND SYNTHESIS OF RESEARCH IN INDUSTRIAL ARTS EDUCATION

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August 1966

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The Work Presented Or Reported Herein Was Performed Pursuant To A Grant From The U. S. Office Of Education, Department Of Health, Education & Welfare.

INTRODUCTION

In keeping with The Center's responsibility for stimulating and facilitating research in vocational and technical education and its commitments to information retrieval and dissemination, this Review and Synthesis of Research in Industrial Arts Education has been developed. The stimulus for this paper evolved from the recognition of need for establishing a base or "benchmark" for current research efforts and for the national information retrieval and dissemination system being developed by The Center and linked to the Educational Research Information Center in the U.S. Office of Education.

This review paper should aid researchers and practitioners in assessing the current state of the art in research for the field of industrial arts education. Further, it should assist in identifying voids in our present research framework and help "sharpen" future studies, both in terms of their substantive focus and methodological approaches. It is logical to assume that this compact review should also assist practitioners in accelerating the applications of research findings to current practice in vocational and technical education programs.

It is recognized that since the ERIC network and its information retrieval and dissemination system was not yet operative when this paper was prepared, the review is subject to gaps and that, in the main, the paper does not reflect the rapidly evolving findings

generated by funds available through Section 4(c) of PL 88-210. Admittedly, the author had problems in securing all available material, but nevertheless, in our judgment, he has done a splendid job of "pulling together" the significant research in the area.

This paper is one of seven published by The Center dealing with research in a substantive area of vocational and technical education. Other research review papers include: Business and Office Education; Distributive Education; Home Economics Education; Technical Education; Trade and Industrial Education; Agricultural Education.

Through The Center and the ERIC Clearinghouse for Vocational and Technical Education, it is anticipated that in the immediate future, other research review and synthesis papers will be developed to assist the profession in assessing an updated "state of the art" and of the potential impact of research on educational practice.

We are indebted to Jerry Streichler for his scholarship and efforts in providing the profession with this new benchmark and perspective on research in industrial arts education. Recognition should be given to Dr. Jerome Moss, Professor, Industrial Education, University of Minnesota, Minneapolis, Minnesota, for his critical review and helpful suggestions for refining the manuscript prior to publication. Acknowledgment is also due Dr. Virgil E. Christensen, of The Center staff, for coordinating the work of the several authors.

Final acknowledgment is given to Dr. Willis E. Ray, Professor of Education, Industrial Arts Teacher Education, The Ohio State University, for his review and assistance in tne development of this publication.

We solicit the suggestions and comments of the profession for improving these publications.

Robert E. Taylor
Director

PREFACE

This report covers research in industrial arts education from 1960 to 1966. Materials for this review were considered appropriate if there was evidence that specialized research techniques were used in organized attacks upon the stated problems.

The material includes doctoral and masters' theses, masters' research project reports, staff studies, and personal research. That studies are discussed or listed in the bibliography, or have been omitted, does not imply a qualitative judgment of the research. While quality and significance were sought in the available research, selection was not based upon these criteria alone. To have done so would have precluded a true representation of the status of research in the field.

To a limited degree, periodical articles of personal opinion, mainly in the areas of philosophy and objectives and curriculum, are reviewed. Similarly, some materials outside the delimited time span are discussed as they were judged pertinent to the full development of topics.

The material reviewed in this report was gathered from library sources, from individuals who conduct, direct, or report research in colleges and universities and from state supervisors of industrial arts. Whenever possible, complete research reports were reviewed.

It became necessary to consult abstracts and summaries of research when complete reports were unavailable.

The author gratefully acknowledges the assistance of the many state supervisors of industrial arts and the college and university department chairmen who responded to a request for aid. Eckart A. Jacobsen, Professor and Head of the Department of Industry and Technology at Northern Illinois University, was particularly helpful, as was Frank Francisco, teacher of industrial arts electronics at Princeton High School, whose research assistance was extremely valuable and appreciated.

Jerry Streichler

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PHILOSOPHY AND OBJECTIVES

Objectives are viewed in the broadest sense and embrace aims, functions, goals, purposes, values, and contributions that commentators have noted for the field. However, achievement of objectives is omitted from this section as it is a topic judged appropriate to the section on evaluation.

The nature of this section requires a departure from the established limitations. Statements in periodical articles and some material published prior to the period under consideration are reviewed. While the latter are kept to a minimum, their inclusion seems to aid in the development of the topic and, if anything, this reviewer may have erred by not including sufficient material of this kind.

It is common knowledge that there is disagreement within the ranks of industrial arts educators concerning aims and objectives. The many contributors to the debate over the objectives of industrial arts have tended to become so involved with the objectives per se that it is sometimes difficult to associate their suggestions with an existing educational philosophy or relate them to psychology of learning. Several studies reveal the diversity in opinion and extent of agreement concerning objectives. While Hammond (1956) found a diversity of aims and purposes in the field, he noted that the objectives of general education were becoming less distinguishable from those of industrial

education. Although the objectives published by the American Vocational Association (1953) were favored in 38 state guides, they did not recognize certain selected sociological factors of contemporary American society according to Miller (1961). Consideration of these factors which included (1) mechanical inventions, (2) population movements, and (3) natural resource changes would aid industrial arts in directing itself toward exploration emphasizing the student's personal development, certain personal-social traits in individuals, and would contribute to the guidance of individuals.

The AVA objectives of 1953 were considered in Talkington's (1962) study. Q-sort response method was used to determine whether there was agreement in the priority of industrial arts objectives between industrial arts teachers in Colorado and 35 selected industrial arts leaders throughout the nation. These two groups have identical rankings for three objectives but disagreed upon the priority ranking for six objectives. Within-group agreement of the Colorado teachers was determined by dividing them into six categories based upon experience and preparation. These six groups agreed on the priority of only two objectives.

Woody (1963) performed a similar study with teachers in Oklahoma and national leaders. While he found some agreement within the teachers' group and between teachers and national leaders, there was not enough agreement to suggest unanimity.

Hawse (1964) attacked the problem of acceptability and recognition of the objectives of industrial arts by studying opinionnaire responses from selected industrial teacher educators, industrial arts teachers, school administrators, industrial employment officers, and

selected parents in the State of Illinois. The responses caused him to conclude that a basic agreement existed on the value of industrial arts objectives subscribed to by industrial arts teachers in America.

Leaders in the field have commented on the objectives and their statements are diverse. In some instances, the general education values of industrial arts have been emphasized. For example, Beck and Nelson (1960) viewed industrial arts as a somewhat specific subject matter area making a primary contribution to general education. Dudley (1963) held the view that science and mathematics, problem solving, and sensitivity to human relations should be emphasized in industrial arts as general education. These would provide a proper understanding of industry. Duffy (1963) was concerned that understanding technology serve a general education function and suggested industrial arts school tracks appropriate to students with different abilities; Jarvis (1963) urged that industrial arts needs to develop a sequence of offerings which would serve college preparatory students; and Evans (1962) pointed out that industrial arts could serve a pre-engineering function and could do so if content and immediate objectives for this function were derived from recommendations of engineering educators.

Crawford (1961) studied the literature and the questionnaire responses from directors of adult programs. Industrial arts as general education, he learned, contributes to the extension of the education of the individual, the development of manipulative skills, and to the promotion of the conservation of human and material resources in recreational and do-it-yourself activities for adults. He further found that both men and women were active in courses of the industrial arts type on the adult level, that there was flexibility in the

offerings with respect to the fact that they conformed to student needs and demands, and that industrial arts as an area of the primary and secondary schools is better interpreted to the public through the participation of adults in these programs.

The adult programs are rewarding to the adults who take part through the things they make and they come to understand the values of industrial arts in the public schools.

The relationship between industrial arts and vocational education has attracted comment. The question of whether industrial arts is supplementary and preliminary to vocational education or whether it is a phase of vocational education has been argued by many contributors to the professional journals. In this regard, Streichler (1963a) suggested that industrial arts was on the industrial education continuum and has been closely related to all other facets of industrial education such as vocational trade and industrial education and technical education. He also pointed out that at the schism between vocational and general education has prevented improvement of offerings in the industrial education field.

Some discussions concerning the relationship of industrial arts and vocational education revolve about particular or specific objectives of industrial arts. The guidance goal of industrial arts is not overlooked in the analyses of industrial arts objectives. An example of this view is seen in the work of Bateson and Stern (1963) who stressed the importance of the guidance objective. The gap between the world of work and industrial education, they said, can be bridged if this objective of vocational guidance is kept in mind. They suggested that this objective can be met if proper exploratory experiences

in the functions of industry are provided in the school shop and that these would prepare the student to deal more effectively with the problem of occupational choice.

Stadt (1962) and Moss and Stadt (1966) bridge the topics of objectives and philosophy. They suggested that the function of secondary education should be solely general education and that industrial arts, in order to be included in the secondary school of the future, must take on more of the attributes of general education. Some objectives dealing with the development of manipulative skills in the junior high school have been unrealistic, they declared, because students at that level have not attained the neuromuscular development required to master such skills. At the junior high school level, students should have first-hand laboratory experiences with various worker roles as they may be extracted from industrial functions. At the high school level, the study of industry would take on a more abstract, generalized form with possible integration and coordination with the study of business, distribution, and agriculture. They rejected the pre-vocational aspects of industrial arts and observed that the major benefit derived from programs of a vocational nature by most high school students is the general education they accumulate as a result of increased time in school. Some of the views expressed by Moss and Stadt are being considered in ongoing curriculum development projects which are discussed in the Curriculum Development section of this review. Those noted here serve as samples of philosophic considerations, some of which may have influenced curriculum development programs.

