DOCUMENT RESUME

ED 185 239 CE 023 476

AUTHOR Dyrenfurth, Michael J.; Householder, Daniel L.
TITLE Industrial Arts Education: A Review and Synthesis of the Research, 1968-1979. Information Series 183.
INSTITUTION American Vocational Association, Washington, D.C.; ERIC Clearinghouse on Adult, Career, and Vocational Education, Columbus, Ohio.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.; Ohio State Univ., Columbus. National Center for Research in Vocational Education.
PUB DATE 79
CONTRACT 400-76-0122
NOTE 224p.
AVAILABLE FROM National Center Publications, The National Center for Research in Vocational Education, The Ohio State University, 1960 Kenny Road, Columbus, OH 43210 ($12.25).

EDRS PRICE MF01/PC09 Plus Postage.
DESCRIPTORS Administration; Curriculum Development; Delivery Systems; Educational Facilities; *Educational Research; Educational Theories; Guidance Programs; *Industrial Arts; *Industrial Education; Instructional Materials; Learning Processes; *Program Evaluation; *Research Projects; Supervision; Teacher Education; *Teaching Methods

ABSTRACT

This monograph presents a compilation of research in industrial arts education from 1968 through 1979. The first section reviews studies which deal with the philosophical bases of industrial arts and which examine its historical development. The second section identifies studies that emphasized industrial arts' role as an integral component of a comprehensive human resources delivery system. The next section cites projects pertaining to the programmatic aspects of industrial arts. The development of industrial arts curriculum is investigated in the fourth section. Studies in the fifth section examine variables affecting the learning process. The next section discusses studies devoted to instructional media, methods, and materials. Studies investigating the guidance characteristics of industrial arts are found in the seventh section. The studies reviewed in the eighth section examined facility-program interaction in terms of facilities, equipment, and safety. Next, studies on evaluation are divided into four major categories: development of tests/instruments, interaction analysis, program evaluation techniques, and the effects of evaluation. The final three sections review, respectively, studies in teacher education, administration and supervision, and professional concerns. A summary chapter and bibliography conclude the document. (CT)

Information Series No. 183

INDUSTRIAL ARTS EDUCATION: A REVIEW AND SYNTHESIS OF THE RESEARCH 1968-1979

written by

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1979

FUNDING INFORMATION

Project Title:	ERIC Clearinghouse on Adult, Career, and Vocational Education
Contract Number:	NIE-C-400-76-0122
Educational Act Under Which the Funds were Administered:	Sec. 405 of the General Education Provisions Act, 20 U.S. Code 1221e, (PL 92-318) As amended by PL 93-380 and PL 94-482
Source of Contract:	Department of Health, Education, and Welfare National Institute of Education Washington, D.C.
Contractor:	The National Center for Research in Vocational Education The Ohio State University Columbus, Ohio
Project Director:	Marla Peterson
Disclaimer:	This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to freely express their judgment in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official National Institute of Education position or policy.
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This publication was prepared with funding from the National Institute of Education, U.S. Department of Health, Education, and Welfare under Contract No. NIE-C-400-76-0122. The opinions expressed in this report do not necessarily reflect the position or policies of NIE or HEW.

FOREWORD

The Educational Resources Information Center on Adult, Career, and Vocational Education (ERIC/CE) is one of sixteen clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered in the ERIC data base. This paper should be of particular interest to industrial arts teachers and administrators, curriculum development specialists, teacher educators, researchers, and graduate students.

The profession is indebted to Michael Dyrenfurth and Daniel Householder for their scholarship in the preparation of this paper. Recognition also is due James Fales, Purdue University, Carl Wallis, Utah State University and Stanley Cohen, the National Center for Research in Vocational Education, for their critical review of the manuscript prior to its final revision and publication. Robert D. Bhaerman, Assistant Director for Career Education at the ERIC Clearinghouse on Adult, Career, and Vocational Education, coordinated the publication's development. Cathy Thompson assisted in the editing of the manuscript and Carol Hartley, Bonna Somerlott, Andrea Ardito, and Colleen Donaldson typed the final draft.

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ABSTRACT

This monograph presents a compilation of research in industrial arts education from 1968 through 1979. The first section reviews studies which deal with the philosophical bases of industrial arts and which examine its historical development. The second section identifies studies that emphasized industrial arts' role as an integral component of a comprehensive human resources delivery system. The next section cites projects pertaining to the programmatic aspects of industrial arts. The development of industrial arts curriculum is investigated in the fourth section. Studies in the fifth section examine variables affecting the learning process. The next section discusses studies devoted to instructional media, methods, and materials. Studies investigating the guidance characteristics of industrial arts are found in the seventh section. The studies reviewed in the eighth section examined facility-program interaction in terms of facilities, equipment, and safety. Next, studies on evaluation are divided into four major categories: development of tests/instruments, interaction analysis, program evaluation techniques, and the effects of evaluation. The final three sections review, respectively, studies in teacher education, administration and supervision, and professional concerns. A summary chapter and bibliography conclude the document. (CT)

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INTRODUCTION

This monograph seeks to present a compilation of accessible research in industrial arts education from 1968 through 1979. In some ways, it is expected that it will serve mainly as a large scale map to identifiable topics in research rather than an actual synthesis of all possible findings. As such, it is hoped that this publication will provide an overview of the variety of research during this period. While the document could not be a fully definitive in-depth analysis of the state-of-the-art, it seeks to provide a description of the stage of development attained by research in this area. To place this perspective in its proper context, readers are encouraged to review the first two review and synthesis papers authored by Streichler (1966) and Householder and Suess (1969).

Like its predecessors, the intent of this review and synthesis is to establish a useful benchmark for reference, the validation of opinion, and the stimulation of further research. While the summary chapter focuses on suggestions for additional work, other inferences are discussed in each section. Apparent research voids also are identified. This information can be useful to establish a frame of reference for further research.

It is hoped that this document also will be useful to stimulate research by those who do not typically engage in such activity. It is generally recognized that all too frequently the dissertation represents the sole significant research of the vast majority of doctoral recipients. However, there seems to be an abundance of pararesearch. Administrators frequently collect data to support their decision among alternatives, evaluators devise analytical approaches, and supervisors render judgments. While these efforts may fall short of the ideal in terms of methodology, reliability, validity, and

dissemination, if well-designed and carefully conducted, they may provide valuable insights for the field. We hope this review and synthesis will facilitate such methodological action by providing a concise reference to lessons learned and a guide to solutions and procedures employed.

SELECTION STRATEGIES

Items selected for inclusion had to appear in the literature during the period 1968 through 1979. Only items considered to have direct relevance to industrial arts were reviewed. The major search targets were the ERIC data base and the ACIATE/NAITTE *Summaries of Studies in Industrial Arts, Trade and Industrial, and Technical Education* (annually), compiled so faithfully for the profession by David Jelden of the University of Northern Colorado.[1] The latter was manually searched; through the support of the ERIC Clearinghouse on Adult, Career, and Vocational Education, the ERIC base was systematically computer searched. Supplementary articles and research reports were identified by a scan of the AIAA and AVA's publication lists, ACIATE Yearbook lists, and the ACIATE and ACIAS monograph titles.

The initial scan of the literature sought to identify items with the key words "industrial arts" or "industrial education" in the title. Since this rather artificial restriction limited the result, the selection process was expanded to include entries containing these key words in the abstract. Since even this expanded review failed to encompass all documents of significance, the reviewers selected a limited number of additional studies that had significant implications and/or which drew conclusions of direct importance to industrial arts education. Because the field encompasses several divergent points of view, it is recognized that not everyone may agree with the selection. They should note, however, that an attempt was made to include documents representative of major points of view specifically relevant to industrial arts education, whether they used that term or not. While it is recognized that this "closed system" notion of industrial arts is inappropriate to the true scope of academic endeavor, for purposes of achieving closure in some reasonable period, it was necessary to impose such delimitations.

1. For a description of this resource, see Jelden, *Journal of Industrial Teacher Education*, 11 (Fall, 1973): 92-95.

The reviewers also experienced considerable difficulty in attempting to delineate between research and non-research publications. Research in industrial education should be expected to exhibit the characteristics of disciplined inquiry. The reports should provide evidence of the existence of an appropriate data base. Analytical, historical, and descriptive studies were included for they demonstrated a reasonable scope of inquiry, utilized generally accepted methodologies, and provided some expectation that the results might be generalizable. Studies which relied on a theoretical framework as the base for further inquiry also were included, as were experimental and predictive studies.

Unfortunately, not all relevant studies that could be included were cited. Which studies should have been added is, of course, a matter of judgment. It is hoped that those whose studies were omitted will excuse our oversight and/or judgment and that those who would prefer to see their studies interpreted differently will accept our apologies in advance. The reviewers made a conscious effort to provide a broad-scale review contrasted to a more in-depth treatment of fewer studies. In attempting this challenge, considerable subjectivity was required. Because of this, we recognize that alternative interpretations are possible. Readers, therefore, are encouraged to consult the sources and form their own opinions regarding the implications of any finding. Since the review's overall structure reflected similar subjectivity, readers also are encouraged to review all subsections of relevance to their topic of interest. In this way reader-author differences in organization will be less of a problem.

In the interest of future review and synthesis efforts, researchers, administrators, curriculum developers, teachers, and students are encouraged to submit their products to the ERIC system. As documents are entered in the system, they become readily available through computerized retrieval systems.

The authors wish to express their gratitude to Dr. Robert E. Taylor, Director of the National Center for Research in Vocational Education. Additionally, both the University of Missouri-Columbia and Texas A & M University deserve recognition for their support. The efforts of the industrial education secretarial staffs of both institutions particularly deserve commendation.

HISTORY, PHILOSOPHY, AND OBJECTIVES

This section reviews studies which deal with the philosophical bases of industrial arts and which examine its historical development. Studies dealing with the evolution of objectives also are included. These foundational areas focus attention upon basic issues of purpose and goals.

HISTORY OF INDUSTRIAL ARTS

Invariably, all fields sooner or later document their evolution. Perhaps because industrial arts is a relative "youngster" only a small number of historical studies were found. The classic works of Bennett (1926, 1937) and Barlow (1967) have been examined by students of the profession. Undoubtedly Sredl's (1966a, b, c, d, 1967) multi-part article also has been reviewed. But have the others? While it seems that no major comprehensive historical work has appeared during the decade under consideration, a number of valuable descriptive works have appeared. The contributions of Johann Gottlieb Heusinger, in terms of their effects on Dewey and Bonser, have been documented by Luetkemeyer and Vogel (1978). Similarly, Luetkemeyer and McPherson (1975) charted the contributions of Frederick Gorden Bonser and Wirth (1972) provided an interesting contrast of John Dewey's perspectives versus those of the social efficiency philosophers. Another example is Bzowski's (1969) analysis of the influence of kindergarten, manual training, art education, and the arts and crafts thrusts on manual arts education. In addition, he investigated the influences of educational psychology on the pedagogy of the day and explored the transition from manual arts to industrial education. His characterization of the evolutionary environment of that time as mutually cooperative -- until the industrial education movement emerged -- might hold a lesson for all of us. Herschback (1976) and McPherson (1976) also have traced the development of the profession and some of the current problems that beset it.

Hostetter's chapter in the Thrower and Weber, (1974) treatment of industrial arts in the elementary schools provided the profession with a set of historical reflections on elementary school industrial arts that illustrates the importance of

retrospective analysis. Similarly, many of today's debates may be found in Bleeke's (1968) documentation of the development of the Project Method as "an identifiable entity" in American education. He gave particular attention to the role of Kilpatrick in the infusion of this methodology. The work of Kilpatrick and his followers is credited with establishing the method with such strength that it remained in the activity curriculum despite subsequent disenchantment with progressive education. One can note in Bleeke's review the forerunners of the relevance, experiential, and activity movements. With similar continuity in an extensive review of the development of industrial arts in the intermediate school, Allen felt that practitioners were frequently unable to fully understand and implement the basic objectives in their intermediate school courses, particularly as they pertained to the role of junior high school industrial arts in career education.

Martin (1979) assembled a cogent treatment of historical and philosophical issues. His ACIATE Yearbook contained relevant chapters on industrial arts' precursor movements and the evolution of elementary school industrial arts. Also included were reviews of industrial arts' relationships to general and vocational education, both crucial aspects of our profession's future.

The basic purposes of black vocational, technical, and industrial arts education were presented by Hall (1974), who also chronicled its evolution. A more restrictive treatment of black industrial arts history was documented by Cobbins, Jr. (1975). Although formally restricted to Mississippi, this investigation yielded stages of industrial development that probably had similar implications for black industrial education elsewhere. These stages -- slave, reconstruction, regression, emerging, and transitional eras -- depicted a gradually increasing presence (except during the regression era) of industrial education opportunities until 1965. At that time, due to state initiatives to dissolve segregation, the trace-ability of black industrial education as a distinct entity became difficult.

Another historical study with relatively stringent scope was Stuart's (1968) documentation of the evolution of industrial arts and vocational education in Texas. He observed that unless the trend towards more specialized courses reverses, industrial arts cannot justify its claim of being a part of general education. On a national front and as one possible solution, Bensen (1977) attempted to organize the spectrum of innovative industrial arts curricula that, in part, sought

to address the overspecialization referred to by Stuart.

The historical studies reviewed contained detailed analyses of individual contributions to the profession, e.g., as those by William Everett Warner. Latimer, (1974) presented a detailed, and sometimes personally interpretive, account of Warner's contributions. Latimer recognized the contribution Warner made to the philosophy of industrial arts, to industrial arts curriculum, and to the development of industrial arts laboratory organizational patterns. Warner's involvement in the founding of Epsilon Pi Tau and in international curriculum efforts also were explored.

HISTORY OF TECHNOLOGY

Sheffield (1969) reviewed the historical development of basic hand tools used in industrial arts. Each of the major tool groups was studied from its origin, with attention given to the utilization of materials in the construction of the tool, the sequence of improvements as the tool was developed, and the relationship of the specific to the general tool development processes. Three phases were identified, i.e., utilization, fashioning, and standardization. The role of these processes in advancing technological development was explored. Distinctions were made between tools which were developed during and after the industrial revolution and those which evolved gradually during the preceding years. A more comprehensive treatment of the historical perspective of industry is presented by Luetkemeyer (1968). This ACIATE Yearbook provided treatments of people's relationship to technology, the evolution of technology, the role of capitalism, management, labor, and automation and cybernetics.

A different perspective on our industrial heritage is found in the Mississippi Valley Conference's 1974 debate on the third revolution in work. Here Wiens described the concept and Bjorkquist and Kagy examined its implications in terms of work values. While at first glance such issues may seem far afield from the rather pragmatic nature of industrial arts, when the reader considers the profession's focus on technological literacy and technology's impact on work, the issues examined certainly draw closer to the mainstream of our profession.