Some of DeVore's (1964) views have roots in earlier statements like those expressed in a 1947 proposal by Warner (1965) and those of Olson (1957). DeVore (1964) suggested that industrial arts may have reached the point of maturity where it could organize its knowledge to the level of a discipline and that this knowledge be organized about technology. He defined discipline and technology and pointed to those aspects of man that are related to technical endeavors. These aspects are man as a builder, a communicator, a producer, a transporter, a developer, an organizer and manager of work, and a craftsman. They would provide the themes around which content for industrial arts would be organized. Micheels and Sommers (1958) directed a staff study at the University of Minnesota which may be considered a benchmark with respect to philosophy and curriculum of industrial arts. While there is little evidence that this program has been entirely implemented, the report itself has some significance and may also be considered one of the stimuli for later curriculum development efforts. The staff determined the nature of the world of the future, what a person living in that world would need to know and understand, and what general skills he would need to possess in order to function in that world. Out of generalizations concerning this probe of the future, certain specific assumptions were made relating to the social, economic, and technological forces at work which would affect education and industrial arts education in particular. A curriculum for industrial arts teacher preparation was suggested with three major cores of experience: (1) science-mathematics, (2) technology, and (3) design. A coordinated flow of experiences between the three areas which would carry over into

the professional and so-called general education areas of the teacher education curriculum was recommended.

Baird (1961) analyzed Dewey's philosophy and applied it to a proposed industrial arts teacher education program. Baird sought an integration of action and thought and defined the role of instructor in relation to fulfillment of objectives of the experimentalist program which grows out of the social and industrial needs of man.

Svendsen (1961) observed that the theory and practices within industrial arts did not completely exploit the potential of the curriculum. While industrial arts reflected a vocational emphasis handed down from manual training, a liberalizing emphasis resulting from the Dewey-inspired philosophy contended with the vocational emphasis and resulted in a closer relationship between reflective thought and action. Only selected portions of Dewey's theory have become a part of the new industrial arts and there remains a dominance of physical activity over reflective thought. A combination of reflective thought and physical activity is necessary for a liberal study of industry, and an investigation of its technology by problem-solving methods will resist any force which seeks to confine the theory and practice of industrial arts to trade and fabrication activities and knowledge. This should be considered a benchmark study for its quality and its considerations of psychology of learning as related to values, purposes, and content of industrial arts.

Svendsen's study serves as a summary agent for this section. He noted some of the influences bearing on industrial arts: the residuals of manual training, the advocates of a vocational emphasis, and the supporters of general education. Objectives resulting from advocated

views are not uniformly accepted within the profession and leaders continue to promulgate differing purposes, goals, and functions for industrial arts. Thus, one sees eclectic philosophy and objectives which active curriculum development programs may eventually perpetuate or clarify.

MANPOWER NEEDS AND EMPLOYMENT

While some research relating to pre-vocational education and teacher recruitment and placement may have some relation to the heading of this section, they have been judged more appropriate to other categories. Consequently, no studies are reported here.

CURRICULUM DEVELOPMENT

The variety and diversity of philosophical opinions and statements concerning objectives have parallels in the area of curriculum development. To demonstrate this diversity, this section is divided in the following manner: (a) status, (b) curriculum proposals that have been made in the past, (c) curriculum proposals which are currently being formulated and tested are presented, and (d) curriculum proposals which cover a particular phase of industrial arts.

Two studies offer information on the national status of industrial arts. Schmitt, Harrison, and Pilley (1961) analyzed the state curriculum guides in the United States and found that their contents, essentially derived through the analysis technique, were concerned with hand tools and operation of machines and reflected little agreement among the states as to what should be taught.

Also, the guides were found to mirror the objectives developed by the American Vocational Association in 1953. Another factor in curriculum development is revealed by Schmitt (1964) who surveyed industrial arts courses, grades seven through 12, for the United States Office of Education. His figures reveal the enrollments and number of schools offering certain courses under the title of industrial arts. These notify the curriculum developer of the size and nature of the "establishment" with which he will work or which he will try to change. The number of shops and laboratories of certain types is itself revealing since curriculum proposals, it may be inferred, recommend facilities to accompany proposed content.

Some historical perspective relating to curriculum proposals seems desirable. One can trace many antecedents but one of Warner's (1965) works serves as a prime example. He and his students presented the results of a team effort to the 1947 convention of the American Industrial Arts Association. Several large divisions of subject matter resources, namely power, transportation, manufacture, construction, and communication and management, were proposed for industrial arts content. This certainly was one stimulus for industrial arts to reflect technology on all levels of education. Ten years later, Olson (1957) proposed eight major categories of industry which he identified as manufacturing, construction, power, transportation, electronics, research, services, and management; and, similar to the Warner team's effort, he identified subject matter groupings within the major categories. While this attempt resulted in an amalgam of products and materials, it too must be regarded as a significant

effort within the field of industrial arts and a precursor of present-day efforts.

In the 1960's, several proposals attacked the industrial arts curriculum problem. Ziel (1962) proposed the study of the world of work, its dominant technologies, and its complex social interrelationships as a program for secondary school industrial arts. Elements of general shop activity, a study of selected technologies, and subject matter related to finance, psychology, and sociology were evident in the proposal. The Functions of Industry approach (Bateson and Stern, 1963, and Stern, 1964) was somewhat more clearly defined than Ziel's proposal. The latter proposal sought content from the goods-producing and the goods-servicing branches of industry. Functions and sub-functions within the major branches were identified and organized around a sequential set of concepts. In another proposal, Yoho (1964) applied the Systems Network Analysis Process and developed SNAP MAPS or models. From a model of the total functioning society he extracted an Industrial Communication Arts SNAP MAP, from which the curriculum content for industrial arts could be derived. A variation of analysis of industry is represented in Larsen's (1964) work. He examined modern industrial management techniques, concepts, and practices. These he advocated as usable sources for curricular experiences, subject matter, and personnel organization patterns which should be applied to industrial arts.

Two current curriculum projects are attempting to refine some of the earlier work and eventually implement programs in schools. The Industrial Arts Curriculum Project (IACP) (Towers et al., 1966)

delimits and defines the subject matter of industrial arts with a view toward organization for instructional purposes. The supporting rationale for the project suggests that there is an area of man's knowledge into which the study of industry appropriately fits and that a body of knowledge which pertains to industry per se can be identified and separated. Some of the content which has been judged appropriate in the past is rejected as being more relevant to other disciplines and, when applied to industrial arts, is seen to create confusion in philosophy and practice. Essentially, the research workers on this project view the subject matter of industry as limited to the theory of man's practices in the transformation of materials by man and machine through the two major divisions of industry, construction and manufacturing. Knowledge of man's practices about these two major processes can be extracted and organized to form the content of industrial arts. Consequently, they differ with those who suggest that the content of industrial arts should include such areas as transportation, marketing, or banking and finance as major concerns of industrial arts.

Face and Flug (1965) are directing a major curriculum development program which they call American Industry. American Industry is seen in a broad context; all areas of subject matter directly related to industry (all knowledge used by industry, not only industrial knowledge as defined by IACP), and which in turn affect humans, seem to be judged pertinent for consideration as to their inclusion within the curriculum. Their pedagogical approach is based on concept teaching and learning, as is the IACP program. This represents recognition by

industrial arts leaders of recent findings of the educational psychologists and of awareness of curriculum directions in other disciplines.

Schwalm (1966) is also working on a conceptually-oriented and interdisciplinarily organized curriculum. He has selected one of the traditional areas of industrial arts, the graphic arts, and enlarges this area conceptually. He sees visual communication as the organizing agent for his concepts. Concepts apply to the conception, development, production, use, and evaluation of the effect of any type of visual communication in such a way that once understood for one type they aid in understanding all forms of visual communications. The curriculum effort is under way in several schools in the northwest where several tracks can be observed; something equivalent to a general education track, a pre-vocational track, and a pre-technical track leading into a junior college. An experimental curriculum on the college level is also under study.

Industrial arts has also been adapted to pre-vocational goals. The Richmond Plan (1962) is directed toward the engineering technician band of the occupational spectrum. The industrial arts instructor, known in this plan as the technical laboratory instructor, works in a team which includes himself, a science, a mathematics, an English teacher, and a guidance counselor who cooperatively plan an 11th- and 12th-grade high school program. Students are selected for the program after being identified as possessing certain abilities and interests. The plan was originally conceived to create a program of greater interest to students which would hold them in high school until completion and facilitate entry into a post-high school engineering technology program.

Kishkunas (1966) and Olson (1965) spoke of the total occupational, vocational, and technical curriculum in the Pittsburgh public schools. Here, it seems, industrial arts subjects in the junior high school grades emphasize exploration to permit a selection by the student of one of three high school tracks--occupational, vocational, or technical. In the high school, industrial arts courses become preparation for work in the occupational track by providing experiences for grouping of semi-skilled and service occupations.

Turnquist (1965) reported on a program conceived for the Detroit public schools which is similar to the effort in Pittsburgh. Here, too, one can see the use of industrial arts courses in a pre-vocational and vocational sense. These programs were developed in response to serious educational and manpower problems within these school systems and cities. Creative and forward-looking educators are working in these locales and their work should be studied carefully. Possibly, with the solution of immediate problems, school systems may change or add to the current emphasis in industrial arts programs in the junior and senior high schools.

Maley and Keeny (1962) held that industrial arts as general education should be oriented to the talents of different students. To demonstrate this view, a program of research and experimentation for high ability junior high school students was developed. This was based on activities and content derived from research, experimentation, and development functions of industry in the belief that students having a scientific or mathematics orientation could do well in laboratory work which reflected this industrial activity. This program

was established and tried out in some schools of Montgomery County, Maryland.

Several studies represent efforts to derive content of a specific nature and are applicable to subject area divisions within industrial arts. Jelden (1960) developed a list of 628 topics in electricity and electronics. With the cooperation of 134 college industrial arts departments and 20 manufacturers, the list of topics was evaluated regarding topic inclusion in instructional programs. While the industries agreed that theory and application of recent advances in electricity and electronics, such as transistors and semi-conductors, were important, the researcher noted that these materials were not necessarily present in existing electrical instruction or in the books used by instructors at the time of his research.

Fritz (1960) and Paulin (1964) did research in the area of the ceramic industry with emphasis on the technology inherent in that industry. The contemporary society in the United States, they agreed, is basically technological and educational institutions should reflect this technology. Fritz developed a subject matter outline which illustrates that available curricular elements are diversified and numerous and contain a wealth of material for potential units of instruction. Paulin, on the other hand, presented an analysis of the function and organization of the ceramic industry. The industry, he said, needs to be viewed as an enterprise which would require more penetrating plans to teach its importance and implications as an area of technology than those currently used to teach it as a simple craft.

In the field of plastics, Runnalls (1965) analyzed and described the production processes and materials used in the plastic industry and determined the extent to which industrial arts teacher educators gave instruction related to the body of knowledge he derived. He found it relatively simple to derive the content and suggested that processes can be determined and modified into instructional content. Results of his survey of teachers in education institutions. however, indicated that only 14 departments required a course in plastics for their industrial arts majors while 73 departments indicated that there were some instructional units in plastics included in other courses.

The role of industrial arts as a supporting activity for other disciplines reflects still another belief concerning its values and role in curriculum. In this regard, some guides have been developed and some research has been done. Engelbrektson (1961) suggested a way by which science education could be treated in the industrial arts shop to increase the scope of both science and industrial arts. Consequently, he developed a resource unit by researching textbooks, curricular statements, courses of study, handbooks, and astronomy books in order to develop a resource unit in astronomy for the industrial arts curriculum in junior high schools in New York State. Such industrial arts activities as pre-planning, design, and project-making were found to hold promise for the teaching of astronomy in the junior high school.

Griffin (1965) determined science concepts from textbooks used in grades four, five, and six. Members of the American Council for Elementary School Industrial Arts selected those concepts which they believed held promise for industrial arts related experiences. Since

this researcher found support for the contribution of industrial arts to the development of science concepts in grades four, five, and six, he suggested that industrial arts be implemented and utilized to reinforce science concepts. A unit on weather was developed by Champion (1965). The unit was experimentally tested with two groups of students. The researcher concluded that industrial arts could be implemented on the elementary school level and could serve to motivate the children in the unit to which it is related.

Another example of the related subject view of industrial arts in the California State Department of Education guide (1960) which aimed at improving the instruction in mathematics courses relating to industrial arts. Auto mechanics, drawing, electricity and radio, graphic arts, handicrafts, metal and wood are related to mathematics in this work prepared by teachers representing these areas during a summer workshop.

In summary, diverse views of industrial arts are apparent in curriculum development. To some, it is a motivating activity: to others, an occupational or pre-occupational subject; some view it as general education which serves all students while making provisions for different abilities; some derive its content from a broad interpretation of technology or American industry while others derive content from a delimited analysis of man's practices in industry in converting materials to products; some analyze processes and materials of specific industries to derive content and others analyze functions common to many industries. While the curriculum situation appears eclectic, it seems that the ongoing curriculum research and development programs may lead to a much needed agreement on the values of

industrial arts. Once the values are accepted, the various approaches which are and will be suggested for the achievement of value objectives will, of course, need to be tested empirically.

EDUCATIONAL PROGRAMS

Research which might have been reported under this heading was judged to be more appropriate to other categories. Consequently, no studies are reported here.

INSTRUCTIONAL MATERIALS AND DEVICES

The research reviewed here is limited to those studies in which emphasis is on development of or information about instructional materials and devices. Studies employing materials and devices in connection with learning processes and teaching methods are considered under the section following this.

The reviewer expects that much work is being done in developing instructional materials and devices that is not reported as research. Efforts that are so reported follow.

Lists of available materials can be useful. In this connection, MacLean (1963) determined the availability, value, organization, and effective use of United States Government publications. This effort resulted in a selected annotated bibliography indexed by subject which is available to industrial arts teachers and which directs them to many resources available from government publications. MacLean warned that the Monthly Catalog of United States Government Publications, while extremely useful, requires a continuous evaluation and cataloging in order to abstract pertinent materials for industrial arts.

All issues of Industrial Arts and Vocational Education for the period 1948 to 1958 were surveyed by Poray (1964) who listed the teaching aids and devices which appeared during that period. While the collection may not be of extensive value at this time, some of the conclusions which the researcher reached as a result of his survey may be pertinent to direction in research and significant to the field. He observed that only a limited number of instructors of subject matter was represented in the periodical and as a consequence many fine projects, teaching aids, and devices have gone unpublished and unknown to the field.

A study to determine the status of development and utilization of instructional media in industrial teacher education in selected colleges and universities was completed by Payne (1965). The data he gathered through a refined opinionnaire indicated that in the majority of institutions the responsibility for selecting and planning audio-visual materials such as models, mock-ups, and educational bulletin boards is borne by the individual instructors who use them, that 16 mm. motion pictures were used more than any other media and overhead transparencies ranked second in use. The least used medium at the time of the research was video tape recording.

The development of instructional materials and devices is a field to which many beginning researchers devote their energies. This type of work is represented by the efforts of Grobe (1962) who developed teaching aids for use in the high school machine shop. After analyzing subject matter and the associated teaching methods in a selected high school, four subject areas were identified as difficult to present in an effective manner. Teaching aids and suggested methods for their use were developed for these areas.

Rodrick (1964) pursued a similar objective. He produced three-dimensional teaching aids which could be used for an eighth-grade unit in electricity. Types of three-dimensional teaching aids which should be selected, constructed, and used in the unit on electricity were recommended on the basis of a documentary review.

Another type of teaching device was developed by Van Rooy (1965). Out of his analysis of the explosive forming method in industry, a working explosive metal forming device was constructed. The developer believed this successfully demonstrated the concepts involved in high energy metal forming. It involved an explosive source transmitted through a hydraulic medium and acting on a work piece fastened over a vacuum.

A laboratory manual, another type of instructional aid, was developed by Allen (1965) for experimental metal cutting and metal tool performance. The manual included experiments on chip types in metal cutting, calorimetric determination of specific energy of metal removal, the effect of nose-radius, cutting speed and feed on surface finish, cutting forces and tool geometry, evaluation of cutting fluids for turning, machine tool deflection during cutting operations, and machine tool testing and evaluation.

There may not be a need for emphasizing more work in developing industrial arts instructional materials and devices. However, the question may be fairly raised which probes the competency in psychology, learning theory, and communication principles of those who develop devices without some sort of objective evaluative criteria. Some research orientation does exist in evaluating the effectiveness of

certain devices as they are developed. This is evident in the following section.

LEARNING PROCESSES AND TEACHING METHODS

The largest number, and possibly the best, of experimental studies has been done under this general heading in industrial arts. It is commendable that many of these operate within theoretical frameworks developed in educational psychology and attempt to test theories as they relate to or affect industrial arts practice.

Maturation, Perception, and Practice

One of the benchmark studies in this area was done by Fuzak (1958) whose findings, while almost 10 years old, have apparently not "trickled" down into the school program. We found that grip strength of junior high school students in industrial arts was highly, positively related to their ability to perform certain manipulative tasks and suggested that teacher expectations of achievement may often be beyond the student's capacity at that age level.

A study by Middleton (1962) revealed that successful achievement in beginning drafting on the eighth-grade level is partially dependent on adequate perceptual-motor development. Certain perceptual-motor tasks were found to be effective predictors of success or failure in beginning drafting. The description of surface configurations which are oblique to the principal planes of projection were more difficult for the eighth-grade students in the study and the perceptual-motor tasks which best predicted success in this area of drawing are the diagonal movements of right and left eyes.

Erickson's (1964) study was also revealing. A factor found to be significant in mechanical drawing achievement among adolescents is the visual-haptic aptitude, not formerly considered by teachers. A continuum was based on one extreme from visuals--students who tend to prefer optical experiences to the other extreme of haptics--students who predominantly rely on non-visual sensory stimuli.

Reading is related to perception. Miller (1966) sought to determine the effects of readability of textbook materials upon student achievement. The researcher rewrote selected material to a predetermined readability level and subjected two groups of students to a controlled experiment. No significant difference between achievement of students reading the original material and those reading the same material rewritten to a lower readability level was found.

The effect of practice on the performance of intellectual and manipulative tasks interested Hull (1964). He divided a group of high school students on the basis of I.Q. scores and subjected them to three treatments involving practice, repetition of training, and control in an intellectual and a manipulative task. The group with higher I.Q. scores was superior to the lower I.Q. score group in the performance of the intellectual task; the practice treatment group was superior to the no-practice treatment group in the performance of the manipulative task; and females were superior to males in the performance of the manipulative task.