HISTORICAL STUDIES IN RETROSPECT

It should not be surprising that these studies do not by themselves yield a coherent view of the development of the profession. Despite this fact, the body of literature for the period covered does seem to reflect improvements in methodology. However, there is still need for historical research dealing with major problem areas in industrial arts. As problems are carefully selected and delimited, rigorous investigation could yield valuable suggestions for future actions. It is unfortunate that the field of industrial arts education seems too small to encourage the development of frequent, full-fledged historical reviews. For this reason, it seems imperative that the profession maintain its archives with care. Future scholars will need access to many source documents. The profession is still in its infancy. As it matures, increased interest will be placed upon the contributions of individuals and groups during these formative years. Some of this work has already begun, however, much remains to be done.

PHILOSOPHICAL FOUNDATIONS

It is fitting to begin this section by citing the work of Brown (1977). In this first monograph of the AIAA's Academy of Fellows series, Brown introspectively developed the foundation of a model containing the components of its identification process, subject matter, instructional methodology, and implementation. Another, and even more personal, view of the salient aspects of industrial arts is found in Micheels' (1978) monograph, the second in the series.

Philosophical studies ranged from the relatively basic to the specifically applied. Koble (1970) provided a terse, yet useful, description of the foundations of the industrial arts. Swanson (1976) advocated concern with accelerating technological advance, social problems and the reappraisal of personal values in outlining purposes for industrial arts. He recommended that industrial arts be involved in the study of industry, career education, and areas of technological responsibility. He suggested that industrial arts is a key element in understanding and solving technological and social problems.

Similarly, Bell and others (1976) attempted to assess the processes by which individuals adapt to technological change. This multidisciplinary research has impact upon industrial arts as perceived by those who support Swanson's ideas. As a result of the analysis, Bell and his colleagues developed a model of adaptation to technological change. This concept offers significant potential for reorganizing approaches to industrial arts education.

Technology, environment, career, and vocational education all figure prominently here. The concept of technology as a new theoretical base for industrial arts has been exhaustively treated by Kasprzyk (1973). After a somewhat critical analysis of earlier versions of technology-based industrial arts (e.g., Warner's) Kasprzyk set out to clarify the meaning of technology and outline a scheme for identifying and structuring the essential elements of technology in any given realm of work. He reasoned that industrial arts should study scientific and technological subject matter from the field of engineering. While the judgment of the success of this venture will be left to the readers, this document represented one of the milestones that serious scholars will want to review. Lauda (1976) also expressed the opinion that technology should serve as the basis for industrial arts education programs. His argument is based upon the permeation of technology throughout contemporary society and the ability of industrial arts to assist individuals in dealing with the complexities of the technological society. Earlier, Lauda (in *Technology, Values, and Education*, 1971) provided background useful in understanding the technology thrust in industrial arts.

Essential variations on this theme also are addressed by Kranzberg (1972), Pinder and Ritz (1977), Blankenbaker and Miller (1970), Lux (1977) and by the California State Colleges (1970). The most fundamental and far-reaching assemblies of the argument are found in Kranzberg's analysis of technology's implications for industrial arts and in Lux's statement. Pinder and Ritz, and Blankenbaker and Miller supported the rationale by providing somewhat more application-oriented items. The former do so by detailing the implications of the production aspect of technology; the latter do so by virtue of their annotated bibliography on the interpretation of industry.

The topic of building an industry-education partnership escalated in significance to become a topic in a series of forums that addressed the relationships of man, society, and technology. Supported by EPDA funds, this project resulted in a major report (AIAA, 1972) that included the

perspectives of industry, the profession, and some carefully selected scholars. Contained in the report are many of the technology's major tenets (e.g., technological literacy), although in terms that may be more obtuse than desired by practitioners. (The September/October issue of *Man/Society/Technology* [AIAA, 1972] also is directly related to this.) Perhaps th most practical manifestation of this is embodied in the California State College treatment of it. Their proposed policy and recommendations realistically grapple with key issues, at least at the four-year college level. At the secondary level, Stadt (1969) provided a detailed written description of one possible implementation of this; he named it "Man and Technology."

Another approach to dealing with the implications of technological society is contained in the conference proceedings edited by Devore and Smith (1970). Considerably more provocative than the California document, this conference used a human resources perspective to direct its attempt at identifying how "educational institutions become part of the solution rather than part of the problem of technological society", (page iii). Besides the cogent expositions of relationships among technology, social purpose, education, and change, the proceedings included important analyses of the role of values and the future of Man.

Both Hoots (in Thrower & Weber, 1974) and Miller (1976) examined philosophies related to elementary school programs. Miller identified five philosophical groupings in elementary industrial arts: developing habits, attitudes, abilities, and interests; meeting the developmental needs of children; producing useful objects; serving as a vehicle for occupational awareness; and enriching the elementary curriculum. Each position was seen as contemporary and tenable; each offered a specific dimension to the elementary industrial arts program.

Parker (1972) identified written philosophical expressions dealing with industrial arts. These were submitted to industrial arts teacher educators in order to identify the degree of concurrence between their opinions and those expressed in the literature. A general concensus was found; however, Parker felt that the groups studied were not necessarily in close correspondence with more contemporary philosophical positions in industrial arts.

EMERGING FRONTS

Ray (1978) evolved a cogent rationale for a practical arts experience for intermediate level students. Envisioned as involving the integration of learning in agriculture, home and family living, health, industry, business, office, and distributive arenas, the careful procedures and documentation lend themselves to the author's self-avowed intent of serving as a vehicle for major restructuring of the formal and intended learning experiences of students.

The literature on recreation was reviewed by Tate (1970), who sought to identify the appropriate recreational purposes for industrial arts education. A set of guidelines was developed for industrial arts curriculum, methodology, media, facilities, and evaluation for meeting the recreational function in industrial arts education.

Acker (1971) reviewed the literature in order to clarify the nature of the consumer function of industrial arts education. His study indicated that industrial arts could provide a unique contribution to consumer education as a part of general education. Consumer studies in industrial arts were recommended in such areas as economic planning, expenditure standards, information about consumer goods, and maintenance guidelines. He indicated that industrial arts needs to coordinate its involvement with other subjects.

Open education was considered by Donald (1974) to have implications for industrial arts. He presented the historical background of this movement and related it to learners, facilitators, and environments by formulating the methods' implications for industrial arts. In doing so, he drew extensively from Piaget. Industrial arts in the open access curriculum also is systematically explored in Anderson's (1978) ACIATE Yearbook.

Several other emerging thrusts have been studied. Environmental education was found by Bame (1973) to receive little emphasis, particularly as it related to the technology-environment interface. His jury concluded that these objectives should receive major emphasis. In this same year, the AIAA's (1973) Environmental Education Committee issued a booklet that in essence, implemented Bame's recommendation for a rationale to guide infusion of this thrust into the practice of the profession.

Career, industrial arts, and vocational education were considered by Smith (1974), who reported that they did not differ in meaning, that is, by career education and industrial arts/vocational education practitioners. A more pervasive overview was embodied in Cunico's (1974) Delphi study of the future of industrial education. In an attempt to systematically and specifically identify which emerging thrusts will shape the future, Cunico's Delphi panel of twenty-four leaders determined that industrial education must provide experiences needed to allow students to become a part of the complex industrial and technological society in which they find themselves. This is surely a challenging, if not, a definitely helpful, conclusion. However, reasonable optimism is appropriate in that he also found that his sample group of industrial education teachers, supervisors, and administrators concurred with the Delphi panel as to future goals, objectives, and orientation of industrial education. From this, the profession might optimistically conclude that a greater degree of convergence is possible in the future than has been the case in the past.

Cunico's forecasting efforts were paralleled by Starkweather (1976) and Pautler (1978). Starkweather, using a Delphi process, identified a host of potential futures for industrial arts that deserve the attention of planners. Pautler, on the other hand, used a more introspective approach in interpreting presentations delivered at the Bicentennial Conference on Vocational Education in terms of their implications for industrial arts.

A whole new emerging thrust -- the one that is probably the most significant in terms of actual impact on the practice and the future of industrial arts -- is centered on the vocational contributions that industrial arts can make. Specifically, the considered opinion of key professional leaders resulted in the inclusion of industrial arts as an activity fundable by federal vocational education money. An historical perspective of this thrust was presented by both Good (1975) and Householder (1970). The mechanics of such possibilities are described by Good and Steeb (1977). However, the implications of such legislative permutations are not clearly treated anywhere. As early as 1969, clear assualts were being made on industrial arts objectives in favor of occupational development ones (Pratzner, 1969). These authors were not able to surface any study that pursued the implications of this recent and most significant legislative change in terms of its effect on recasting the objectives, or their emphasis, toward vocational education. While a broad scale evaluation of such impacts was not evidenced, it seems that this thrust and its antecedents did

generate a series of studies that sought to clarify the industrial arts-vocational education relationship. Lathrop and Farr (1968) and Colorado State University (1976) each conducted this kind of investigation. In essence, both reaffirmed the multifaceted role of industrial arts in terms of its contributions to general education, career education, and vocational-technical education. The 1969 dialogue among Venn, Carrell, Olson, and Woodward represented another treatment of the industrial arts-vocational education relationship.

Career education, as another new thrust, also was well-documented in the literature. Some of the basic philosophical concerns regarding the industrial arts career education interface were dealt with in Kagy and Lockette (1972), AVA (1971), AIAA (1971-1973a, f), and Edwards (1974). The first three sources represented compilations that evolved from the assumption that the career education thrust is inherently positive and that industrial arts' own goal attainment is enhanced by active participation in career education. The AVA and Kagy documents were the outgrowth of systematic, professional, and consensus-seeking activities they genuinely outlined the key industrial arts/career education relationships as well as useful implementation guidelines. The careful nationwide effort that went into these reports merits their special value. The AIAA document contrasted the preceeding approach by presenting a set of individual views as contained in three years of *Man/Society/Technology*.

In sharp contrast to the preceding positive views, only rarely do the adverse effects of career education surface in the literature. Edwards (1974) pointed out the possible misuses of and problems with career education, e.g., the emphasis of continuing the present corporate order, the increased confusion generated by yet another term, the lack of definition, and the apparent anti-intellectualism of the program.

In a position paper that reviewed the career education, vocational education, and avocational potentials of industrial arts, Dyrenfurth (1978) extended the range of industrial arts to the postsecondary, adult arena. The review, together with its subsequent objective-program-population matrix, attempted to detail a new projection for industrial arts.

The nation's recent awareness of human resource development imperatives, such as those embodied in the Comprehensive Employment and Training Act, also is relevant. While no

industrial arts research directly treated this topic, the reviewers' perception of the worth of our profession was considerably enhanced by the profession's early treatment of the concept of work. Lauda (1970), DeVore (1970), and Kabakjian (1970) all documented some of the concerns of the profession, as well as its human resource development potentials.

PHILOSOPHY IN RETROSPECT

Lerwick's (1977) efforts have provided a useful stepping stone to a more coherent future, at least in philosophical terms. His analytical approach to leadership models in education yielded the conclusion that there exists a considerable mismatch between these leadership models and their root philosophies, particularly in their ethical and moral aspects. Lerwick called for the recognition of this problem and the focus of a more systematic effort on solving it. Scholars versed in analytic philosophy will find this work an important perspective. Other students may simply wish to refer to Lerwick's subsequent descriptive treatment (1979) of vocational education according to each of the schools. Another contribution of Lerwick (1978) outlined his view of industrial education's position within today's force field. His historical review led him to conclude the existance of a serious decline in industrial education's philosophical conviction and initiative. Despite the apparent methodological precision exercised by this author, the reviewers were somewhat disappointed by the negativism implicit in his "Coho salmon" analogy, particularly since Lerwick committed the analytical philosopher's cardinal error by omitting definitions of key terms (in this case, industrial education). A terse example of what could have been was provided by Glazener (1970). Because other and more positive analyses exist, attention also should be paid to another and more specific focus of philosophy presented by Pierson (1974b).

FOUNDATIONS OF INDUSTRIAL ARTS: OBJECTIVES

It seems commonplace for regular AIAA conference attendees to experience at least two types of presenters; those who claim our profession has reached agreement on its fundamental goals and those who point out that convergence is not the case. Edmison (1973) represented one of the latter. He forcibly pointed out that a continuing problem of this field has been its inability to develop a generally acceptable definition, or statement of objectives, and to define a body of knowledge

from which its program should be drawn. Evidence of the depth of these issues may be found in the AIAA's special volume of *Man/Society/Technology* (1970) which described the National Forum of Industrial Arts.

Atkins (1974) attempted to make order out of disorder. His valuable contribution, because it transcended mere cataloging and tallying, identified more than 550 purposes and classified them into continuing, fluctuating, and newer categories. He found that the occupational, recreational, consumer, skill, industry understanding, personal-social growth, critical thinking, and exploration purposes had considerable durability; all had experienced varying degrees of emphasis. Van Dyke (1970) also identified commonalities in terms of what school personnel and community leaders thought should be the objectives of industrial arts for small high schools. His respondents agreed that industrial arts should be an aspect of the general education curriculum and that it should offer a broad introduction to many occupational areas of industry. Concerned with the elementary school level of industrial arts, Nichols and Young (1973) reported on an investigation with essentially similar purposes. Their article summarized the commonalities of objectives, content and method among leading elementary level industrial arts program directors. Particularly noteworthy in the light of considerable intuition to the contrary, they reported general agreement on the majority of their survey questions.

Another approach to seeking order and explanation is exemplified by a group of studies that compared the varying perspectives of teachers, administrators, and other school personnel. Burns (1975), Sucharski (1975), and Backus (1968) used this approach. Because it is frequently claimed that industrial arts teachers, principals, and counselors are thought not to understand industrial arts' objectives, Burns systematically tested this hypothesis. He concluded that the three groups did not perceive the priority of industrial arts objectives differently; in fact, he noted that there was a high degree of concensus but that instructors were more confident of their attainment than are principals and counselors. Mason's (1970) earlier study also found principals and counselors strongly agreeing with the objectives of industrial arts. The strong positive attitude of these groups was related to industrial arts as a part of general education. Principals and counselors in larger schools were more positive toward industrial arts than were professionals in smaller schools. Mason's finding are partly supported and partly contradicted by Mosely (1970).

Like Mason, Mosley found that Florida educators exhibited a high degree of agreement on the purposes of industrial arts as perceived by teachers and supervisors in the field. A Q-sort technique indicated that most participants emphasized traditional industrial arts concepts, such as skillful use of tools and materials in working on projects. However, the contradictory element was that counselors and industrial arts teachers did not agree on the importance of the various objectives identified for industrial arts.