Problem-Solving and Creativity

While there is much in the general literature of industrial arts on creativity and problem-solving, three experiments were found to

consider creativity and the problem-solving abilities of students in industrial arts. Sommers (1961) performed a study in a college drawing course in which a control group received the traditional instruction and the experimental group was exposed to a technique which the investigator calls "sketch storming." He found that certain abilities associated with creative thinking in an industrial arts laboratory type course can be improved while not negatively affecting the subject matter to be learned. Growth in creativity was found in an experiment by Anderson (1963) who compared two methods for developing creative problem-solving abilities in an industrial arts course. One treatment employed brochures with content dealing with creative thinking plus imagination exercises. A second group was exposed to group-type imagination exercises. A second group was exposed to group-type imagination exercises derived from the brain-storming technique, and a third group received instruction in the traditional manner. While there was no significant difference among final course test means of the three treatment groups, the researcher found that tests for creativity revealed a significant difference in the creative thinking of the group that used brochures and imagination exercises. Cornwell (1961) experimentally compared the effectiveness of the use of problem-centered instruction sheets as compared to the use of traditional instruction sheets. Although there was some method by instructor and instructor by method interactions, the problem method seemed to be favored in results of performance tests and retention tests.

Research interest in problem-solving and creativity has taken directions different from experimentation. Ferns (1962) reviewed

writings of authorities in education, educational philosophers, and experimental research studies dealing with problem-solving and developed principles which could guide individuals and groups in designing and conducting learning experiences for improving problem-solving abilities in the industrial arts; and an inventory composed of individual creative and non-creative behavior items was developed by Clay (1965) and administered to a random sample of junior and senior high school industrial arts teachers in the State of Michigan. Clay was attempting to determine whether differences could be found between encouragement of creative behavior and such variables as junior and senior high school teaching, multiple or limited area laboratory teaching, belief in the primary objective or purpose of industrial arts, and educational background and length of experience as well as the interrelationships among these variables. Teachers in multiple area laboratories tended to encourage creative behavior while teachers of limited area unit shops on the junior and senior high school levels tended to encourage non-creative behavior. Further, teachers who indicated that they emphasized skill development or the interpretation of industry objectives in industrial arts tended to indicate greater encouragement of non-creative behavior than the teachers who tended to emphasize self-realization objectives.

Renken (1962) performed a survey to determine whether the project approach or the problem-solving approach was most popular in industrial arts in high schools in the State of Kansas. He found that there was an increase in the use of the problem-solving approach and that more of it existed in metal working than in either the general shop or woodworking classes. Of possible significance at the time of this research

was the fact that nearly 30 per cent of the teachers responding had, themselves, never experienced the problem-solving approach in teacher education.

Two recently completed studies used the Minnesota Test of Creative Thinking, Abbreviated Form VII. Duenk (1966) found that the MTCT, Abbr. Form VII may be measuring factors other than those required of industrial arts students in the performance of creative tasks. He suggested that researchers should distinguish between creativity scores representing what the student is able to do and scores which indicate what he actually does. Both Duenk and Moss (1965a) agreed that a low or insignificant relationship exists between test measures of creativity and I.Q. for an above-average population and that there is a high relationship between unusualness and creativity.

However, Moss pointed out that the abilities presumably measured by the MTCT, Abbr. Form VII are inadequate to account for creative output. He suggested that such factors as motivation, emotions, familiarity with subject matter of problems, as well as I.Q. and substantive creativity, need to be considered for efficient prediction-explanation of creative output.

More work needs to be done in the area of problem-solving and creativity. Their true nature and definition seems unclear. And if clarified, techniques and applications require further investigation. Some techniques may already hold promise in this respect.

Techniques

The direct-detailed and the directed discovery methods of teaching have received some attention. The former consists of continuous

positive presentation of all the information to be acquired and understood while the latter method provides direct positive instruction for only that content considered basic and relies upon carefully structured and ordered questions and hints to facilitate the subject's discovery of the remaining information and relationships that are to be acquired and understood. Ray's (1957) study of the two methods in connection with teaching micrometer measurement techniques can be considered among the pioneer efforts in comparing the two methods with industrial arts content.

Moss (1960) performed an experiment which attempted to determine the relative effectiveness of the two methods described above in the teaching of non-manipulative, technical content (letterpress imposition). He found no significant difference between the methods with regard to initial learning, retention, or transfer, nor were there apparent advantages in using either of the methods with different intelligence level students.

Suess (1962) compared the effects of varying degrees of the directed discovery method on learning principles of orthographic projection. He, too, found that there was no significant difference in initial achievement, in retention, or in transfer between the experimental or control groups. The direct-detailed and directed discovery methods were also tested by Rowlett (1963). Information on orthographic projection was presented, using a tape recorder in conjunction with workbooks. The directed discovery method was superior for low ability students in terms of transferring principles and skills six weeks after instruction and subjects receiving direct discovery

instruction significantly improved their test scores one and six weeks after instruction.

An experimental comparison to determine the effectiveness of the use of instruction booklets and demonstrations was conducted by Hofer (1963). Taking four metal working operations--foundry, copper enameling, drilling and counterboring, and threading, the researcher directed the teaching of 50 seventh-grade boys by alternate methods of presentation. Each student received instruction on how to perform two groups of operations by demonstrations and the other two operations were taught via the instruction booklets with the student performing the operation as he read his instructions. Self-instructional materials, it was found, may be expected to produce slightly higher achievement than demonstrations with respect to the amount of terminology and knowledge of procedure learned and retained. However, the self-instructional materials require slightly more student time for instruction and performance than demonstrations which are followed immediately by performance; this difference in time should increase with students of lower intelligence and reading ability.

Programed materials were tested in various ways. A teaching machine designed by the researcher (Ruehl, 1961) could confirm a correct answer immediately through use of a green light which was absent in the event of an incorrect response. An experimental group using this machine was compared to a control group that received a 24-hour dealy in knowledge results. Students using the "comparator" machine achieved significantly better in a final test. This difference disappeared when a retention test was administered eight weeks later. Hinckley (1962) contrasted four methods of teaching wood identification

using Ruehl's automatic teaching machine for one method. All methods were found to give equal results. Consequently, the researcher concluded that those methods which were essentially student-directed were preferred to those that were teacher-directed. A commercially-prepared Skinnerian linear program was compared with a specially-prepared textbook on basic electronics by Lease (1964). There were no significant differences in the effectiveness of the Skinnerian program and the text in terms of material initially learned, material retained after six weeks, the ability of students to apply facts and principles initially learned, and their ability to apply facts and principles retained after six weeks. There was also no significant difference between two groups Kumro (1965) compared to determine the effectiveness of programed materials in teaching the notes and figures involved in screw threads.

Weffenstatte (1965) experimented in the area of basic electronics in a somewhat different manner. He was interested in determining the effect of the introduction of the variable of laboratory experiences on the learning of basic electronics when a programed instruction system was employed for two equated groups. Consequently, one group received laboratory instruction while the other did not. Holding other factors the same, including the use of a programed instructional system, the researcher found that basic electronics can be taught effectively by this method without the laboratory and suggests that this opens the way for many possibilities of savings and starting more programs.

The preceding studies reveal that certain values may be inherent in self-instruction devices. First, in programed instruction and teaching machines, the teacher is freed without measurable reduction in

learning. Second, the directed discovery method, which lends itself to automated instruction, may also be regarded as a problem-solving process involving insight as a phase of the process.

Laboratory activity before and after presentation of electrical theory in terms of student performance and achievement was found to make no difference in the achievement of the entire group. But Freeman (1965) found students with higher intelligence did better when theory preceded activity while students of lower intelligence did better when activity preceded theory. When the project method was compared to a combination of the project method and the use of quick circuitry in a college level introductory electricity course, Fowler (1965) found that there was no difference in the effectiveness of the two methods with respect to understanding fundamental principles and concepts, manipulative skills, and over-all retention. Koble (1963) experimentally compared a group method to an individual method of instruction with matched groups of seventh-grade graphic arts students. The results of pre- and post-test data revealed no significant difference in effectiveness of the teaching method.

Teaching techniques which employ different forms of visual aids have been tested. The effects on learning and retention in beginning woodworking when conventional methods of teaching are supplemented with overhead transparencies were studied by Brooks (1964). Achievement of the students in selected units of woodworking was significantly greater when special overhead transparencies were utilized in addition to convential methods of teaching. The experimental group's over-all retention was significantly greater than that of the control group.

According to the experimenter, the fact that the lower level intelligence groups possessing intelligence quotients of 100 and below in the experimental group were able to achieve and retain a mean score only 0.3 points lower than the mean raw score obtained by the upper intelligence sections in the control classes was of special significance. Yeager (1965) conducted an experimental study to determine the value of projectuals in presenting selected units of basic electricity in junior high school. Although Yeager's procedure was similar in concept to that of Brooks, his conclusion was somewhat different. He found that initial learning and over-all retention were equal in both methods. However, teaching time was reduced by one-third when projectuals were used.

Observer check sheets and job sheets were used by Herbert (1964) to evaluate the effectiveness of single-room closed circuit television in industrial education. Fifty televised classroom demonstrations conducted in wood techniques, printing, electricity, and metals were appraised. Students, demonstrators, and observers indicated a high degree of acceptance of the single-room closed circuit television primarily because it increased demonstration ability.

Horning (1964) compared the effectiveness of a conventional face-to-face demonstration with a closed circuit televised demonstration on trouble-shooting utilizing a particular kind of volt-ohm-meter. He found that the demonstration on trouble-shooting was as effective using closed circuit television as the conventional face-to-face classroom method. He also learned that it is possible for an inexperienced instructor to render effective demonstrations in a relatively short time by using the television media.

Using one control and one experimental group equated for reading ability, mechanical ability, and previous industrial arts experience, Snyder (1961) found that there was no significant difference in teaching a perceptual motor skill with a teacher-produced instructional film or with a live demonstration method on the junior high school level.

Organization of Content

The effectiveness of four ways of organizing complex technical content related to the metallurgy of carbon steel were compared by Tomlinson (1964). Using the entire junior and senior classes of a high school, the researcher allowed each of the subjects 45 minutes to read an identical word passage based on the subject matter which included 10 sections in the written passage. This was followed by a common 15-minute demonstration which illustrated the principles and relationships in the written passage. The passage was varied in four ways in order to test for significant differences in the organization. In the inductive method each section of written instructional material was closed with an underlined summary statement of the generalization or generalizations developed within the section. The inductive discovery confirmation method included at the end of each section of the instructional material a question to encourage the subject to develop his own generalization which he was permitted to check against generalizations on a provided check sheet. In the deductive method each section of the learning passage was introduced with a broad generalization or generalizations. Finally, the inductive discovery method closed each section with a question designed to encourage the student to develop his own generalization but the student was not permitted

to match his generalization against a check sheet. The inductive method was superior to all other methods with regard to initial learning. The four methods were equally effective for retention and transfer one week after instruction. The inductive-discovery-confirmation method was inferior as measured for retention transfer five weeks after instruction. A straight-forward expository method of presentation, either inductive or deductive, was superior to other methods containing questions designed to encourage the formulation of generalizations as measured for retention and transfer after five weeks.

Personnel in the Bureau of Industrial Arts Education in the State of New York (1965) were faced with a rather common problem. More instructional materials had been developed and disseminated than, it seemed, could possibly be organized for teaching during the time allotted in the seventh and eighth grades. Consequently, teachers from selected schools were asked to teach a series of lessons that were identified by the staff or the Bureau. In large measure, this was an attempt to support the basic concept of having the six industrial sections, which were evolved for the comprehensive general shop in New York, available at all times. These areas are general ceramics, general electricity, general metal work, general printing, general textiles, and general woodwork. The results of the study showed that conscientious organization of instructional materials and the teaching process would allow the instructor to cover more material than formerly thought possible. No data concerning effects upon learning were available.

The preparation step in teaching assumed a new dimension when Dawson (1965) sought to measure the effectiveness of what Ausubel calls subsuming concepts through the introduction of an advanced organizer in the presentation of typical industrial arts technical content. This involved the introduction of a reading passage structured at a higher level of generality, abstraction, and inclusiveness than the learning task that followed it. It was found that the organizer significantly facilitated initial learning but not retention and that the use of the organizer was more effective with lower ability students than with those of greater ability. Mass production has received wide attention in the general literature and some researchers have also been attracted by the approach. Smalley (1962) posed a philosophical point of view which supported teaching of mass production in the school shop and tested the feasibility of so doing. Students who experienced a mass production unit scored significantly higher on a researcher-designed test of knowledge of mass production than those who had no organized contact with mass production.

Two surveys were conducted to determine the status of mass production teaching in industrial arts. Ressler (1962) surveyed 27 regional high schools in New Jersey to determine whether mass production was included in the program. He learned that approximately 50 per cent of the schools use mass production techniques in industrial arts programs and those that were located closer to large cities tended to use the technique more than schools in outlying areas. Approximately four-fifths of the teachers using the technique had been educated and received their teaching experience within the state. A similar survey was conducted by McBain (1964) in suburban Chicago. He found that

the method was used in approximately 47 per cent of the secondary schools surveyed and that there was an indication that this would increase to 59 per cent during the following year. The greatest use of the mass production technique was indicated to be within the instructional areas of woodworking and graphic arts.

Learning processes and teaching methods are extremely fertile areas for the researcher. As theories of learning are promulgated, they need to be tested in industrial arts and as the technology of education advances, the new media must be examined with regard to the field. An opportunity, however, does exist here for further research which would support or reject theories of learning based upon activity per se and to further examine the efficacy of certain kinds of activity like projects, exercises, and experiments. The research reviewed does touch upon several of these problems. Much more needs to be conducted.

STUDENT PERSONNEL SERVICES

The material in this section divides itself into three topics. Studies which examine the guidance function of industrial arts make up one category; investigations which provide data relating to prediction of student success and advanced placement make up a second category: and a third deals with research attempts to characterize the abilities and/or nature of students who enroll in industrial arts courses.

The Guidance Function

Two studies were located which belong in this section. Miller (1965) performed a survey to determine the vocational guidance practices of industrial arts teachers in selected junior high schools in the United States. A majority of the industrial arts teachers who

responded had professional preparation in guidance. The guidance functions performed were of an incidental nature and were rarely included in the planned formal presentations to the class. The major difference in emphasis placed on the objectives of industrial arts existed between teachers who stressed guidance functions and those who did not. Those who did stress the guidance function considered one of the major functions of the junior high school to be exploration of industry while the others believed the major function to be the development of manipulative skills.

Prediction and Advanced Placement

Studies concerned with prediction of success in post-high school work have been done but have generally dealt with specific industrial arts subject areas. Kari , 1963) attempted to determine the extent to which the background of high school students in drafting would affect achievement on the college level in the field of graphics. He studied the records of 946 students and found that the study of high school drafting did have an effect on college graphics. He infers that the lack of high school drafting might have been the cause of student drop-outs in college. Criteria for assigning students to accelerated sections of engineering drawing were determined by Lemons (1965). Mechanical drawing experience and measures of student academic ability consisting of mathematics and verbal score on the College Entrance Examination Board Scholastic Aptitude Test were considered for one group of students. The Essential High-School Content Battery of mathematics and English achievement scores and knowledge of drawing fundamentals were considered for the second group Although students

with previous mechanical drawing experience did not have sufficient knowledge of drawing fundamentals to permit omitting that content from the college course, the number of semesters of high school mechanical drawing was the best single criterion of success determined. Students with at least two semesters of mechanical drawing experience had sufficient knowledge to qualify them for accelerated sections of college engineering drawing. Further, he found that for students with high school drawing experience, the most valid predictor of probable success in engineering drawing is a combination of mathematics aptitude scores, average mechanical drawing grade, and the number of semesters of mechanical drawing experienced.

Blum (1965), working at Texas A & M, sought to develop and standardize an achievement test which could be used for placing college students in general drafting courses. The content for the examination was gathered through a nation-wide survey of college drafting instructors and was evaluated by a panel of five subject matter specialists in the field. As a result of administering the test to a sample of students from six Texas colleges and universities and validating the items and the test itself, the researcher concluded that he had developed a comprehensive general drafting examination which may be considered a standardized measure of drafting achievement of satisfactory length which may be used as an advanced placement instrument.

Students Who Take Industrial Arts

One of the blocks to communication between the industrial arts theorist and practitioner is the premises from which they speak. One sees content, method, and objectives as they apply to a cross-section

of American youth. The other cannot unscramble or interpret these code-like pronouncements because he knows that he has never come in contact with, nor does he expect to teach, all students. The realities that one faces tend to make unrealistic ideals out of the statements of the other. But this raises a question that may have great pertinence. What has been done in the form of positive contributions, through the unique methods and techniques of industrial arts, for those students who do come or are assigned to the program?

A study which describes the type of student in a high school in Louisiana found that there were more than twice as many drop-outs enrolled in industrial arts courses as there were among other curriculums. This caused the researcher (Atkins, 1964) to recommend immediate improvement of industrial arts courses. Also the researcher suggests closer cooperation between the guidance and industrial arts departments for earlier identification of drop-outs. Possibly, drop-out-prone students were being assigned to the industrial arts department in extremely large numbers in this instance.

Grice (1965) came up with conclusions almost directly opposite to those of the preceding study. He surveyed the high school drop-out problem in a Louisiana parish and concluded that students who enrolled in industrial arts tended to stay in school one year longer than students not enrolled in industrial arts.

The academic ability of industrial arts students as compared with other students in seven secondary schools in the State of Kansas was determined by Winsor (1962). A survey of test results in areas of science, mathematics, English, social sciences, total achievement, general ability, clerical speed, and accuracy in spelling permitted

the researcher to conclude that industrial arts students ranked lower than other students in all areas but English, science, and mathematics.

Some reports were found dealing with the prediction of achievement in industrial arts classes. In three such studies, measures of general intelligence were shown to be insignificantly related to industrial arts grades (Hoagland, 1959, and Long, 1959) or less related to industrial arts grades than to grades in academic subjects (Larsen, 1959).

In light of the content of typical intelligence tests, it appears that success in industrial arts demands more than high verbal ability and convergent thinking. This is borne out in Long's study by the fact that language grades and scores on standardized reading tests did not contribute to a prediction of grades in senior high school industrial arts classes. But it should be remembered that these results can only be generalized to a particular student population and set at learning conditions.

Research can contribute much to the improvement of student personnel services. While industrial arts educators may blame guidance personnel for shortsightedness, there has been no discernible effort to demonstrate the values of industrial arts objectively. Federal funds have provided impetus to make up for this void and the curriculum projects discussed earlier must certainly gain the attention of those who serve student personnel.

FACILITIES AND EQUIPMENT

As the major curriculum projects develop, facilities and equipment, instructional materials and devices, and teaching methods will receive wider attention. There has been little research under this topic other than state guides generally developed by small committees or individuals. This reviewer has been unable to secure any other than tentative guides dated in the 1960's. A problem which applies to syllabi and teacher certification standards applies to equipment and facility guides with equal force. These may have unforeseen effects upon creative innovation and teaching unless provisions for change are included.