Also contradicting the suggestions of similar perceptions of industrial arts are the findings of Russell (1970), Sucharski (1975), Backus (1968), and Ryerson (1978). Russell found that industrial arts teachers and high school principals differ substantially in their views toward industrial arts goals, purposes, content, and direction. The principals tended to feel that industrial arts should provide a broad exposure to the world of work, assist in the development of work habits and appropriate social attitudes. Industrial arts educators, on the other hand, rated technical knowledge, problem solving abilities, and an understanding of the American industry as important concepts. Sucharski also found that there was little agreement among industrial arts instructors when ranking goals. In his study, industrial arts teachers placed relatively low priority on goals pertaining to the relationship of industry and society and on the interdisciplinary functions of industrial arts. Comparatively, they placed the highest priorities on safety, skill, and problem solving goals. The divergence of opinion found by Sucharski essentially verified Backus' earlier findings regarding the perceptions of industrial arts objectives by superintendents, industrial arts coordinators, and industrial arts teachers. Backus identified considerable conflicts in priorities both within and between local districts. In addition, his results predicted Sucharski's finding of disparity between the thought of practitioners and that expressed in the professional literature with an essentially similar one. The fact that -- despite the seven years between these two studies -- the leadership/practitioner disparity continues seems grounds for serious professional attention. Another finding of Backus, namely that superintendent/teacher disagreement over the objectives of industrial arts increases with school system size, also should serve to indicate an important direction for professional action.

Ryerson summarized his study of the perceptions of industrial arts objectives with the observation of a shift from "lofty" to more "practical" objectives. However, because the writers of this paper were privileged to attend the presentation of

the survey's results, it is only fair to state that other attendees interpreted the findings differently. However, if the methodological limitations are kept in mind, Ryerson did present the views of industrial arts teachers, students, and the lay public in an interesting manner.

The effects of the varying interpretations of industrial arts served as stimulus for the projects of Nelsen (1975), Gill (1972), Jennings (1968), and Mattson (1974). The consistency between the implicit objectives of evaluation models and those of industrial arts teachers was investigated by the former. Nelsen concluded that it was apparent that industrial arts high school teachers' evaluation practices are not in agreement with the emphasis which they felt should be given to the five goals of industrial arts.

Gill reviewed industrial arts objectives for specific groups of students (1972). While most industrial arts teachers did not have preparation in special education or in dealing with students with special needs, their rating of objectives of industrial arts for mentally retarded students were closely correlated to the ratings provided by special education teachers. Differences existed between the relative emphasis placed upon objectives of industrial arts when the program was considered to be for average students and that assigned when it was intended to serve students with special needs. However, ratings given by teachers appeared to be related to the difficulty they experienced in teaching students with special needs.

Mattson's study compared the achievement of basic industrial arts objectives as affected by learning experiences in traditional industrial arts, Industrial Arts Curriculum Project (IACP) manufacturing and construction programs. While the results did not consistently support either program, he concluded that both innovative treatments allow students the same opportunity to attain the basic industrial arts objectives as does the traditional program. However, there were differences in the attainment of objectives beyond those in the basic core.

The previously mentioned leadership-practitioner gap also was documented by Jennings' (1968) analysis of the role of industrial arts in the achievement of economic objectives. In what might be a gloomy precursor to today's economic education thrust, the researcher found that teachers of lower socioeconomic class students perceived the role of industrial arts in the achievement of objectives of economic efficiency as less important than teachers of middle or upperclass students. Perhaps as serious as these teachers'

loss of faith in the power of education as a social change agent is the profession's internal inconsistency and, not surprisingly, varying perceptions of our nation's elected leadership.

A survey of legislators indicated that members of the 91st Congress did not agree with the commonly accepted objectives of industrial arts (McClellan, 1971). The misperceptions of the legislators seemed to indicate that they perceived quite a different type of industrial arts from that envisioned by the profession.

The disparity among the studies of the perceptions of teacher educators and administrators indicated the need for further clarification. Without more consistent results, it is not possible to generalize concerning the actual perception held by various populations. While some of the difficulty may be related to regional samples, the overall lack of generalizability is disappointing.

SUMMARY

Probably because our profession is still relatively young, historical studies are less common than in professions that are more established. However, the studies that exist seem relatively well-documented. They enable one to assemble an overview of the profession's evolution. Genuine historical studies with emphasis on original documents and/or first hand data are, of course, in the minority -- but then it may be that Bennet and Barlow have supplied us with what is needed in this regard. It seems to the writers that there is a gap in what exactly has been documented. Specifically, it seems that there is a host of "intermediate history" items that are neglected. Only recently have the AIAA and its various councils begun to show significant concern about the value of archives. The entire evolution of our profession at the state level appears to be haphazardly chronicled. To be sure, the effects of major events such as legislation and key philosophical and theoretical events have been charted, but the evolutionary aspects of the practice have not been. We are left with a nagging question as to where the history of genuine practice of the profession is being recorded. We would recommend systematic attention to the charting of the profession's "grass roots," to its process and product, and--most importantly--to the reasons for its actions.

The philosophical foundations have received considerably more attention than the historical studies. It is unfortunate, however, that the attention seems to be relatively minimal in terms of studies that investigated the relatively pure aspects of epistomology, metaphysics, ethics, and axiology. At least the writers were unable to identify any significant number of studies that involved the use of formal logic as applied to these realms and their subsequent extensions to industrial arts. Rather, the existing philosophical studies appeared to be *post hoc* in nature in that they seem to be an attempt to use philosophy to support pre-existing ideas. A formalized process of inductive or deductive reasoning to establish from a "blank slate" the implications of philosophy were not existent.

Furthermore, in a profession that has been influenced mainly by individuals identified with certain key concepts (i.e., the Maley Plan, the Ziel Plan, etc.), systematic philosophical investigations of the impact of an individual's contributions and/or the evolution of that person's ideas also are strangely lacking. The closest facsimile to such documents was provided

by Bohnet et al. (1970). Nevertheless, it clearly did not meet the preceding call, nor was it in fact so intended. Of the various professional thrusts that do exist, the one concerned with technology is most carefully described. Interestingly, this thrust seems to us to be furthest from actual practice. Yet, of the various issues, its treatment seems to be disproportionately extensive. One must wonder whether the issue itself is inherently more philosophical in nature, whether it is the most important issue faced by the profession, or whether a sense of professional opportunism prevails.

The latter, in fact, may be evidenced by the fact that this section identified a series of explorations on a variety of emerging fronts. Environmental education, open education, futurism, and the like have been explored in terms of their implications for our profession. Perhaps this is as it should be. Until a careful examination is conducted, one cannot distinguish between fad and genuine concept. Certainly it would appear that the initial investigations of such concepts are legitimate academic endeavors that the profession needs to encourage. Parenthetically, it seems reasonable to note that there have been more fads in the larger field of education than in industrial arts.

Another well-documented thrust is the one dealing with futurism. Educational futurism -- the concern for what the future will hold, the projection of a variety of scenarios, and the delineation of the implications of such scenarios -- has received considerable attention. An increasing number of practitioners seemingly feel that such studies are useful. However, we are a little concerned because it may be that, like the philosophical studies conducted to *prove* a point, the futurist studies may be conducted for a similar purpose. Additionally, there is some concern as to whether our profession is capable of handling such studies. We are reminded of the insight of Rupert Evans to the effect that he does not perceive himself as *omnipotent* enough to be a futurist.

Omnipotence would undoubtedly be a useful characteristic of new researchers in the area of industrial arts objectives. This segment of the profession seems to be somewhat in a disarray; the confusion might even be appropriate. We recommend that nationwide studies be conducted, particularly ones that are carefully stratified in terms of urban and rural dimensions and various levels of education. Our profession's relative values on the cognitive-affective and psychomotor domains remains uncharted, even though global parameters have been addressed. As might be expected of other disciplines, but

which is somewhat surprising for industrial arts, the psychomotor domain curiously has been neglected in terms of studies dealing with actual specification of objectives. It also would be safe to observe that affective educational objectives of industrial arts could merit increased attention. Besides those who point the way toward new technical content and process, those who would have the profession concentrate on goals other than cognitive and psychomotor also are evident. Sucharski (1975) is one who clearly called for attention to affective domains, particularly in teacher education programs.

In short, the studies dealing with industrial arts objectives leave the profession's general education claim in considerable jeopardy. This central tenet has in no way received the support commensurate with its importance to our rationale. Clearly it presents an important area open for research.

HUMAN RESOURCES RELATED STUDIES

The identification of only a small number of studies in this area undoubtedly reflects a combination of the effects of a search strategy that emphasized industrial arts and the profession's relatively recent acceptance of its role as an integral component of a comprehensive human resources delivery system. Of the studies identified, most focused on the infusion of minorities and sex equity. Others addressed an industrial survey to determine human resource needs and an exposition of the contributions that industrial arts makes to America's population.

EQUITY

Two studies (Spence, 1976; Bakamis, 1977) pursued data descriptive of the composition of college and university faculty involved in industrial teacher education. While both used the *Industrial Teacher Education Directory* (Dennis, annually), jointly published by Goodheart-Wilcox, the American Council on Industrial Arts Teacher Education, and the National Association of Industrial and Technical Teacher Educators to identify the basic institutional population, Spence augmented his sample with engineering technology institutions. [NOTE: While technically not a research study in terms of our criteria, this document deserves special mention. It has served as a population and sampling tool in many studies. Additionally, its dedicated compilers, presently Ervin Dennis and formerly Gus Wall, included a brief annual analysis of some key characteristics of the teacher education profession. A detailed ten year longitudinal analysis of these characteristics by Dyrenfurth (1977) is described elsewhere in this section.]

Reporting by percent of faculty, our teacher education profession was found by Spence to be comprised of whites, non-Hispanic (90.8 percent); blacks, non-Hispanic (5.2 percent); Asian/Pacific Islanders (1.8 percent); Hispanics (1.4 percent); Native Americans and Alaskan natives (0.4 percent); and nonresident aliens (0.4 percent). Similar data were presented by Bakamis in his summary of institutions. The latter, however, indicated an equal percentage of institutions with black and

oriental faculty (16 percent). According to Bakamis, 81 percent of the institutions indicated a total absence of female faculty in industrial education programs. In terms of absolute numbers, Spence's findings were that there were 217 females employed, 9.4 percent of the industrial education teacher education profession. Both Spence and Bakamis concurred that there was a significant disparity between population and profession profiles in terms of both racial and gender composition. Both called for additional research on infusion strategies and longitudinal monitoring of progress.

A study of women teaching and preparing to teach in secondary school industrial arts was conducted by Baron (1974) who sampled the population of female industrial arts teachers and teachers in training to determine personal characteristics, educational backgrounds, professional responsibilities, problems, and opinions. His results indicated that while females are majoring and teaching in all technical areas of industrial arts -- as Aagaard (1975) also disclosed -- most of those presently teaching did not major in industrial arts. Baron also called for effort on the part of colleges to address themselves to infusion strategies for women. One such strategy, albeit within a larger perspective of nontraditional vocational programs, was developed by Kane et al. (1976). Their model pertained to both industrial arts and trade and industrial teacher targets. Probably due to the fact that this project represented noneducational system research, it contained data sources and insights that are worthy of further investigation. Retraining of women industrial arts graduates and skilled women with work experience were posited as two viable entry mechanisms into the practice of industrial art teaching.

The difficulty of the task of inducing a significantly greater proportion of females to participate in industrial arts is abundantly clear. These difficulties apply equally to participation as K-12 students, as instructors of these students, or even as teacher educators of these instructors. A valuable historical retrospective on these difficulties was provided by Richter (1971). Unfortunately, while the article is [illegible] in explaining some of the reasons behind the current situation, Richter did not provide much cause for optimism in terms of the development of a more equitable state of affairs.

RECRUITMENT

With today's affirmative action programs, invariably the issue of professional choice and recruitment arises. Baron, as well as Aagaard (1975), investigated these issues. Both concluded that much of the resistance to women becoming industrial arts teachers is found within the profession itself. Aagaard noted that many women felt school administrative hierarchies, teachers, *and* students were prejudiced in regard to female presence and abilities. If this conclusion is correct, Baron's earlier point that teacher preparatory institutions need to be more supportive of female participation in our profession is appropriate and needs to be broadened to include the public school system. In terms of the factors actually influencing female choice of industrial arts, Baron identified the traits of liking to work with one's hands and with children as the most important determinants. Testing indicated that these factors were the same for female practitioners as well as college students.

Recruitment techniques involving radio and television announcements were ranked most effective by Aagaard's sample; parents and relatives together with faculty were most influential in terms of personal advice. He concluded that there was a relationship between the quantity of recruitment information and its relative influence. Accordingly, he recommended provision of more recruitment information to parents, guardians, and relatives.

HUMAN RESOURCE AND INDUSTRY NEEDS

Envick (1970) surveyed plastic converters and processors in order to identify both the criteria for use in developing plastics education programs as well as the industry's perceptions of the importance of such an education. The variability of responses led to the conclusions that the relative importance of a process needs to be determined by processors specifically concerned with it as well as by the overall industry. With respect to his second objective, Envick found that while respondents indicated the importance of industrial education courses, they attributed slightly higher values to general education courses. However, the industry also pointed out the difficulty in finding "pre-trained" employees and indicates that plastics education would generate substantially better employment opportunity.

SUMMARY

In sharp contrast to other authors who merely exhort their readers to become aware of industrial arts' contributions to the nation's human resource pool, Maley (1979) carefully delineated the areas of contribution. He systematically documented the profession's contributions to citizenship, industry, leisure, and consumer skills. Particularly noteworthy is the presentation of evidence and rationale in support of the claims.

Hopefully the next review and synthesis will show an increased recognition of the importance of the nation's human resource and delivery system. Such evidence hopefully will be reflected in an increasing number of studies devoted to examination of industrial arts' role as a component of this overall system. As is obvious by the shortness of this section, few such studies exist now. Those that do deal largely with equity concerns do so at a surface level. It may be that this is the result of the relatively new emergence of these concerns or it may be that as a profession we are too inwardly focused. Perhaps we consider ourselves separate from contributions to the nation's human resource delivery system. Certainly we found little evidence of systematic data analysis of the inflow of our graduates into society. Nor were industry's needs carefully charted. On an empirical basis, the needs of society and industry were strangely absent. It seems that some methodologically supportable research is needed to document the impact of industrial arts in terms of our human resources. It would appear, too, that it is time for studies that transcend the intuitive, exhortation, and reasoning approach used in the philosophically-oriented studies. A move to a more factually and/or demonstrable end of the continuum seems desirable at this time.

Additional needed human resource studies are those concerned with the supply and demand. In his initial treatment of this subject, Dyrenfurth (1977) presented a useful longitudinal analysis of eight years of teacher education supply. The present avowed shortage of industrial arts teachers was foreshadowed by his observation that the portion of teacher education represented by industrial arts declined from 68 percent to 49 percent (of the total industrial education effort). Still, there are many facets to be developed. The demand side of the equation seems particularly appropriate for future research such as that provided by Smith (1979) and earlier by Zook (1976). This report of the AIAA's Recruitment

Committee documented industrial arts teacher supply shortages, as evidenced by placement director and state industrial arts supervisor impressions: 19 states reported rural needs. An earlier, but related article, by Ohanneson (1975) provided comparable information regarding the identification, preparation, and deployment of career education teachers.