Some studies have covered equipment needs. Bonde (1964), Hansen (1964), and Doutt (1965) evaluated selected elementary school industrial arts hand tools. Elementary school educators were provided with a resource unit based on tool categories determined through a survey of members of the American Council for Elementary School Industrial Arts. Students in grades one through six utilized the tools in skill tests. Teachers in each grade have been provided with suggestions as to which tools, in terms of size and weight, to use. Suggestions were also made with respect to the elimination of certain tools in certain grades. Trapanese (1964) developed a handbook for administrators and teachers regarding shop facilities, tools, equipment and materials to be used in elementary school crafts programs in the State of New Jersey. This was the result of a survey within the state which revealed that there was no definite plan for inclusion of crafts programs or facilities in the elementary schools and that

those found were largely off-shoots from the art or industrial arts programs. There seems to be an implied differentiation here between arts, industrial arts, and crafts.

Finances relating to equipment and supplies seemed to have been of vital concern to Schad (1962), who performed a field study in the State of Virginia. Recommendations dealing largely with the financing of consumable supplies for industrial arts classes in that state resulted. He recommended certain monetary formuli which can be applied to different areas of industrial arts. For example, he suggested a per pupil clock hour range from .016 to .028 cents be applied to unit drawing programs. His recommendations covered annual appropriations, use of revolving fund systems, and the methods of collecting funds.

Koch (1964) attempted to determine basic educational specifications which he believed would serve as a guide to educators and architects in designing modern shops. The researcher limited his area of concern to general automotives, drafting, electricity, graphic arts, machine, sheet metal, and woodworking shops. He interviewed responsible parties in state education and local school agencies in order to acquire sufficient information to develop his recommendations. These cover the methods of planning, specific considerations of enrollment, class period length, curricula considerations, size of shops, auxiliary rooms, and specific comfort considerations which are particularly pertinent to industrial arts laboratories.

One area which seems not to have been touched at all, except slightly in the preceding study, is that of laboratory utilization.

Industrial cost accounting procedures may be applied in the laboratory utilization studies. Hopefully this would have a positive effect on expansion posibilities.

TEACHER EDUCATION

The research in this field falls into four categories. Much research has been done to identify the abilities and personality factors of those who would and those who do teach industrial arts. Some research has also been conducted in undergraduate teacher education curriculum, in problems of student and beginning teachers, and in graduate education.

Scholastic Achievement and Personality Factors

Several studies determined the relationship of certain scholarship factors for students enrolled in industrial arts teacher preparation programs. Reams (1963), using the scholarship criterion of grade point average through the first quarter of the senior year, found no relationship between amount and quality of high school industrial arts experiences and scholastic success, a significant relationship between number of grade points earned in high school mathematics and physical science subjects and a high correlation (.58) between SCAT verbal score and scholatic success. Similarly, both Turner (1965) and Mavey (1961) found no significant relationship between achievement in high school industrial arts courses and success in industrial arts teacher preparation programs. Torres (1963) found no significant relationship between first and third semester industrial arts and over-all grade point average earned and scores on the Owens-Bennett Test of Mechanical

Comprehension, Form CC, the Minnesota Paper Form Board Test, Series MA, and the Cooperative English Ability Test, Form AA. The subjects of this study were junior college transfer industrial arts majors at Long Beach State College.

While the preceding reflects an interest in and search for useful predictors, some industrial arts teacher educators may be faced with the problem of "image" on their respective campuses. Prover (1962) provided some data which may prove useful in connection with this problem. In comparing the performance of industrial arts, English, social science, speech, art, and home economics students at Kansas State College at Emporia, he found achievement of the groups in their majors was not significantly different and that all groups, except English majors, performed equally well outside the major area.

Another area of prediction seems natural in the sequence from high school grade relationships to within-college comparisons. That is, the relationship of scholastic attainment to rated success of secondary school industrial arts teachers. Powers (1961) sought to determine this relationship and found a low positive correlation (.32) between rated success and marks earned in undergraduate technical courses. However, he found higher positive correlations between rated teacher effectiveness and marks earned in "academic" courses (.52), professional education courses (.51), and total undergraduate scholarship (.51). While not entirely conclusive, these results should raise questions concerning the nature and distribution of professional, technical, and "academic" or general education courses in some institutions. They also raise certain questions related to the establishment of effective methods for evaluating industrial arts teachers.

Several studies attacked the problems of industrial arts teacher personality. Morgan (1961) determined personality variables which are prominent among industrial arts teachers as measured by the scale of the Edwards Personal Preference Schedule. He found that the instrument differentiated between industrial arts teachers and a normative group of college men and between successful and unsuccessful industrial arts teachers. Messman (1963) used the Edwards instrument and the Minnesota Vocational Interest Inventory and identified relationships between vocational interest patterns and personality traits of freshmen industrial arts majors. Rex A. Nelson (1964) used the Edwards instrument ard the results differentiated between industrial arts college students and industrial arts teachers, between industrial arts college students and a normative group of college men in such a way as to provide effective aid in guiding incoming college freshman. Studies by Monroe (1960) and Vacek (1962) have also shown that the Edwards Personal Preference Schedule can be a valuable tool in teacher selection. The Schedule was capable of distinguishing between industrial arts freshmen and freshmen in five other curricula, between industrial arts freshmen and industrial arts seniors, between industrial arts freshmen and industrial arts teachers, and between "most and least successful" industrial arts teachers. In his work with the Minnesota Vocational Interest Inventory, Howard F. Nelson (1962) developed keys which discriminate between satisfied and dissatisfied experienced teachers as well as satisfied and disssatisfied freshmen in industrial arts teacher education programs.

The foregoing indicate that there are personality patterns unique to industrial arts teachers and students. While these findings are

not generalizable, some educators may receive it with mixed emotions. Yet one may rightly wonder what personality criteria--if any--beyond successful college entrance are being and can be applied in the recruitment, selection, and guidance of students in industrial arts education and the relationship of these criteria to teaching success.

Once they are prepared to teach, however, a measure of the success of the preparation is always interesting--even if the educator one day finds he has been preparing a teacher with the "wrong" kind of personality or scholastic profile. Researchers have been active in the area of attempting to appraise the product of teacher education institutions. Ehrenborg (1963) developed a device for identifying successful industrial arts teachers. The device contained items relating to the teacher's instructional program, management program, and to the teacher himself. These items were determined through a forced choice technique and were then used in rating teachers. The ratings on the device were analyzed to determine which dimensions were correlated significantly with the criterion of success--the principal rating.

Studies have evaluated the effectiveness of teacher education curricula using an opinionnaire approach. In one case (Erwin, 1963), graduates of one institution rated the shop courses they took to be of greater value than professional courses. Suggestions for improvement, however, included the desire for more specific instruction in methods, shop planning and organization, and curriculum construction. Another study (Padham, 1961), soliciting opinions from graduates of a different institution, found that of the professional courses taken methods and

shop organization were considered most essential. In one study (Powers, 1961) 200 teachers, each with 10 or more years of experience, were rated by their supervisors. Measures of undergraduate scholastic success were also obtained for each teacher. The reported correlation coefficient between grades in professional education courses and rated teaching success was .51; the coefficient between success and technical course grades was only .32. Findings from a study by Scherer (1960) tend to support the importance of scholastic success in professional courses. Teachers with graduate credit and better grades in professional courses were rated higher by their principals than were teachers with no graduate credits or low grades in professional education courses.

Much has been learned about the achievement and personality patterns of industrial arts teachers. But much remains to be done. Curriculum changes, "upgrading," and the use of new media may call for teachers who possess different patterns from those revealed in the studies reviewed above.

Curriculum

Major curriculum research, appropriate to the secondary level, was discussed in the Curriculum Development section of this report. Curriculum work oriented more closely to the immediate concerns of those responsible for teacher education is discussed here.

Blomgren (1962) engaged in a study concerning the relative growth in understanding of American industry of selected industrial arts education majors. He compared the results of a test which he formulated and administered to freshman and senior groups of industrial arts

education majors and social science majors. While there are some limitations to the study, his conclusions, which should be examined by those interested in achievement of objectives on all levels, were: (a) freshman industrial arts students enter college with less understanding of industrial America than social science majors, (b) senior industrial arts majors showed a higher level of understanding than the freshman in the major, and (c) the industrial arts seniors were not superior to non-major seniors in any phase of understanding, and were comparatively lower in their understanding of labor in industry. While the researcher inferred that growth does take place between freshman and senior years, it is not clear that the growth can be attributed to the industrial arts curriculum. This opens avenues of research in the formulation and attainment of objectives and curriculum revision on the teacher education level.

Reynolds (1963) sought to determine the curriculum revision techniques and procedures utilized in selected institutions in the northeastern United States. He classified 123 procedural elements, surveyed 16 institutions, and intensively studied four through visitation. He found that revision techniques neglected research in the field, widespread staff and administrative participation, cooperatively determined procedures, and utilization of consultants.

Heilman (1963) developed a curriculum for the professional preparation of industrial arts teachers which, he states, could be accepted nationally. He justified his approach on need occasioned by increasing mobility of the teacher population. While he did not so state, the implication is clear that certification requirements should be uniform and nation-wide as well. In this regard, more uniformity

was found in state certification requirements than in college curriculums--in the southeastern United States, at least, by Turlington (1964). He noted a wide range in the college requirements for industrial education majors with emphasis on graphic arts, woods and construction, metals, electricity, crafts and mechanics within the major area, and a growing emphasis on mathematics and physical science outside of the major area.

Elementary industrial arts is a growing movement within the field. Little research effort has been directed to this area but there are two studies which have bearing on the movement and the preparation of teachers. Low (1963) questioned a sample of 217 elementary school teachers to determine the skills and techniques they judged necessary to teach industrial arts on their level in California. A parallel check list was submitted to college teachers of industrial arts classes for elementary teachers. The responses from both groups were in agreement. Further, the elementary school teachers urged that industrial arts experiences be provided on the undergraduate level for future elementary school teachers. Bruce (1964) learned that 94 of 165 industrial education departments responding to his survey were offering courses for elementary teachers. These were largely elective, concentrated on laboratory work, and were in the areas of wood and metal. He found considerable uniformity and was able to predict future growth on the basis of observable trends.

Several curriculum studies have been done in specific industrial arts areas. Sexton (1965) determined the status of design instruction in teacher education and compared the views of design teachers and industrial designers regarding content and instructional practices.

He constructed a comprehensive information form (which in itself represents a contribution to design teaching) which he mailed to educators and designers. The data revealed numbers of courses offered and textbooks used and 65 per cent projected growth in design offerings by industrial arts education departments. There was significant agreement between designers and educators over content and instructional practice. Brown (1960) determined the manipulative operations and equipment required in connection with these operations by electrical workers. He formulated recommendations for teacher education programs based upon the data gathered. Carlsen (1961) likewise considered industrial practices in graphic arts in order to make comparisons and recommendations for teacher preparation programs. His findings pointed to certain manipulative activities, informational topics, and equipment and facilities which should be included in graphic arts for teacher preparation. Further, work experience for teachers in training was strongly recommended.

The power area, like many others within industrial arts, is in flux. Two investigators surveyed the practices and trends in industrial arts teacher education with respect to courses in this area. Allen (1963) found the area growing with respect to offerings, trends toward a broad study of power and transportation, activity developed around problem solving and operations rather than projects and content essentially exploratory. Ecker (1965) observed a "traditional" position oriented to the service aspects of the automotive industry and advocates a "progressive" position which conceives the body of knowledge as being included under power, transportation, and service. Ecker developed a detailed program in power technology which

identified 50 applicable scientific principles and included each of the energy sources for prime movers.

The chicken and egg problem is obvious in teacher education. It is reflected in all phases of teacher education but it seems particularly strong in the area of curriculum. Dare the teacher educator expose his charges to experiences which may not be consistent with existing public school curriculum, content, facilities, and techniques--and to what extent? To what extent is the teacher educator obligated to provide training consistent with existing public school standards? Several studies reveal that certain college and university investigations have taken a lead in innovation. To what extent, however, has this resulted in change in teacher education institutions or in the secondary schools?

Student Teaching and Beginning Teachers

Christoffel (1960) developed a handbook for master teachers who work with student teachers in industrial arts. Cappiello (1964) studied selected teaching problems through the appraisals of supervising teachers and recent industrial arts graduates. He determined desirable experiences, methods, and techniques which pertain to the functions of the student teacher, the supervising teacher, and the responsible college personnel.

Poleszak (1964) administered a questionnaire and the Minnesota Teacher Attitude Inventory before and after State University of New York College at Buffalo students completed student teaching. A majority of the total expected and actual outcomes as verbalized by the students were related to the student teaching objectives of

"become acquainted with the role of the school; knowledge of methods and materials of teaching; and assuming the responsibilities of a regular classroom teacher." These industrial arts student teachers also felt that the most influential person with whom they came in contact was their supervising teacher. This was an outcome expected before and realized after the student teaching experience. Students with high positive scores on the MTAI held different expected and actual outcomes from students with low negative scores.

Thomas (1964) considered the relationship between competence and dogmatism as revealed on the Rokeach Dogmatism Scale. He found no significant relationship between competence of student teachers and dogmatism. He suggested also that there was a tendency for student teaching supervisors with low Rokeach Dogmatism scores to give high competence ratings to student teachers with high Dogmatism scores and the same supervisors tended to give low competency scores to student teachers with low Dogmatism Scale scores.

Walls (1964) investigated an aspect of beginning teaching through a questionnaire administered to a selected graduating group of a Michigan college. He determined that the same type of problems were anticipated by the respondents when they were students and in their first year of teaching, that the problems they encountered were more serious than expected, and that they felt much the same as seniors and as first-year teachers with regard to their preparation to handle problems. Rutherford (1962) was also concerned with beginning teachers. He surveyed the practices in California relating to the selection, placement, and guidance of beginning teachers. His findings are pertinent to curricular considerations since he makes recommendations

concerning major area, professional, and student teaching improvement. He also found a lack of mutual understanding between administrators and teachers.

Graduate Education

The monograph by Miller and Ginther (1965) contained the results of a nation-wide survey and provides comparative data and statistics relating to courses, enrollments, and requirements in graduate education. Swanson (1964) developed an instrument to gather data from department chairmen in institutions offering the master's degree in industrial education. This enabled the researcher to catalogue superior practices in graduate industrial education.

One is reminded of two yearbooks of the American Council on Industrial Arts Teacher Education. Hornbake and Maley (1955) dealt with superior practices in industrial arts teacher education and Norman and Bohn (1961) treated the topic of graduate study in industrial arts. Both provide historical perspective and data relative to status and trends in their respective areas and times.

Continued data gathering seems necessary and desirable in graduate education. A serious void seems to exist in information on training researchers in industrial arts education.

ADMINISTRATION AND SUPERVISION

Three investigations were located which centered on the functions of industrial arts supervisors.

Shank (1965) formulated a check list based upon reported duties, activities, and responsibilities of supervisors and he determined that

supervisors in industrial arts perform a number of functions different from other areas of education. McRobbie (1963) conducted interviews and utilized a critical incident technique with selected supervisors and teachers in California. Successful performance of industrial arts supervisors was largely determined by their successful performance in the area of human relations while making little effort in evaluation, research, and planning. He also found that industrial arts department heads contribute little to the improvement of instruction in schools where other kinds of industrial arts supervisors do not exist.

The role of the county industrial arts consultant in California was determined by questioning district superintendents, district industrial arts supervisors, teacher educators, and county consultants (Taxis, 1962). The cumulative judgments of the respondents indicated a useful role for county consultants in administrative and executive duties, professional and instructional improvement, and procurement of equipment, supplies, and housing.

Other areas of concern related to administration and supervision were reflected in Campbell's (1961) study concerning the relationship between student attitudes toward mandatory junior high school industrial arts and such variables as physical condition of the laboratory, methods and management used in the laboratory, the teacher's philosophy of education, the teacher's view of the administration's attitude toward industrial arts, and the amount of student time and experiences in industrial arts. He found no significant statistical relationship between the variables and student attitudes.

Industrial arts presents major challenges in administration and supervision. Creative leadership will be required and, one is

emboldened to observe, may very well be lacking today. Articulate leaders are needed who can understand and translate into active programs current movement in the field. Research may well be directed to the development of criteria which may identify qualities germane to this type of leadership.

EVALUATION

All research is evaluation of one form or another. Consequently, the reviewer was faced with problems of classification. Where does one locate the evaluation of an instructional method or a visual aid--under Instructional Materials, Teaching Methods, or Evaluation? Hopefully, the best and clearest judgments have been made. Two principal areas of evaluation are content and curriculum and achievement of objectives.

Content and Curriculum

Subject content has received attention in research circles. Bailey (1961) administered a design test to school students in Michigan in order to determine the relationship between experience in industrial arts and achievement in design. He found no relationship between experience (number of industrial arts courses) and an advanced knowledge of design. He did note that students who elected an increasing number of industrial arts courses tended to have lower intelligence. This report may also be considered an evaluation of attainment of objectives since design may have a relationship to appreciation and use, creativity, and problem solving.

A study more directly related to content was designed by Herring (1962), who developed a 60-item test of knowledge of electricity and administered it to eighth- and ninth-grade boys. The researcher reported that students who indicated interest and/or participation in electrical experiments, science experiments, amateur radio, reading, Cub Scouts, and Boy Scouts had significantly higher means than those who were non-participants. Subject groups that indicated interest and/or participation in sports, go-carts, and automobiles had means significantly lower than those who were non-participants in these activities. There was no statistically significant difference between subjects taking industrial arts electricity and those who were not. Apparently much of what is covered in textbooks in industrial arts electricity and electronics at the junior high school level is already known by the students.

Bohatch (1964) examined the automotive course offerings at a California college by soliciting information from graduates, most of whom indicated that the program was adequate but suggested addition of a course in small engines.

Achievement of Objectives

There were studies to determine the extent to which certain objectives were achieved in the schools. A questionnaire containing lists of student behavior relative to the objectives as published by the American Vocational Association (1953) was formulated and submitted to industrial arts instructors, coordinators of cooperative work experience, industrial arts students, and students of cooperative work experience by Hawlk (1960). The results showed that the students in cooperative work experience programs achieved at a higher estimated

level in only two of the objectives and achieved at approximately the same level for one objective.

Roy (1963) attempted to determine the degree of accomplishment of three industrial arts objectives in ninth-grade metalworking and woodworking classes. The objectives, interest in industry, appreciation and use, and shop skills and knowledge, were also derived from the American Vocational Association guide. It was found that ninth-grade metalworking and woodworking students made significantly higher grades on an interest in metalworking or woodworking industry test, on an appreciation and use of metal or wood products test, and on a shop skills and knowledge test than did ninth-grade industrial arts students who had not taken metalworking or woodworking. The findings do indicate effectiveness of metalworking and woodworking courses in meeting specific objectives but leave some question concerning the actual achievement of general objectives of industrial arts.

Arkema (1961) was interested in the relationship between industrial arts education and home leisure time activities. Students enrolled in industrial arts engaged in leisure time activities at home with their fathers. Students not enrolled in shop courses indicated that they engaged in very little leisure activity at home. Pagley (1965) pursued a similar course of research at the college level. He was interested in determining the contributions of industrial arts to the leisure time activities of certain graduates of a state college in Missouri. A large percentage of the graduates felt that portions of some college courses should be devoted to leisure time activity instruction and that graduates who had taken industrial arts courses while in college (not necessarily industrial arts education majors) were

more likely to be using an area of industrial arts as a major leisure time activity than those who had received no such instruction.