EDUCATIONAL PROGRAMS

Numerous projects pertaining to the programmatic aspects of industrial arts were cited in the literature. They included a set of documents related to special needs populations, status studies, and programs in other countries.

SPECIAL NEEDS

While earlier and more definitive treatments of this topic are found in Buffer (1973), in Dugger's (1977) summary of the participation of special need students in industrial arts, and Gallington (1970), we have included some relevant special needs studies for purposes of context. Beyond the few listed in this section, other special needs documents will be found throughout this review as they relate to other areas.

Industrial arts activities for the educable mentally retarded were investigated by Wentz (1969). He produced a guide of suggested junior high school activities, tools, equipment, and discussion topics. Additionally, during 1968-1969, he surveyed 146 industrial arts and special education teachers to determine whether a difference existed in terms of the types of programs that were being implemented. The null hypothesis was not able to be rejected on the strength of his data.

The similarity between practices employed by specialists of different backgrounds also was identified by Baugrud (1968) in a study of industrial education for the visually limited. Both industrial education teachers and education specialists for the blind generally concurred on the approaches that could be used and those considered most important in serving visually impaired students. Baugrud concluded that the professional preparation of industrial education teachers is inadequate in terms of special preparation for the education of the visually impaired. A related study by Black (1970) surveyed businesses and industries in Iowa regarding hiring policies related to the blind. As might be expected from his use of self-reporting techniques, favorable interpretations resulted. Black concluded, however that this was only "lip service." Another finding with perhaps more direct implication is that, despite the fact that the majority of clients indicated industrial arts programs gave them self-confidence,

one-half of the respondents stated that the primary reason for taking industrial arts was because it was required.

Correctional education was another extension of industrial arts and one that seemed to have potential, according to Nielson (1970). His survey of the California Juvenile Detention Program found that the therapeutic objectives of industrial arts were deemed most important. Additionally, some of the confusion reported in a preceding section dealing with industrial arts' objectives resurfaced in his findings. He reported that respondents from small correctional facilities tended to interpret industrial arts to be vocational in nature. Further evidence of the versatility of industrial arts in serving students with special needs may be found in Shenck's et al. (1968) description of industrial arts' contribution to Upward Bound.

STATUS STUDIES: GENERAL

One version of status studies is represented by the ACIATE's three yearbook series by Thrower and Weber (1974), Lockette (1973), and Householder (1972a). The approach in these yearbooks is to commission a cadre of experienced leaders to prepare a synthesis of practice and to envision the future. The yearbooks constituted legitimate status studies. They also qualify as research. Each addresses the relevant aspects of the role of industrial arts, the learner at various life stages, desirable program characteristics and content, and faculty characteristics and capabilities.

The establishment of a benchmark, such as the one provided by Schmitt and Pelley (1966) against which to measure growth, change, progress, and achievement, often is a given rationale for status studies. At other times, such studies serve to provide a background context and, ostensibly, a documentation for the author's primary cause. Both of these legitimate purposes were addressed by Underhill's (1968) determination of the status of and need for industrial arts instruction in the United States Seventh Day Adventist schools. His conclusion that an expansion of such industrial arts programs was warranted was supported by findings that showed the attitudes of Seventh Day Adventist educators to be favorable to industrial arts and that the enrolled students exhibited an "average" interest in industrial arts.

Pinelli and West (1973) reported the findings of another national survey, one that focused on the status of elementary school industrial arts. While they concluded that it was difficult to speak to the expansion of such

programs, they did identify commonalities such as the dependence on federal funds, the combination use of classroom teachers and industrial arts specialists, and the preference for self-contained classrooms and laboratories.

Both Bailey (1968) and Leith (1973) conducted more global studies than Underhill. The former's survey of changes from 1957 to 1967 in curriculum and organization of junior high school instruction disclosed that despite teacher shortages in some regions, art, home economics, and industrial arts maintained their place in the curriculum. The occupational aspects of this "place" served as the focus for his 50-state survey. While this 1971 to 1973 project identified thirty-four states with course offerings designated as career or occupational education, the majority reported such offerings in less than 20 percent of the schools. The data did not evidence the replacement of pre-existing courses with the "new" offerings. Leith also presented data detailing the status of teacher education, pilot programs, funding sources, and evaluation procedures. Significantly, he found that besides an increase in the overall incidence of career education, the vast majority of schools used existing vehicles to provide such education. The most frequently mentioned were agriculture, business education, home economics, and industrial arts. An insightful conclusion was his observation of the need for carefully coordinated effort among all disciplines.

In addressing the issue of "how well are we doing our job," Walker (1977) interpreted the effects of declining school enrollments on industrial arts. Perhaps ominously, he alerted teachers to impending faculty evaluation systems and similar causes of concern. Similarly, Wilkinson (1972) developed a procedure for describing a large urban (Philadelphia) system's industrial arts component for purposes of monitoring program quality. The trial application of the process resulted in the conclusions that improvements were needed in all areas: the preparation and continuing professional development of teachers, the organization, and the content of the industrial arts program, and the equipment and facilities employed.

Another facet of industrial arts was investigated by Mayfield (1970) in a survey pertaining to the educational contributions of industrial arts student clubs. His 1,031-member sample of sponsors, principals, and supervisors indicated that such club activities encouraged student interest and achievement and that curriculum development resulted in better programs and improved student-teacher-administration-community relations. Most significantly, contributions to general education goals also were identified by the respondents, as was the somewhat

surprising -- yet positive -- finding that administrators exhibited more favorable attitudes than teachers and students suspected.

A national random sample of high schools served as the initial respondents for Jensen's (1968) survey of concurrent work education (CWE) for handicapped students. While 44 percent of the schools reported no CWE, the remainder offered CWE for handicapped, work study, reimbursed CWE, and non-reimbursed CWE in order of increasing frequency. Of particular significance is Jensen's recommendation that exploratory CWE, industrial arts, and vocational guidance be assimilated into the structure of vocational education as essential prevocational services for effective vocational education. Additionally, his identification of California's exploratory, general, and vocational CWE as a national model and his suggestion of an integrated diagnostic, prevocational, work experience, job placement, and follow-up program represent useful guidelines for the future.

Biewald (1969) provided data pertaining to the national population of students in technical drawing. His estimates, based on a national sample, are that technical drawing involved grades to the following extent: 10 percent, ninth grade; 23 percent, tenth grade; 30 percent, eleventh grade; and 37 percent, twelfth grade. Females comprised only 2 percent of his population.

The preceding emphases are clearly in K-12 implementations of industrial arts. The reader should not infer that status studies pertaining to teacher education are absent. While the bulk of them are incorporated into the teacher education section of this paper, some mention of such studies is appropriate here. The most comprehensive is by Chaplin (note both reports, ED 069 886, 1972 and ED 099 651, 1974) relating to industrial arts teacher education programs. Incorporating the sanction of the ACIATE, NAITTE, and the Industrial Arts Division of the AVA, Chaplin let the efforts of a committee that painstakingly detailed a picture of our profession's industrial arts teacher education profile in terms of administration and finance, faculty and assignments, degree patterns, departmental changes, articulation with other units, facilities and equipment, course offerings, and services available. Bakamis' (1970) status report of teacher educator professional and economic characteristics served as a useful precursor to the preceding.

Related, but more unidimensional in focus, teacher education status studies were conducted by Coleman (1971) and Baker (1970). The former identified the status of wood instruction

in industrial arts teacher education. The latter focussed on content related to automation and cybernetics.

Finally, this section on the status of our profession could not be complete without mention of the ACIATE's annual yearbooks. While this series does not represent the typical survey-generated status study methodology, they constitute an important parallel to such approaches. In them, the profession's status is described by the analyzer, conceptualizer, and dreamer. These books represent a significant milepost in the evolution of our profession and, as such, they qualify as status studies. Furthermore, the support of the McKnight Publishing Company in publishing these volumes is evidence of the health of our profession. Such support deserves our genuine gratitude, particularly in terms of what the documents generate. For the period included in this review, the topics addressed by the series included: *A Historical Perspective of Industry* (Luetkemeyer, 1968), *Industrial Technology Education* (Dean and Hauer, 1969), *Industrial Arts for Disadvantaged Youth* (Garlington, 1970), *Components of Teacher Education* (Ray and Streichler, 1971), *Industrial Arts for the Early Adolescent* (Householder, 1972a), *Industrial Arts in Senior High School* (Lockette, 1973), *Industrial Arts for the Elementary School* (Thrower and Weber, 1974), *A Guide to the Planning of Industrial Arts Facilities* (Moon, 1975), *Future Alternatives for Industrial Arts* (Smalley, 1976), *Competency Based Industrial Arts Teacher Education* (Brueckman and Brooks, 1977), *Industrial Arts in the Open Access Curriculum* (Anderson, 1978), and *Industrial Education: Retrospect, Prospect* (Martin, 1979).

Insofar as the condition of the profession is characterized by the ideas of its practitioners, one other series documents our status, namely, the AIAA annual conference proceedings. Available from the association (and in some cases from ERIC), these compilations depict a total view of the profession. (Note: The volumes are listed in the references under the name of the AIAA). Similarly, the American Vocational Association's conference proceedings, for the brief period that they were published, represent an equally valuable documentation of the pulse of the profession. The reader is directed to the Industrial Arts Division section of these proceedings. (Note: The proceedings are listed in the references under the name of the AVA)

STATUS STUDIES: STATE SPECIFIC

A host of dissertations established collections of basic descriptive statistics for individual states. These included: Pennsylvania (Kabakjian, 1969 and Dellinger, 1974), Tennessee (Ephraim, 1969), Washington (Edmison, 1973), Iowa (Teig, 1975), Arkansas (Crump, 1968), Idaho (Bird, 1973), Texas (Stuart, 1968; Richards, 1970), Hawaii (Grover, 1968), and Maryland (Wilson, 1969). Using a more comprehensive scope, namely, that of vocational education, the companion studies of Milam (1968) and M-Neil (1968) also provided useful documentation of the profession's status in Alabama, Arkansas, Louisiana, Mississippi, Florida, and South Carolina. There were many similarities in the items surveyed. For example, Grover, Kabakjian, Edmison, Bird, Richards, and Wilson included content and objective question areas. The last three researchers named investigated these as well as teacher credentials and facility characteristics. Among the aspects investigated were expenses incurred by industrial arts students and the amount of occupational information received (Kabakjian), inservice needs (Teig), teaching methods (Edmison and Kabakjian), and state supervisor services (Bird). A historical perspective was presented by Stuart.

In terms of research methodology, these studies broached no new frontiers. All employed conventional questionnaire procedures; some used juries. Perhaps the most innovative was Edmison's use of the Q-Sort technique. While all surveyed teachers, Bird and Richards also sampled principals. Edmison included teacher educators and supervisors/ coordinators; Ephraim also included the latter group.

The findings from such widely dispersed surveys showed remarkable similarities. Courses in general shop, woods, drafting, and metals all were reported as being the most prevalent offerings in reports by Kabakjian, Richards, Bird, and Edmison. Two statistics provided additional insight: Bird reported 26 percent in woods; Grover reported 53 percent in general shop at the 7th grade level. Kabakjian's random sample indicated an incidence of 98 percent responding schools offering woods; 90 percent metals; and 71 percent drawing. There were relatively few reports of industrial arts for the elementary grades (Bird); graphic arts, plastics, electricity-electronics, and energy and power (Bird); energy and power were also found to be offered infrequently (Kabakjian). The latter observed that

the size of schools positively affects the number and breadth of technical offerings. It also is interesting to note that Edmison's comparison of practice to innovative ideas, while not a status study, clearly showed that practitioner groups rated the more traditional industrial arts areas (woods, metals, drafting) more highly than they did the more innovative aspects of new curricular thrusts.

Enrollment in industrial arts is, of course, affected by the availability of opportunity. If these are restricted, as in Ephraim's survey (in Tennessee), a large portion of secondary students will not be able to take industrial arts. This is in contrast to the 70 percent of Hawaii's schools which offer industrial arts. Beyond availability, counselor guidance and teacher input also often affect enrollment. However, Crump's finding directly contradicted this. This leaves school policy as a major determinant. Wilson's review of graphic arts programs in Maryland indicated that even in this active state, there is an absence of school requirements that would have all students take industrial arts. At the time of his survey (1969), Wilson found some industrial arts requirement for junior high school *boys*; however, less than 10 percent are required to do so in senior high school. Bird's survey produced an essentially parallel finding with enrollments of 88 percent male and 12 percent female.

In terms of instructional methodology, the studies typically showed our profession as relatively conservative. Dellinger reported the overhead projector as the most frequently used audio-visual device, but classroom management by students, role-playing team projects, and diagnostic evaluation all merited relatively little teacher interest, according to Edmison. Similarly, Kabakjian found mass and line production, film, and video techniques infrequently used. He also identified the individual project as the most commonly employed instructional technique.

Teacher credentials were a bright spot in all surveys that focussed upon them. Grover, Kabakjian, Richards, Bird, and Ephraim all reported qualified instructors and such data as: 94 percent holding baccalaureate and 34 percent master's degrees (Kabakjian), 50 percent to 93.6 percent having work experience (Wilson and Bird respectively), an average of 6.9 percent years teaching experience (Bird), an average of 35 (Bird), and only 2 percent temporarily or provisionally certificated (Bird). Bird also noted the statistic that 51 percent of the teachers supplemented their income with second jobs.

Teachers reported with consistency the inadequacy of their instructional facilities (Bird) and; with Wilson's respondents,

such judgments were in the majority. Small wonder that teachers felt administrator support was vital for successful programming (Richards) and that they called for facility improvements necessary to offer technological-based instruction. Richards even advocated the restructuring of Texas' industrial arts program to reflect technology.

In the light of such findings, it is not surprising that Kabakjian, Teig, Ephraim, Wilson, and Richards all urged greater professional development, both preservice and inservice. Richards specified the need for more power technology, electricity-electronics, research and development, and graphic arts presence in the state's degree programs.

Minnesota's Industrial Arts-Industrial Education tension led to the state's Division of Vocational Technical Education award of a grant to a private contractor. Its purpose was to identify opinions and perceptions pertaining to state supervision, industrial arts funding, and certification. Teachers, administrators, and teacher educators served as the sampled population. A large amount of descriptive data was incorporated in the final report by Mohrenweiser (1978), along with the following conclusions; the image of industrial arts needed bolstering; priority areas for state industrial arts supervision activities included curriculum development and public relations; teachers did not favor a work experience license requirement; teachers supported master's programs with greater technical emphasis; and equipment, curriculum and inservice funding were desired.

More specific in focus was Szekely's (1977) development of a profile of New York City's newly sex-integrated junior high school home economics and industrial arts classes. Her data substantiated significant differences between student and teacher perception of coed classes, skills, and abilities, changing male and female roles, vocational and leisure interests, and teacher treatment. Not surprisingly, Szekely found that teachers with such coed experiences viewed the laboratory program differently than those who had not experienced it.

In contrast to Szekely's analysis of a single city's program, Collins' (1968) study of industrial arts in the public secondary schools of the southern Appalachian region represented a different approach than the preceding city, state, and national perspectives. Conducted as part of an overall study of these schools, the investigation resulted in one of the few descriptions of rural industrial arts.

FOREIGN PROGRAMS

Some foreign students who have studied in this country quite naturally have focussed on adapting what they have learned to the needs of their countries. Together with students from the United States, who are interested in international issues, a number of foreign students have conducted studies which constitute a useful mirror for our profession. Target countries have included Jordon (Al-Bukhari, 1968), Taiwan (Chinese Ministry of Education, 1969; Chang, 1974), Trinidad and Tabago (Dyer, 1974), Ecuador (Gilman, 1969), South Vietnam (Long, 1974), American Samoa (Thomas et al., 1973), Japan (Yoshio, 1975), and East Pakistan (Mohee, 1968).

The most prevalent objectives were the attempts to develop a program suitable for implementation in the target country. Chang did this for an industrial technical teacher education preparation in Taiwan. Yoshio did the same for the industrial arts teacher education program at Tokyo's Gakugei University. Dyer planned a junior high and secondary school industrial arts curriculum for Trinidad and Tabago. Mohee established an overall industrial arts program for East Pakistan. These studies often provided insights useful to the hosts as well as the guests. Examples included Chang's formulae for the prediction of teacher demand and Mohee's suggested staging of industrial arts and vocational education offerings in the context of an overall program.

Essential features of these "exported" programs included Chang's call for inservice teacher education, Dyer's identification of the imperative nature of vocational guidance as well as a complementing vocational education program, and Mohee's emphasis on the general education aspects of industrial arts. The latter also are embodied in Dyer's demand for careful correlation between science and industrial arts. Additional recommendations parallel to United States practice is found in Mohee's call for general purpose laboratories and in Dyer's adaptation of IACP and his objective that all students should experience industrial arts.

The studies by the Chinese Ministry of Education and by Thomas et al. provided evaluative descriptions of foreign projects. The former presented a major UNICEF and UNESCO effort toward enhancing industrial arts and vocational guidance in Taiwan. Thomas found a need for curriculum development, follow-up studies, community surveys, scheduling changes, inservice education, and support system improvements in industrial

arts and vocational education as practiced in American Samoa.

In switching now from an export outlook to analyzing other countries' industrial arts-related programs, the chauvinism of "one way" considerations become apparent. For example, Yoshio's (1976) review of Japanese industrial arts presented a parallel program model, one that obviously exists in a society radically different from ours. Nevertheless, many of the perceived problems bear a marked similarity to those faced by industrial arts practitioners in this country. Similarly, Eggleston's (1976) perspectives on the transformation of industrial arts in Britain provided equivalent input from that country. The three other foreign studies were less directly related to industrial arts, but each had implications for foreign applications. Essentially, all employed case study approaches. Al-Bukhari pursued a human resources perspective and combined it with a review of the relative cost effectiveness of Jordan's alternative occupational education delivery systems. Gilman used a similar methodology to identify links between education and the larger economic and social planning issues of Ecuador. Long pursued these links for South Vietnam and presented historical documentation of vocational and technical education. As did Chang, Long projected educational demands. Both Long and Al-Bukhari identified the need for careful coordination between industry and education. Lond echoed Dyer's recognition of the importance of vocational guidance.

The preceding three studies were provocative in that each failed to address the crucial aspect of career development and prevocational education, as well as the more pervasive one of technological literacy. Comprehensive documentation of foreigh developmental approaches, such as Gilman compiled, seemed to neglect industrial arts and its contribution to the foundations of industrial development. Our nation's comparative education thrusts might very well be able to assist our profession in developimg a strategy to combat this shortsightedness.

SUMMARY

Perhaps due to the decision to summarize special needs programs as they pertained to other aspects of this review, no significant, overall system was observed that would suggest that the special needs research was comprehensive in nature or systematically pursued. In fact, the number of such studies is surprisingly small compared to the amount of journal space it has occupied. The obvious morality of the issue seems so heavily loaded in favor of its careful treatment that it seems

generally immoral for it to have received such little attention. Since we do not consider ourselves to be experts in special needs education, it may be that such experts would take issue with these observations.

Status studies presented a rather curious contradiction. A sizeable number have been conducted at the state levels. They typically have been done in a relatively traditional survey approach and have been concerned with rather limited descriptive statistics. What is strange, however, is that despite all their similarities, there is little in the form of an overall aggregation of these projects. It seems that individual building blocks exist, but no one as yet has put the wall together. Perhaps Schmitt and Pelley's research in 1966 (and, hence, outside the time scope of this review) is the only national perspective available. There is hope in that the USOE has recognized this need and has, in fact, commissioned a national study to develop a data base for our profession. It will be particularly interesting to compare the findings of this study to the projections for 1980 that were advanced by Mannion and Spencer (1971). What is almost inexcusable, however, is that the existing data-gathering mechanisms have apparently allowed industrial arts information to "fall between the cracks." More specifically, it seems unconscionable for state division of vocational education to collect detailed program information for the traditional service areas and then--although industrial arts is treated as a member of the vocational family -- not collect equivalent data for industrial arts. It also appears that considerable practitioner resentment would be aroused if there were greater awareness of the fact that little of the abundant data that principals, superintendents, and teachers supply to state departments is retrievable.

It also appears that there are some status studies that are useful contributions to the teacher. Specifically, it would seem that a careful analysis of industrial arts in state career education plans, in plans for the education of the disadvantaged and the handicapped, and as part of various state human resource plans all would be significant. Even more challenging would be a careful analysis of industrial arts and its presence in state plans for vocational education. For different reasons, another difficult -- yet important -- study is for a review of the contribution and activities of state industrial arts associations, and particularly ones focussed on the effects of industrial arts association and AVA related activities. With the recent incorporation of the American Industrial Arts Student Association and the increase in its membership, a status study of student groups also seems appropriate. An urgent need for a description of current

practice seemingly is called for by the nation's increasing attention to urban education. This thrust suggests a corresponding one in terms of rural areas.

The contributions of the American Council of Industrial Arts Teacher Educators yearbooks to the documentation of the profession's views on educational programs cannot be overstated. This contribution, which can only be made possible by a joint effort between the profession and the publisher, in this case the McKnight Publishing Company, is particularly significant in that the authors marshalled research effort in ways that are relatively nontraditional in our profession. The resulting documents are not department oriented or individual oriented; they are truly professionally oriented. Similarly, the contributions of AIAA and AVA conference proceedings should be noted along with the fact that it is inconceivable that the latter have been discontinued. When one considers the magnitude of the person hours and financial investment by six to nine thousand professionals in a conference that lasts for four intensive days, one cannot conceive of any reason for not documenting the fruits of those labors. Certainly the AVA's yearbooks are a significant contribution; however, they cannot begin to substitute for conference proceedings. The industrial arts sector of the vocational education profession needs to be cognizant of this omission and take steps toward rectifying this situation.

Foreign studies were presented but only to a limited degree. Truly comparative efforts are nonexistent. We would recommend a study of the roles of technological literacy in a variety of societies and in the ways educational programs attempt to develop this type of literacy in their youth. Clearly, our profession's evolution is beyond the stage where we merely want to "exhort" what we are doing. The investment in human resources in countries such as Japan, Great Britain, and West Germany certainly could provide useful insights, as could reviews of such agencies as UNESCO and the International Labor Organization.

To conclude: "The current industrial arts curriculum does not even measure up to the program recommended by the profession ten to twenty years ago" (p. 30). From the data reviewed in this section, we would find it difficult to argue with this quotation. What is tremendously disquieting is that the quote is abstracted directly from Schmitt and Pelley's research -- published in 1966. Now, some thirteen years later, we still ask why can we not take issue with such a concern.

CURRICULUM

The development of industrial arts curriculum occupied the attention of a substantial portion of researchers. Studies ranged from rigorous investigations to speculative inquiries. Their nature and number make accurate evaluation impossible and classification almost impossible. For operational purposes however, studies were assigned to one of the following classifications: comprehensive efforts, curriculum processes and analyses, industry-education analyses, instructional units, IACP, and evaluation of curriculum implementation effectiveness.

COMPREHENSIVE EFFORTS

A general focus has been provided in a number of studies. For example, White (1974) studied curriculum developers to identify their location, involvement, problems, and needs. Householder's (1972b) review and evaluation of industrial arts curriculum efforts analyzed and compared the innovative programs of the 1960s. He concluded that, despite a concern for improvement, there was still no instance where an innovative program has been implemented across all grade levels.

Householder also developed an updated review of the curriculum movements of the 1960s in an ACIATE Yearbook (Martin, 1979). Ziegler did the same for the 1970s. Also relevant to the overview is this Yearbook's treatment of development processes used by two innovative industrial arts programs, the impact of technology on industrial arts subject matter, and industrial arts as a discipline for studying the future. Another useful overview was provided by Wolansky and DuVall's (1975) discussion of curriculum models and relevance.

Some solutions to the lack of implementation, as identified by Householder, may be found in Mason (1971). Also included there is a perceptive analysis of change related industrial arts curriculum literature, an exposition of Cochran's (1970) and the AVA's (1970) classifications of innovative curricula. The AVA's earlier booklet (1968) on improving instruction in industrial arts also was an attempt to advance appropriate practice in industrial arts. Besides its useful treatment of content, it also presented workable suggestions for facilities and evaluations that will support the desired curriculum.

Innovative approaches to industrial arts education in secondary schools were studied by both Mongerson and Cochran in 1968. The former reported that despite the apparent diversity, methods, content, and organization were similar in the programs studied. Cochran (1968) examined the aspirations of the developers of innovative curricula as contrasted with Mongerson's focus on implementation. He utilized factor analysis techniques to compare contemporary programs in an attempt to identify common elements, basic directions, and contributions to the field. Cochran's later publication (1970) served as a milestone comparative study of innovative industrial education programs. The AVA's booklet on innovative programs in industrial arts (1970) provided similar and even more concise treatment.

Maley's report (1969) on the Maryland Plan provided a useful description of a process for establishing a coherent system of objectives, program, and outcomes. The relationships between theory and practice are brought to the fore; the resulting contrast to traditional approaches becomes obvious. Other innovative industrial arts programs are described in the AIAA's (1971 - 1973 d) *Focus: Curriculum Projects* reprint of seven articles.

During this same time period, the implications advanced by advocates of innovative programs frequently suggested the desirability of a uniform nationwide industrial arts curriculum. Carter's (1970) responses from 360 college industrial arts chairpersons, state supervisors, and industrial arts teachers revealed that while considerable importance was attributed to curricular reform, the concept of a national curriculum did not receive endorsement. However, the sample allowed that a "common core" of industrial arts learning experience should be established. Essentially the same position was reported by Anderson (1970).

Relevance, an essential criterion for industrial arts curriculum development, was described by Martin (1973). Budke (1970) developed guidelines for vocational programs at the junior high school level. Principals were selected from a review of the literature and validated by a jury. Thirteen program areas were considered to be important in the junior high school prevocational program. Such guidelines for curriculum development also were the core of Burroughs' (1970) study. He developed criteria for an adequate industrial arts program by reviewing literature, research, and curriculum guides. These criteria were used in a survey to ascertain the appropriateness of industrial arts programs. Similarly, Bender (1976) represented the efforts of a core of North Dakota's industrial arts leadership in systematically reviewing

and applying curriculum guidelines. The result was a curriculum structure and guide for secondary school industrial arts that is effectively integrated with the state's industrial arts master plan. Such articulation is, of course, mandatory if genuine implementation is expected. It also is important that the developed materials comprise a representative facet of the larger national industrial arts context.

For these reasons, it seems fortunate that such state-wide efforts are increasing in frequency. New Jersey (Dyrenfurth, 1978), North Dakota (Master Plan Committee, 1975), Texas (Pierson, 1974 a, b, c), Virginia (Virginia Industrial Arts Education Service, 1977), Oregon (Tri-County Goal Development Project, 1973 a, b, c), and Iowa (Iowa Department of Public Instruction, 1975) are some states for which documentation is readily available. As might be expected, these materials range considerably in content. In some, such as New Jersey, only the precursors to curriculum action are described. An emphasis on the establishment of a rationale is evident in Pierson's (1974 a, b, c) and Iowa's (Iowa Department of Public Instruction, 1975), and Oregon's (Tri-County Goal Development Project, 1973a) project descriptions. Recommended curriculum processes comprised a large portion of Pierson (1974c) and the Tri-County Goal Development Project (1973b). Key curriculum products resulting from these projects included a detailed set of K-11 course goals in industrial education (Tri-County Goal Development Project, 1973c) and a set of cluster curriculum guides in North Dakota and Iowa. The latter are discussed in the section on instructional units. Ritz and Wright (1977) reported on another state approach by providing useful flow charts that depicted how to work with industrial arts guides once they are developed.

With the relatively recent emergence of career education, Rauley's (1978) development of a model is not unexpected. What is unusual is that it is the only one that documented an approach whereby senior high school students achieved career objectives by means of an emphasis on the concepts of industry in a comprehensive industrial education program.

CURRICULUM PROCESSES

DeVore (1968) provided the profession with a pervasive overview of key curriculum development processes as well as significant introduction to the implications of discipline-based effort. He also laid the foundation for the case of the technology education thrust. Furthermore, he even evolved an implementation of his structural concepts and possible school application.

Studies by Byle (1975) and Cremer (1970) generated important curriculum process information. The former used and verified an occupational analysis model to identify metric measurement competencies for preservice and inservice graphic arts education. Cremer, in addressing objectives rather than content identification, developed planning guides to assist teachers in writing behavioral objectives. His comparison of teachers, supported and not supported with these guides, indicated that the use of guides consistently allowed greater success in writing objectives to various levels of the cognitive taxonomy.

Like Cremer, Dyrenfurth (1976) sought to evolve a system to facilitate instructor development of a comprehensive and articulated set of objectives from very global program goals to the extremely specific behavioral objectives used to guide each learning episode. Contained in this AIAA presentation are examples and descriptions of procedures that allow classroom instructors to conveniently chart such a continuum of objectives.

The recent emphasis upon criterion referenced instruction has led to the publication of performance objective statements for industrial arts. In most instances, these statements of performance objectives have been developed and field tested. However, many await systematic validation studies. Barrington et al. (1970) recommended behavioral objectives for elementary industrial arts programs. Goldsbury et al. proposed performance objectives with criterion measures for American Industries courses (1975a, 1975b). Related publications presented performance objectives in woods (Bunch et al., 1972a), metals (Bunch et al. 1972b), graphic communications (Duvall County School Board, 1973), and power and transportation (Goldsbury et al., 1975c).