The opinions of former high school industrial arts students were secured about the occupational and general values of the program and Wallis (1960) reports that increased depth and specificity of skill development was desired.

Moss (1966) was interested in gathering information concerning the pre-vocational value of senior high school industrial arts. He compared the scholastic achievements of statistically equated groups of students in four different clusters of post-high school trade and technical curriculums on the basis of several industrial arts related variables. These variables were (a) amount of industrial arts taken (broken down among students who had no industrial arts, those who had some industrial arts, and those who had many semesters of industrial arts), (b) high or low achievement in senior high school industrial arts, (c) post-high school curriculum directly or indirectly related to the content of senior high school industrial arts courses taken, and (d) the relative emphasis on pre-vocational and vocational objectives in the senior high school industrial arts courses. He found that there were no differences in the scholastic achievement of students enrolled in any of the four post-high school trade and technical clusters which could have been attributed to any of the variables except grades earned in industrial arts. According to Moss (1966, p. 24):

> The study showed that academic courses, particularly the physical sciences, were apparently as effective in preparing the students who took them as industrial arts was for the students who enrolled in it. The results, therefore, indicate that industrial arts educators should be a

> great deal more conservative in the future than they have been in the past about justifying senior high school industrial arts on the basis of its greater pre-vocational value for all youth who intend to enter post-high school trade and technical curriculums. As most programs now exist, they are probably not in a position to "put up."

Moss has some justification in speaking as he does. He has moved into unexplored territory--the testing of objectives--with relatively sophisticated research techniques. It is an area in which much more work needs to be done.

The foregoing are samples of studies which fall in the category of evaluation--with the qualifications mentioned in the introduction to this section. Research into evaluation techniques is infrequent in the field although many research techniques reported in other sections are applicable to evaluation of programs, achievement of objectives, performance, and activity.

RESEARCH

History and Status

This section is included because it reflects an area in which there has been some volume of research and serves to more clearly depict the research posture of the field.

Sredl (1964) traced the history of industrial arts from 1920 to 1964. More than four decades of growth are revealed in which one may find the roots of present day lack of consistency in philosophy, objectives, and practice. In the fourth decade of this century, the researcher pointed out, two views emerged concerning industrial arts. The first view identified itself with the standards movement and rallied behind the findings and interpretations of the American

Vocational Association's committee on standards. The second interpretation championed the liberal view of the curriculum area. While growth of the field was interrupted during the first half of the 1940's by the Second World War, it provided a period of reappraisal which resulted in a multitude of new goals and even greater confusion with respect to aims and objectives of the curriculum area. The researcher found that one term, "defensive," denoted most of the positions of industrial arts educators in the period following the Second World War. Two philosophies in industrial arts emerged toward the 1950's. One emphasized the pre-vocational values in industrial arts and derived its content from an analysis of trades. The other attempted to stress the place of industrial arts in the contemporary technological society and identified it as a curriculum area which can most contribute to the understanding of today's world. The former influence seems to have permeated educational institutions to a far greater degree than the latter point of view.

For the most part, other histories have been devoted to the development of industrial arts or industrial education in states or communities. An equal emphasis has been found on histories or biographies of individuals in the field. Examples include Nix's (1964) work which is a history of industrial arts in Georgia. Various events and movements that contributed to industrial arts as a subject of study in the elementary and secondary schools in Georgia were traced. The severe setback that it suffered during the depression years of the 1930's was documented and it was at this time of crisis that the term industrial arts gained wide acceptance in the state. Following the Second World War, greater effort was given to expanding educational

facilities in Georgia and this was particularly true for industrial arts laboratories. He pointed out that teacher education facilities have kept pace and that supervision in the form of state coordinators has been provided as the program grew in the state.

A history of the evolution of industrial arts in a large city was done by Foytick (1962) for Pittsburgh, Pennsylvania. His starting point was the enactment of the Smith-Hughes Act and he traces three developmental periods, from 1917 to 1923, from 1923 to the beginning of World War II, and after World War II. He pointed to various innovations and experiments which the Board of Education attempted through the years as it tried to meet the needs of at first selected students and then of all the students through industrial arts and industrial education programs.

Hammer (1962) provided an example of biographical research. The educational contributions and philosophies of Charles A. Bennett are traced. Bennett's life is described as the reader is taken from his work as a mechanical engineer, to teaching assignments in Minnesota, to his appointment as professor of manual training at the school which was to become Teachers College, Columbia University, to his elevation to Dean of Manual Arts at Bradley Polytechnical School, to his publication work, and finally to his notable work in producing the two-volume History of Manual and Industrial Education.

Status studies by Cooper (1961), Thrower (1961), McIoney (1965), and Smith (1965) were undertaken for the States of Alabama, North Carolina, San Diego County in California, and the State of Oregon, respectively. Each of the researchers performed their investigations with some variations but essentially they searched available files

within the area in which they were working and used questionnaires to gather additional data. The recommendations as a result of these surveys are interestingly similar. Some differences may be attributed to the four-year difference in the work as well as the effect of the Vocational Education Act of 1963. Recommendations can be found for facilities, teacher education, increased supervision, safety standards, and increased breadth and depth, as well as for vocational emphases where the researcher believed it was needed.

Another type of status survey is reflected in Porter's (1961) attempt to determine the extent to which industrial arts teachers in Wisconsin assumed their responsibilities for extra-curricular and non-teaching duties. He found that approximately 75 per cent of these teachers were fulfilling their responsibilities for extra-curricular and non-teaching duties.

There is a body of literature which is improving and expanding and which should be mentioned in this section. This is the sources of of published research in the field. The Journal of Industrial Teacher Education, first published in the fall of 1963, has provided a publication outlet for the researchers in the field and is certainly an avenue of dissemination for important research. The American Council on Industrial Arts Teacher Education supports a yearbook series which has also served to stimulate research. Two yearbooks are particularly pertinent to the topic of research; they are the 13th, titled Classroom Research in Industrial Arts, edited by Porter (1964), and the 15th yearbook, titled Status of Research in Industrial Arts, edited by Rowlett (1966).

Another publication series which has been launched recently by the American Council on Industrial Arts Teacher Education should also be noted. First of this series is a monograph by Miller and Ginther (1965) which determines the status of graduate work for industrial arts education personnel in the United States. Research in Industrial Education (1957) and the supplements prepared by Strong (1961 and 1962) provide summaries of studies which are reported for the period 1930 to 1959 in the areas of industrial education including industrial arts.

The importance of history and status research should not be diminished. This review itself has elements of both. It is an attempt to take stock and look about before moving forward. In this period of rapid growth and development, it may beem foolhardy to expend valuable research time and talent to determine the events of the past or present since the call of the future is enticing and, possibly, more exciting. More efficient techniques and methods need to be developed and employed in status and historical research. Automation should be extremely helpful; consequently, the ERIC at The Ohio State University will certainly contribute to this and other research areas.

SUMMARY

This is a general commentary concerning status, trends, direction, and quality of research in industrial arts. Specific comments have been made within the several sections of the review and they are not repeated here.

Quality of Research

Some excellent examples of research exist. Highly refined research techniques were employed and reflect high standards which should be emulated. This has been achieved mainly in some of the experimental work, some follow-up research employing causal-comparative methods, and in some philosophical studies. Cited ongoing curriculum projects reflect high standards of objectivity and clarity of purpose as far as this is possible in that type of research. Unfortunately, there is research in the field which does not achieve high standards.

"Contrived" research of extremely poor quality--the kind that seems to be done only because someone has to do it to obtain a degree--is discernible. Industrial arts has an unfair share of experiments which are poorly conceived, controlled, and treated: of surveys which are unclear as to instruments used, intent, population treated, and conclusions reached; and of philosophical and historical research in which the researcher is obviously unacquainted and unprepared to use the tools, procedures, and research methods peculiar to the type of research. This is not the place to consider causes but one is pressed to observe that institutions in the field, by accepting low quality standards, may be producing individuals who erroneously conceive themselves able and accomplished researchers. This is dangerous!

Some of the research cited has proceeded within a framework of theory. Observable trends in this respect point to more of this--a healthy approach. Further, the testing of theories in education suggests team research whereby behavioral scientists, social scientists, and industrial arts specialists cooperatively attack problems. Certainly, the industrial arts researcher must at least be

acquainted with research techniques in those fields if his research is personally conducted. A large number of studies have been done on a great variety of topics in the field and while there is room for criticism, quality seems to be improving.

Trends

The extent of acceptance of industrial arts objectives has not been clear. New directions and purposes are being framed and some existing objectives are being declared unachievable or unrealistic. Even so, studies reveal that content and curriculum offerings in public schools and in teacher education institutions are largely designed around "traditional" offerings.

Major questions which one may infer from a review of the research revolve about industrial arts teaching methodology. Some studies have raised questions concerning types of activity: some even suggest the accomplishment of certain course objectives without manipulative activity. Curriculum researchers who attempt to adopt concept teaching and learning must consider the question of type and extent of activity as well as means for measuring attainment of objectives they establish for their curriculums. Research in the field already associates different teaching methods with different ability groups and largely differentiates content for different groups as well. Certainly there will be experimental studies concerning similar content conceptually taught to all students. It seems that efforts, in the near future at least, will be directed to the concerns raised by the major curriculum development projects. These will influence teacher education, administration and supervision, teaching methods, facilities and equipment, and will have implications for research in evaluation and in research itself.

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