The issue of competency-based content was addressed at a two-day conference at the University of Wisconsin-Stout. In the proceedings (Wright, 1973a), Bensen referred to a "paint by number" analogy as indicative of a major weakness of competency based instruction; one can paint but only in a compartmentalized fashion. The need for careful specification is acknowledged. However, instructional implementation requires significant attention to humaneness of instruction as well as to the integration of competencies into a whole. Bensen emphasized the need for an overall systems model so that both instructors and students can establish accountability at all times.

A complete statewide plan for developing competency-based instruction and a catalog of competencies, objectives, and criteria was reported by Ritz and Joyner (1978). They recommended fifteen task area catalogs be developed for

Virginia. Another statewide effort was documented in the North Dakota State Board for Vocational Education's introduction to their Level 1 Curriculum Guide (1977a). Although this guide was not competency-based, it was designed to assist industrial arts teachers to develop programs consistent with overall state rationale.

The careful analysis of purpose and performance required to develop behavioral objective statements can be a useful research process in industrial arts education. At this writing, there is little significant body of knowledge which enables a researcher to predict the probable attainment of behavioral objectives. In a related process investigation, computer analysis of the body of knowledge of industrial technology was utilized in the curriculum development process by Rosser (1968). Computer assistance was utilized to formulate objectives, identify curriculum content and experience combinations, and monitor continuity. Computer utilization was found to be cost- and time-effective in the curriculum development process. Computer-based planning (Paulter, 1972) in the form of machine-generated research units, was another effective application of contemporary technology.

Another application of systems theory was reported by the University of Alberta's Department of Industrial and Vocational Education (1971). The report outlined the results of an application of network methods to curriculum organization. As a product these networks have the advantage of providing a visual overview of a curriculum as well as the sequences in it. Mongerson (1971) also illustrated the use of network approaches; critical path methods were described as a tool for developing curriculum. The precursor to the two previously cited studies may well have been Yoho (1969), since his *SNAP* Map application of his systems analyses technique to industrial arts curriculum development clearly establishes precedence in the use of the technique.

Educational systems design provided a basis for the development of guidelines (O'Hara, 1972). The technique, designed for a freshman course in engineering, was modified to develop a unit for beginning industrial arts students. Based on an initial study with junior high school students, the technique appeared to be appropriate for the higher level of cognitive behavior, i.e., analysis, synthesis, and evaluation. Israel (1973) field-tested an organizational pattern focused on a hierarchical task organization pattern. While not definitive, the findings offered some substantiation for the system.

Working closely with a curriculum revision process, Wright (1976) identified the type of change agency situation. Both the formal and the informal organizational structures were

studied to identify the key individuals in the setting. Pierson (1974a, b, c) developed a rationale for selecting learning activities in industrial arts on the basis of the individual utilization of the competency. Both philosophical and psychological bases were identified in the curriculum derivation model. Similarly, Altman (1971) outlined some key psychological principles in curriculum design. Pierson (1974c) pointed out that the link between cognitive and affective aspects of learning has been neglected by traditional curriculum development processes. The analysis of transactions procedure which he described is specifically designed to derive a curriculum that is more humanistic, concrete, and inductive than those developed by others.

For a more specific subset of industrial arts students, a similar intent was pursued by Davis (1971). Industrial arts programs for mentally retarded students were the subject of a survey in junior and senior high schools. Davis reported on factors considered important in selecting industrial arts course content for mentally retarded students and suggested subjects of interest to them in this area.

Secondary school students served as the subjects in a survey by Hilton (1970) who identified which experiences in industrial arts would be most significant for students. While his sample was drawn from only one school, the technique of seeking student response is one which is long overdue in industrial arts. If similar studies were conducted, it would be possible to generalize on the student appeal of industrial arts courses.

Along these lines, Trocki (1977) attempted to develop a model describing student adoption of an industrial arts curriculum innovation. While the empirical nature of the study will require interested researchers to peruse the complete work, it is important to note that Trocki identified relative advantage, compatibility, industrial arts grade point averages, total number of courses taken, and the level of innovativeness as important factors -- first two for both groups with and without industrial arts enrollment experience and the last three for those with industrial arts enrollment experience. Subjects without industrial arts enrollment experience also indicated the importance of utility, junior high school industrial arts experience, grade level, sex, and the level of innovativeness.

Content identification was the object of DeVore's report (1970). Additional insights into his perspectives are available in his earlier article (1968). He posited the need for industrial arts to identify content through discipline-based structures

and process. He also presented one research procedure that could accomplish this. Sarapin (1978) presented a detailed model for the formative evaluation and revision of curriculum materials. Curriculum evaluation also was the focus of Carrel (1978) who assessed the extent to which Mississippi Valley Industrial Teacher Education Conference members used clusters as an organizer for their curricula. Considerably less implementation was noted.

Before concluding, we must refer to *Operation Resource* as conducted by the Undergraduate Studies Committee of the ACIATE. This file contained abstracts of key industrial arts teacher education curriculum development activities. The 1977 ACIATE supplement updated the 1976 volume. (See ERIC document, ED 126 265).

INDUSTRY-EDUCATION ANALYSIS

One of the more popular techniques in industrial arts curriculum research has been the survey of industrial representatives in order to identify potential content for industrial arts in a specific area. Existing industrial arts programs are surveyed and the degree of correspondence between such programs and recommendations from industry are analyzed. In many ways, the outcome is predictable, since industrial arts never has pretended to precede industry in the development of technological processes. However, the studies are valuable in that they identify contemporary industry related content. For example, Envick (1968) studied the equipment, materials, and processes utilized in the plastics industry and compared his findings with those used in secondary schools. Suggestions were made to improve the low correspondence between the two. Falls (1968) studied metal and woodworking utilization in both manufacturing industries and in the junior high school industrial arts program purporting to teach about those industries. He noted that industrial representatives were less interested in the development of skills than were the teachers. However, the content of the courses seemed rel tively well selected in the opinion of industrial personnel directors.

Quier (1969), Boyd (1973), and Calhoun (1973) studied some aspects of wood technology. Their findings were consistent in noting a discrepancy between the processes utilized in the woodworking industry and those included in the programs surveyed. Similarly, Grannis (1970) reported substantial discrepancies between industrially recommended content and programs in power mechanics. Hildebrand's study (1974 of drafting led him to recommend that the educational irstitutions

seek to duplicate industrial practices and provide contemporary materials. Glogovsky (1970) reviewed the relationship between content in collegiate-level graphic arts programs as reported by the instructors and the recommendations of representatives from the graphic arts industries. Brown (1975) published a mini-summary of research studies in the communications arena. The programs were found to lag behind content in the industries. Photographic technology was studied by Salvagin (1974) who found a substantial need for increased instruction in such techniques at the secondary and postsecondary levels. A substantial disparity occurred between the recommendations of the industries and the educational practices. Industrialists identified content they considered appropriate for manufacturing technology courses in a study by Brueckman (1969). The college industrial arts educators surveyed were not in agreement among themselves, reflecting the wide variability in instructional practices. Specific suggestions were offered for appropriate techniques in content selection for manufacturing technology courses.

Kale and Schmidt presented equivalent goals in more narrowly focused projects. The status of microwave electronics was the subject of a study by Kale (1974). Manufacturers and user companies were consulted in an attempt to define curriculum material related to microwave communications. Schmidt (1971) identified thirteen high school programs in which experimental aircraft had been constructed; ten of the programs were in operation during 1969-1970.

INSTRUCTIONAL UNITS

As might be expected, research efforts have provided various instructional units on a number of topics. Koonce's (1968) overview of state-prepared industrial arts resource materials provided a useful starting point for surveying the status of existing instructional units. He noted (1968 data) that over 50 percent of the states planned to publish or revise such materials, that states typically recommend that teachers adapt state materials (contrasted to direct and stringent adoption), that the majority of teachers develop their own materials, that over 90 percent of the teachers reported state developed materials were inappropriate for direct adoption, that over 50 percent of the teachers wanted descriptions of available state services, and that the perceived value of the state materials is greater for experienced rather than beginning teachers.

State developed materials also were studied by Johnson (1968). He compared the content of these materials to that expressed

by the judgments of key leaders in the field. Johnson recommended that more detail be included in such documents. He also provided nineteen recommendations to assist developers in future efforts. Should readers wish a partial compilation of instructional materials in industrial arts, a two-year bibliography (1967-1969) of AIM citations was compiled by Eshelby (1970). A similar list was published by the Center for Vocational and Technical Education (1970). Further updating and continuation of such efforts would serve the profession well.

Elementary school industrial arts implementations were described in the AIAA's (1971-1973e) *Focus on Elementary School Industrial Arts*. The contents included descriptions of five approaches to K-6 industrial arts programs: Project LOOM, Learning Experiences in Technology, ABLE Model Program, a Technological Exploratorium, and the World of Work. The next educational tier's industrial arts program was outlined in the ACIAS' (1971) pamphlet, "Industrial Arts in the Middle School," which contained a cursory overview of this level's curriculum and objectives, philosophy, plant requirements, and teacher preparation demands.

An initial overview of the state-of-the-art in materials and processes was provided by Andrews (1978). Metal finishing, metrics, and the world of work were the units developed by Singletary (1968), Byle (1975), and Podell (1973), respectively. Besides the analysis and description of metal finishing technology produced by Singletary, Andrews presented the results of a national survey of the incidence of such experiences in baccalaureate industrial education programs. The results indicated a weak exposure to this curricular area. With respect to the occupational function of industrial arts, Podell assumed a similar lack of strong exposure. Accordingly, he historically documented the changing nature of work, and subsequently, developed a study guide. The guide sought to support the potential of industrial arts in contributing to student information on the changing nature of work, activities, and occupations. Blankenbaker and Miller's (1970) annotated bibliography related the interpretation of industry and provided additional information in Podell's area. Byle's unit on metric measurement competencies also was initiated on an assumption of need. His graphic arts specific package involved instruction differentiated by target occupation in a way that focused the most intensive treatment on pressmen and the least training for copy preparers and strippers.

The major nationwide metrification project headed by Feirer also produced curriculum products (Feirer, 1976a, b, c) which systematically treated both curriculum and implementation aspects of metrification. It included resource lists, transparency originals and inservice guides.

A number of investigators identified content from industrial fields and use it to develop curriculum. Graham (1971) investigated foundry industry practices in basic metal casting and recommended the inclusion of a number of experiences in exploratory, introductory, and advanced industrial arts courses. Design was the focus of a study by Frokner (1968) and Isom (1970); both made specific recommendations for additional instruction. Micklus's (1978) teacher and student manuals on industrial design in education provided a comprehensive vehicle by which the earlier recommendations for increased design emphasis can be implemented.

An overall picture of energy alternatives and the role of industrial arts was published by Owens and Pinelli (1977). A very substantial rationale for industrial arts teacher education in energy and power was developed by White (1979). More specific than these was Bender's (1973) review of alternative energy systems which might be used for automotive propulsion. These systems served as a basis for a knowledge structure in transportation technology. Energy and power has been studied by Texas A & M University (1971) and Callahan (1978). The latter provided a complete power technology curriculum guide along with recommended objectives, texts, lectures, demonstrations, and laboratory experiences. The Texas project provided sets of topics, tests, and activities for exploring conventional and alternative energy sources, production, and conservation. Iowa's statewide efforts also resulted in a handbook (Bro, 1978a) for introductory level energy and power classes and one for graphic communications (Bro, 1978b). Graphic communication technology was reviewed by Gysler (1971). A theoretical framework of concepts of management, production, and personnel served as a guide in developing a program in this technology. A similarly focused curriculum guide was developed in North Dakota as part of a statewide effort. The comprehensive guide (North Dakota State Board for Vocational Education, 1977b) included a rationale, content objectives, activities, and appropriate resources.

A resource guide in aerospace education was developed by Packard and Haggett (1968) which included an outline for the presentation of aerospace materials in the industrial arts program. An industrial pilot mechanics study was developed by Woodward and Meyers (1970) in which forty units were included. Charlesworth (1968) reviewed the literature, considered human factors, explored the specific causes of accidents, and subsequently built the case for a program in safety education in industrial arts. It is surprising that more safety instructional programs did not surface.

A source book for teaching material science in the high school was developed by Kaplan (1970). The unifying theme held that the structure and composition of materials determine their properties and behaviors. Field testing of this unit was conducted in order to improve the draft. The final outcome, a source book, is recommended for students who have completed basic science courses.

Dunn (1977) developed a similar material science unit on the properties of clay and its applications. A useful bibliography covering resources for librarians to expand their collections in the technological scope of industrial arts was prepared by the New York State Education Department (1970). This technology-based perspective is exemplified in the following studies. An analytical study by Ritz, Wright, and Trocki (1976) reviewed technology and identified four major subclassifications: natural, physical, psychic, and social. The physical technologies were recommended for inclusion in industrial arts programs. The Canadian Industrial Arts Program, described by the Alberta Department of Education (1979), provided background for the development of a broad, technologically-based general education program. In addition to curriculum development, the study also outlined special industrial arts programs and illustrated laboratory planning and equipment selection. Detailed insight into the thinking of the initiator of this program was detailed by Ziel (1971).

Studies by Larson and Krueger (1978), Gilbert et al. (1978), and Bender (1977) presented comprehensive approaches to curriculum reform. Gilbert used a four-column format to outline content, criteria, instructional resources and the like for industrial arts courses in general industrial arts, manufacturing and construction, graphic communications, and power and energy. Bender reported on North Dakota's cluster-based project to improve teaching in the following clusters: industry and technology, graphic communications, manufacturing, construction, and energy and power. In contrast to the preceding cluster-based approach, Larson and Krueger itemized industrial arts competencies in the specific areas of auto mechanics, electronics, metals, residential planning, technical drawing, woods, and graphic arts. Bame (1973) identified several concept groups. Technology and environment represented two major areas; the interface between them was the focal point of his study. A list of eighty-one concepts was considered to be important by a jury of teacher educators. However, they felt that these concepts received little emphasis in ongoing industrial programs.

Instructional materials dealing with the manufacturing industry were reviewed by Nelson and Selvidge (1972). The project

was intended to assist curriculum developers in incorporating concepts from industrial technology into industrial arts courses. Major components of the model were structure of enterprise, management, research and development, production, marketing, finance and control, personnel administration, external relations, and secretarial and legal functions.

Manufacturing also was the scope of a curriculum guide prepared by the North Dakota curriculum effort previously described. The guide (North Dakota State Board for Vocational Education, 1977b) is one of six cluster-based guides. It contained a rationale, cluster content and objectives, units on manufacturing, instructional activities, projects, and a bibliography of resources, films, and equipment.

A more specific aspect of manufacturing was investigated by Dirkson (1969) who studied the need of the industrial manufacturing operative for specific categories of industrial knowledge. A modified Q-sort was used to ask operatives, managers, and industrial arts teacher educators to estimate the relative importance of personnel, management, production, and industrial practices. A substantial area of agreement occurred. However, differences occurred between groups as they described the importance of specific knowledge.

Another extension of manufacturing was compiled by Umstattd (1979). His article presented a product-servicing curriculum's rationale and structure. Envisioned as a high school sequel to the IACP's World of Manufacturing, this curriculum model still needs to be developed to a stage of implementation. Curriculum guides in career education frequently have included industrial arts. Missouri's Department of Education and the Mid-Hudson Career Development and Information Center both included industrial arts for early adolescents. The elementary industrial arts curriculum guide developed by Barrington and others (1970) provided an outline and suggested projects in several areas. Heasley (1975) reported on the effectiveness of a program in the elementary school. The technological-based activities in conjunction with other programs resulted in substantially higher achievement, increased creativity, and improved "affective" scores.

Guidelines and principles for the development of industrial arts programs for visually handicapped adolescents were presented by the American Foundation for the Blind (1968) in a list which emphasized practicality, usefulness and concrete vocational opportunities. Williams and others (1976) also developed a guide outlining industrial arts activities for children with emotional problems.

The compilation of resources assembled by Anderson et al. (1969) is supportive of special needs efforts, in this case, for the culturally disadvantaged and the exceptional. This highly selected resource book included positively evaluated items that pertained to industrial arts and motor learning as well as other school subjects.

The development and field-testing of units has occupied many industrial arts researchers. Abitia tested a self-instructional system in industrial design methodology, (1971). A programmed unit on construction occupations was tested by Tripp (1974). She found the unit to be effective in a field test with 120 secondary school students. Naroff (1971) prepared a unit providing occupational information on metal-working careers. The unit, field tested with 9th and 10th grade students, worked satisfactorily, though some concern was expressed for its format. Instructional units in electronics were developed by Igram (1971), Brown (1971), and Maness (1969). A graphic arts resource unit was developed by Banzhaf (1972). Wolansky (1968) identified technical content and developed an outline for fluid power instruction in industrial education teacher preparation. Wallis (1969) performed a detailed analysis of tolerances and developed a unit of positional and form tolerancing for drafting courses. Environmental concepts were tested by Cauley (1971); a set of concepts was validated by a panel of teacher educators.

THE INDUSTRIAL ARTS CURRICULUM PROJECT (IACP)

Substantial research has been conducted on the effectiveness of the Industrial Arts Curriculum Project. This is one of the few innovative efforts to have reached enough students in a variety of settings to permit substantial research. The program was found to be generally effective (Pontiac City School District, 1971) in terms of cognitive content mastery by students. Students expressed positive reactions to the World of Manufacturing portion. Most felt it would assist them in understanding the world of manufacturing. However, they were less than enthusiastic about the more abstract concepts in the program. In a comparison study, Fazzini (1970) explored the effects of IACP's manufacturing program on student attitude. Somewhat surprisingly, the conventionally treated students reported more positive attitudes towards manufacturing, automation, and production than those with IACP experience.

The possibility that the project might contribute to occupational selection was investigated by West. Eighth grade students exhibited tendencies toward clarifying their

occupational selection was investigated by West. Eighth grade students exhibited tendencies toward clarifying their occupational interests and toward selecting work activities related to their occupational choices, though these tendencies did not attain statistical significance at the .05 level (West, 1969). A follow-up on the original population of high school seniors indicated that 14 of the 86 responses retained their choices, 54 indicated that they were still considering one of their top three choices (West, 1976). Such a longitudinal study is noteworthy. While the results may not have attained the desired impact, they are worthwhile in that West's work can serve as a model for other researchers.

Since the project utilized a body of terms which were unusual in industrial arts at the time, Mason investigated the meaning of those terms utilized by personnel in management in manufacturing firms (1969). Most of the major terms were considered valid on the basis of the returns. Specific suggestions were made for modifying five terms in the curriculum.

Attainment of cognitive knowledge has been of interest to researcher Miller (1971) who studied the performance of students from the IACP Field Evaluation Centers in comparison to students enrolled in a conventional junior high school industrial arts program. He concluded that students receiving IACP instruction performed as well as those receiving conventional programs when the cognitive content dealt with conventional industrial arts subject matter. When the tests related to the IACP program students scored significantly higher than those from the conventional program. Attitudes were not found to differ significantly between the two groups. Students enrolled only in the World of Construction portion scored significantly higher on a capital construction industry, interest, and inventory than did traditional students (Browder, 1972). The performance of these two groups on an achievement test designed to evaluate mastery of World of Construction did not show a significant difference. Dugger (1970) and Dugger and Buffer (1972) reported on a comparison between conventional instruction and project instruction in the World of Construction, using seventh grade students. Students completing the portion performed significantly better than conventional students on the World of Construction comprehensive examination. However, the mean scores on the general industrial arts test did not differ significantly. Kuwik (1970) conducted a quasi-experimental study to determine if the sequencing of two design experiences -- in construction followed by manufacturing -- had an additive effect compared to just one experience. Although some methodological concerns surfaced, Kuwik felt that the findings indicated a measurably

additive effect.

Mattson developed an instrument which attempted to assess learning in both traditional and innovative curriculums (1974). The instruments were used to assess cognitive achievement of industrial arts objectives and student attitudes toward courses. Students from World of Construction and World of Manufacturing courses and those from traditional courses were pretested. They then received one year of the respective program and subsequently were administered the posttest. The findings indicated that IACP students achieve approximately the same progress towards objectives of industrial arts but made additional gains in objectives specific to IACP. Preference for the industrial arts courses indicated students valued the World of Construction more highly than traditional industrial arts courses which they in turn valued more highly than the World of Manufacturing course. Another comparative study (Schum, 1973) sought to identify differential effects on industrial arts achievement and on the critical thinking ability of students. While both IACP and conventional industrial arts student groups demonstrated equivalent achievement in industrial arts knowledge, the conventionally taught group developed greater critical thinking ability.

These researchers are to be commended for focusing on the development of knowledge regarding the effectiveness of this approach. In particular, synthesizing studies (e.g., Buffers et al., 1971) represented a valuable building block for the profession. While the findings have not always been consistent or favorable for the innovative program, they encouraged subsequent researchers to validate curriculum developments. Optimism is justified when note is taken of the "spin-offs" on the initial experience. Umstattd's (1976) overview of the Manufacturing Education Curriculum project is one of these. Clearly the impact of the IACP is present in how it affected its students as well as the impetus for change it provided. The profession owes these researchers a debt of gratitude.

EVALUATION OF CURRICULUM IMPLEMENTATION EFFECTIVENESS

Teacher attitudes towards participation in innovative programs were studied by Renken (1974). Although nearly half his sample had fewer than five years of experience, most desired inservice courses in the new curricula prior to implementation. Nevertheless, the majority were interested in changing their existing program. However, lack of money, facilities, equipment, and time were listed as barriers. The objective, "Understanding of Industry," has been advocated as one of the purposes of

industrial arts. Spencer (1969) developed a test covering the body of knowledge implied by this objective and administered it to senior high school students. Higher scores were attained by those who completed industrial arts courses than by those who did not. General shop and unit shop courses were equally effective in fostering an understanding of industry, although it was helpful if the teacher considered that objective important.

An assessment of the acceptance of innovation was conducted by Edmison (1973), who used an instrument developed by Cochran (1968). Edmison found that his random sample of secondary school teachers were less accepting of Q-sort items which reflect new emphases than were the innovators. Similarly, the random sample reflected traditional elements in their choices. However, both groups suggested including both sexes in the courses, individualizing instruction, and focusing on the impact of industry.

Starr (1973) studied eighth grade students in the Occupation Versatility project, in terms of their performance in problem solving. Improved performance in this dimension was attributed to participation in the project classes. Another comprehensive approach that has many concepts in common with the Occupational Versatility Project was the Utah model for industrial arts. Evaluation of it was conducted by the AIAA. The final report (AIAA, 1978) complimented the project by indicating that it specifically targeted on "grass roots" needs, enjoyed high student enthusiasm, and generated increased awareness of the relationship between project activities and the specific industrial occupation under study. However, evaluators cited methodological problems as well as severe de-emphasis of industrial art's technological literacy goal (in favor of career education imperatives) as key weaknesses.

Much evaluation research has focused on the impact of the IACP and its adoption. This project was developed from a research-oriented base and it collected much data. While many of the reports are reviewed in the section on IACP, one is cited here. An attempt was made to consider school organizational factors and teacher professionalism in a study of adoption of the IACP (Caron, 1975). Considerable difficulty was experienced in obtaining accurate measurements of the relevant factors in this pioneering study. While the available sample was restricted in its characteristics and the difficulties of measuring variables were apparent, the study produced provocative findings. Caron concluded that innovation, defined as participation in the field testing and adoption of IACP programs, was more likely to be implemented in schools having stable organizational structures and staffing patterns.

Teachers of the implemented programs, however, were not considered to be more professional than teachers who were not innovators. Caron noted the need for standardized measures and terminology.

Using a semantic differential scale, Smith (1974) conducted a unique assessment of attitude change of elementary school teachers as an effect of their participation in the implementation of career education units in Mesa, Arizona. Career education, industrial arts, and vocational education concept meanings were measured using a stratified random sample of 100 control and 100 experimental teachers. Smith reported positive changes for industrial arts accompanied participation in the implementation. Additionally, he found that industrial arts was viewed more positively by males and by intermediate grade teachers, rather than primary grade teachers.

SUMMARY

It appears that the applied nature of industrial arts has come to the fore in terms of the tremendously diverse and rich field of curriculum research. Obviously, much significant research is being conducted relating to instructional units that interpret various aspects of the industrial-technological world. There is no shortage of ideas. It seems clear that such problems as exist do not do so in terms of conceptualizing units but rather in implementing them. Despite this relative strength, there is a clear area of weakness, namely, the senior high school curriculum. This area probably represents our greatest challenge in terms of developing curriculum that cogently distinguishes it from vocational education and yet that provides for advanced study in industrial arts. For some reason, the members who practice our profession do not seem to be content with a notion of breadth as the measure of advanced knowledge or program quality.

The existance of a large number of instructional units also suggests a possible difficulty, specifically accessing and identifying units on topics of relevance to a person's particular needs. Clearly, an improved dissemination method is needed and/or the existing vocational curriculum mechanisms need to be given a clear mandate by their leaders in order to serve industrial arts in a systematic way and to inform practitioners of the services that are provided. Another arena where the vocational community can assist is that of field testing. In this review, this aspect of curriculum development is less evident, particularly in terms of controlled aspects, than might be desirable. It, therefore, seems clear that what is needed are some *very rigorous implementations* of the

developed curricula and the careful evaluation of their implication and effectiveness.

Considerable competency-based instructional efforts were evidenced in the research, largely at the teacher education level. This direction, in connection with significant attention to the establishment of systematic curriculum process, is deemed most desirable by the reviewer. Competency-based instruction at the K-12 level was not evidenced anywhere near the degree that teacher education was, but it appeared that many of the careful delineations of objectives have moved the field in that direction. Perhaps more than any other project, the IACP was an example of a systematic effort illustrating some of the best professional practices. Certainly the individuals involved with the IACP dissemination and field testing deserve the gratitude of our profession. Even if individual persuasions will not allow acceptance of some of the basic premises that are essential to the project, one must recognize the contributions made by the process.

One of the very attractive results uncovered in this review is the significant increase in leadership and development efforts exerted by the industrial arts constituency as compared to its teacher education effort. Such statewide efforts are important in that they draw the profession together at the unit of practice that makes most sense in terms of organizational structure. Systematic efforts are commendable because they typically focused on the establishment of a rationale and detailing of individual conponents necessary to implement it. However, they suffer from the same weakness that other curriculum development activities suffer, that is, there appears to be considerable attention paid to curriculum development but less to the *use* of the developed units. It seems that the local imperatives of control are just too strong to encourage large scale adoption. Of course, the other issue that is clear -- particularly in terms of curriculum -- is that despite the fact that the leaders at the cutting edge would have curriculum efforts move in certain directions, it seems obvious that there remains a significantly large portion of those who do not agree with the leaders. For reasons of their own -- inertia, commitment to other ideals, or whatever -- these professionals are not involved in an effort to implement new curriculum efforts. Since the disparity between leadership opinion and general public opinion is at least equally great, this suggests that considerable effort should go into new curriculum and development activities that incorporate public awareness and sensitivity to the primary objectives of industrial arts as part of the development process. This is compared to public awareness activities that are tacked on only after a curriculum is assembled!

LEARNING PROCESS VARIABLES

The study of variables affecting the learning process is of central interest to industrial arts researchers. While relatively little basic research was expected in industrial arts, studies included in this section investigated the application of basic pedagogical and psychological principles as well as the derivation and validation of such concepts.

PROBLEM SOLVING

Rasmussen (1973) studied the operations of subjects who worked on solutions to mechanical insight problems. Tape recordings of their verbalizations and direct observational data were analyzed to identify characteristic thinking patterns. Organization schemes did not appear to be primary, but persistence and associational flexibility were useful in composing solutions comprised of combinations of set elements. A procedural plan was developed for a systematic analysis of individual problem solving behaviors.

Weiseman (1969) tested the effectiveness of a training unit designed to increase the ability of undergraduate industrial education students to identify malfunctions in rotating equipment. The one-half hour training session was found to be effective in improving the performance of the experimental group. In addition, the group showed significantly improved ability to diagnose faulty machine conditions in a transfer task. Weiseman concluded that vibrotactile performance in machine diagnosis was amenable to training.

Starr (1973) also investigated problem solving. In terms of the effects of an innovative industrial arts program, occupational versatility and problem solving performance and beliefs were enhanced by such participation. A significant relationship was reported between student class performance and problem solving beliefs for treatment and control groups.

ORGANIZATIONAL PATTERNS

Ziegler (1975) attempted to validate Bloom's *Taxonomy of Educational Objectives* (1956) with regard to applications in an introductory industrial arts electricity course.

Behavioral objectives were developed at each of the six taxonomic levels for the course. Students were asked to discriminate between the objectives in a pair-wise manner. While it was possible to identify an application-theory continuum and an operational-computational continuum by multi-dimensional scaling analysis, the analysis did not support the basic taxonometric model with its hierarchial structure.

Doty (1968) studied the effect of prior knowledge of educational objectives and practice conditions on immediate learning. He found that prior knowledge of educational objectives, before a unit was studied, resulted in more efficient student learning. Provision of the actual objects for practice in a laboratory setting, as compared to a written description of the objects, did not yield a significantly higher learning effect. If this study could be replicated with similar findings utilizing public school students, it would cast some doubt upon a number of principles long espoused by industrial arts educators. Actual objects always have been considered necessary for effective learner programs. Because such an identical element approach is futile for industrial arts to attempt, Doty's findings could be very significant -- particularly if it becomes possible to identify conditions under which the actual object is especially helpful.

SPECIAL NEEDS ASPECTS

The relationship of special needs and learning process variables has been treated in a variety of ways ranging from general articles to specific experimental studies. Sullivan's (1978) article on who the special needs students are and how special education and industrial teacher education can help them is an example of the former. Wargo (1977) addressed this task in developing an outline for preservice practicums and inservice workshops designed to aid industrial arts instructors in working with handicapped students.

Miller (1977) and Buffer and Miller (1978) reported an example of the latter category in an investigation of the effects of industrial arts on mentally retarded students' achievement and retention of linear metric measurement concepts. Using industrial arts activities as the treatment and a workbook as an alternative method, this four-group pretest/posttest/control group design failed to support the superiority of industrial arts over workshop methods.

In a study of the variables affecting the acquisition and retention of a psychomotor task, Gaulden (1973) found that educable mentally retarded children with high perceptual ability

performed the task more efficiently than students whose perceptual abilities were lower. However, variations in informational feedback did not result in differential performance on the psychomotor task. In a study on the use of woodworking handtools, Olson (1969) suggested that educable mentally retarded students could benefit from woodworking instruction when using carefully selected tools. He recommended short demonstrations and the integration of informational presentations with other experiences.

Drehnan (1970) also sought to determine the impact of industrial education on mentally retarded individuals. He found that counselors were anxious for educable mentally retarded students to enroll in industrial education classes. He also found that students who had been enrolled in the classes received higher ratings by employers. He, therefore, concluded that an industrial education background would be beneficial to students who would be working in close relationship with other people or in positions where safety precautions needed special emphasis.

Some of the specifics of industrial arts facility modifications necessitated by special needs students were presented by Worrall and Mrowka (1978). A different approach to the special needs aspects of learning process variables was employed by Herrick (1969). He investigated the knowledge of basic industrial terminology possessed by inner city and suburban male youth. Overall, the suburban youth displayed more knowledge of verbal symbols for selected tools and for uses of tools. In the AIAA's (1971-1973c) *Focus on Culturally Different Students*, various writers presented an overview of this special needs population served by industrial arts. The report included a treatment of implications for teacher education, three perspectives of students in urban environments, and an exploration of the use of simulation and gaming with disadvantaged students.

PERFORMANCE DOMAINS

Sensory Motor

While motor performance is crucial to successful laboratory experiences for industrial arts students, this domain represents a relatively unexplored territory in terms of research. To be sure, a few studies exist, but were it not for a systematic effort at the University of Missouri-Columbia and more recently some work by Shemick, the situation would be more pronounced. Herschbach (1975) also

recognized the void; his compilation and analysis of various psychomotor taxonomies provided a most valuable synthesis. At the University of Missouri, a series of exploratory studies by Waisner (1970), Boutwell (1971), Chastain (1972), Meers (1972), Hudson (1972) and Holm (1972) sought to identify relationships between various independent variables and psychomotor performance as the dependent variable. Stress (Holm), audio visual presentation and grip strength (Boutwell), visual and verbal presentations (Chastain), informational achievement contiguity (Hudson), and feedback media (Meers) were the independent variables explored. The findings included the following points:

- Psychomotor performance was not affected by contiguity (Hudson).
- There were no significant psychomotor achievement differences attributable to mental ability level (Chastain).
- There was no significant difference in nail-driving ability due to high and low test anxiety levels or to stress and nonstress treatments (Holm).
- Groups exposed using auditory lead of filmed visual presentations demonstrated psychomotor task superiority over groups viewing a synchronized presentation (Chastain).
- Students receiving qualified directive feedback performed at a higher level of psychomotor achievement than those using self-evaluation techniques (Meers).
- The amount of transfer was significantly related to differences in amounts of practice time (Waisner).
- There were no significant differences in the amount of transfer due to initial task complexity, the interaction of practice time and task complexity, or learning task performance time (Waisner).

A study by Jenkins (1969) paralleled the preceding in many ways. He compared the effectiveness of slides and audio tapes to teacher demonstrations in generating student performance on graphic arts psychomotor tasks and concluded that demonstrations were superior to the mediated presentation. Because feedback is deemed to be as important in learning skilled behaviors as is the initial instructional methodology, Hurley (1971) investigated the effects of different feedback methods and found that video-taped feedback, when augmented

with a check sheet, was more effective than the sole use of a checksheet or video feedback alone.

Also concerned with motor learning, Lutz (1969) identified factors in kinesthesis across a variety of tasks. Factor analysis identified a strong factor labeled "tactile kinesthetic sensitivity" but was not successful in establishing dimensionality. Some instances of relationships between kinesthetic functioning and levels of cognitive functioning were identified. Lutz's instrumentation, however, was unique to our field and represented a contribution in itself. Kinesthetic sensitivity also was the subject of White's study (1970) of the influence of visual-spatial and kinesthetic sensitivity on learning complex tracking tasks. The visual-spatialization measure was an effective predictor of success on the tracking task; however, the kinesthetic measure did not predict success.

In contrast to these studies, Shemick sought first to establish an overall framework for the psychomotor domain and then to pursue specific research activity. He presented the results of his search in a paper entitled "A Tentative Taxonomy of Psycho-Motor-Skilled Tasks" (1976). Subsequently, he described a coding process in his 1977 presentation at the AIAA. Both papers dealt with his views of the applicability of Fleischman's taxonomy to industrial arts. Because of the taxonomy's dichotomous decision tree approach to classifying tasks, it seems to hold considerable value to the profession's future research efforts.

Andrews (1975) attempted to establish the appropriate age levels for introducing two common psychomotor tasks in industrial arts education: the squaring of a small piece of soft pine using a plane and cross-cutting a piece of wood along a line. Subjects aged seven, nine, eleven, and thirteen completed the tasks under controlled conditions. Andrews suggested that boys and girls were capable of using the plane by the time they reached the age of nine. However, the cross-cut saw appeared to be suited more for boys and girls ten and older.

The development of measuring ability is one of the more exasperating tasks faced by industrial arts teachers. Male high school students were the subjects in a study by Shih (1969), who found correlations between measuring ability and finger dexterity, spatial reception, kinesthetic sensitivity, shop work achievement, mechanical knowledge, and numerical ability. Measuring ability was not significantly correlated with intelligence test scores, visual acuity, the number of machine shop courses taken, or the level of

maturity. In view of the substantial proportion of time expended on teaching measurement concepts and procedures, it would appear profitable to follow this study with additional ones in order to provide guidelines for practice in teaching measurement.

D'Ambrosio (1969) sought to identify psychomotor achievement differences between students participating in the IACP World of Construction courses and those enrolled in traditional courses. In general, the groups were similar in achievement after the completion of the courses. Several cognitive achievement factors were identified as related to performance on the psychomotor task. One prerequisite competency also was identified: measurement achievement, the ability to make linear measurements, was significantly correlated with achievement on a psychomotor task. Careful attention should be focused on the contradictory findings of D'Ambrosio's and Shih's studies. Also part of the IACP developmental effort was Buckingham's (1973) exploration of the effects of cognitive enablers on task performance. He concluded that the greater the number of enablers, the higher a performance level was selected as appropriate by a panel of judges. This provided considerable support for the maxim that knowledge is the better part of skill.

Jordan (1974) studied the psychomotor performance of junior high school students on a task in which their initial performance was judged to be failing. He found that high ability students made fewer errors in completing the task, even though they required an equal period of time as students with low mental abilities.. It was found helpful to remove a student from the failure and permit them to work on a different task before they were asked to return to the performance on which they had failed initially.

Obreiter (1978) studied the effect of using behavioral objectives on drafting penciling skill. The study is notable in that Obreiter introduced the notion of psychomotor skill stability. Student performance typically was enhanced by the use of behavioral objectives. Both 16-19 year old male and female students performed better than students 13-15 years old. This suggested the applicability of a direct maturation link to performance. Bortz (1967) investigated maturation and intelligence in terms of the effects on male 7th, 8th and 9th grade students' sawing and hammering skills and concluded that the independent variables accounted for less than one half the variance required to predict performance. A large-scale project by Drummond and Vitro (1976) investigated the effects of practice on hammering and sawing and reported that practice resulted in

higher scores. They also investigated the effects of selected strategies on learning efficiency in vocational-technical education, using readouts in cognitive, affective, and psychomotor domains (Drummond and Vitro, 1974).

Creativity

Creativity in industrial arts was investigated by Clay (1965). After developing and verifying an operational definition of the term, Clay constructed and administered an inventory to a random sample of 297 Michigan junior and senior high school industrial arts instructors. The findings revealed a crossover effect in that while junior high school teachers in multiple area laboratories indicated greater encouragement of creative behavior than junior high school teachers in limited area or unit shops, senior high school teachers had exactly the opposite tendencies. Clay also identified a relationship in that teachers emphasizing the self-realization objectives of industrial arts tended to encourage creative behavior more than those who advocated skill development and/or interpreting of industry.

Irvine (1968) pursued the definition of creativity in terms of identifying the relationship of creative thinking to psychomotor ability, mechanical reasoning ability, vocational aptitude, and overall industrial arts performances of high school industrial arts students. Using data obtained from 177 scores on the Torrance Tests of Creative Thinking and the Differential Aptitude Mechanical Reasoning Test, he concluded that creative thinking was a separate ability from those investigated. He also noted that industrial arts programs were geared more to verbal than figural dimensions of creative thinking ability.

RELATIONSHIPS AMONG LEARNING PROCESS VARIABLES

Some of the key psychological principles affecting learning is contained in Pierson's (1974a) monograph. This overview of research findings was specifically conducted as part of an industrial arts curriculum project and deserves the attention of industrial arts learning process researchers. Pierson emphasized a holistic view of behavior in which each act is understandable only in terms of its context. As such, the model is considerably antagonistic to much of the competency-based curriculum disection activity. Initially,

concept learning also may seem at variance with competency-based efforts but it need not be so. Much of what research evidences about concept learning (Clark, 1977) can in fact be incorporated in curriculum-based instruction (CBI). Likewise, the Piagethian principles outlined by Gore and Schwaller (1977) also have direct application to industrial arts and to CBI. A comprehensive overview, albeit a brief one, of learning process and motivational variables was synthesized by Rosser (1976).

Vogel (1968) compared the effectiveness of common methods of teaching electricity in a study encompassing 1290 junior high school students. He sought to attribute performance differences to method, teacher, or classroom variables. His findings suggested that student achievement was affected more by teacher variables than by the other factors, although method variables explained some differences. Teacher subject matter competency in terms of college credits received, also affected student achievement. Since class size was another important process variable, Olender and Dyrenfurth (1979) reported the findings of a literature search and survey synthesis and concluded that the available research was more provocative than explanatory. Despite the difficulty in identifying the specific influences of class size, it was clear that some mechanism was operating.

Three additional studies involving a facet of creativity sought to document learning process variables. Abromaitis (1969) examined the relationship between adolescent creative ability and the ability to perform, or the motivation toward, typical industrial arts activities. Teacher creativity also was investigated. In a seemingly contradictory finding the data showed that the two relatively noncreative teachers were significantly more successful in selecting creative *and* noncreative students (as measured by the Torrance Tests of Creative Thinking and a Creativity Rating Scale) than were the two creative teachers. Additionally, Abromaitis found a limited positive relationship between creativity and IQ and another between teacher ratings of student creativity and student industrial arts achievement.

Rather than investigating the effects of creativity, Babcock (1969) studied the effect of problem solving on creative thinking and visual thinking ability. The study, which used a random assignment of college students to treatment groups, showed that creative problem solving -- in a descriptive geometry class -- did not improve visual thinking abilities but enhanced creative thinking.

Pursuing the effects of treatment on creativity, Joyner (1973) carefully structured a two by two, posttest only design that matrixed high and low intelligence against structured and unstructured design problems as treatments. Neither treatment method nor intelligence yielded significant results. Analysis to identify interaction effects also failed to surface significant links. The researcher concluded that both high and low IQ students can achieve equally well in situations requiring creativity and that structured and unstructured design problems may be employed for both categories of students.

Transfer

In a study using seventh grade industrial arts students, Waisner (1970) identified conditions which would facilitate transfer of learning. Subjects performed better on the transfer task if they had performed a previous learning task. Somewhat surprisingly, however, an increased number of performances of the initial task did not improve transfer performance. The complexity of the initial learning task was not related to subsequent ability to master a transfer task of moderate complexity. Nor was the quality of the project produced on the transfer task significantly related to the complexity of the initial learning task or to the amount of time spent on practicing the initial learning task. However, there was significant interaction between practice time and task complexity.

Laboratory-Achievement Links

Francis (1973) found that measured laboratory performance was correlated significantly with achievement in a college-level electricity class. Armbrust (1969) identified non-verbal factors relating to success in a high school beginning drafting course. Nonverbal intelligence traits, abstract reasoning, spatial relations, and mechanical reasoning accounted for 36 percent of the variability in drafting course grades. Medium to high levels of two or more of the traits typically were present among the successful drafters. Previous industrial arts experience and chronological age were negatively related to success in the drafting course. As might be expected from Armbrust's findings, a later investigation of the relationship between success in woodworking and differential aptitude test scores by Cliffe (1978) found that significant positive correlations existed.

Spradling (1974) studied the relationship between laboratory experiences and performance in a college level basic electronics course. He found that performance of laboratory activities had a positive effect upon the cognitive attainment in electronics. However, the number of hours devoted to laboratory activities were negatively related to the cognitive scores attained. While this study was not conclusive, it provided provocative evidence that college industrial education courses might consider experimenting with a smaller number of lab hours when cognitive attainment is the primary goal.

In a study which cut across areas of teacher education and student performance, Johnston (1974) investigated over two thousand students enrolled in industrial arts machine shop and vocational machine shop programs. Achievement test scores attained by the students served as the criterion. The industrial arts students and vocational students did not differ significantly in terms of test scores. The amount of industrial work experience possessed by the teacher was not significantly related to mean scores attained by students. The number of years of teaching experience and the academic preparation of teachers also were found to lack significant relationship to student scores. This bit of evidence, if it can be replicated, provided persuasive arguments against many of our traditions. One could argue that the achievement on a test is not the appropriate criterion for success in a machine shop course. However, it seems to be one valid measure; we would expect any real differences to show up with a sample this large. Thomas (1968) found that high school industrial arts experiences were related to performance on a test of manipulative ability. Senior high school boys in woodworking and metalworking demonstrated higher levels of performance on several tests of manipulative ability than were attained by students who had no industrial arts experience. Interpretation of such results are, of course, difficult since students who enroll in industrial arts courses may well be those who have higher manipulative ability.

Scott (1973) tested the effect of a concentrated learning program on work habit skills, attitudes toward work, and psychomotor achievement of eighth grade students. The fifteen slide-tape presentations in the program did not increase work habit skills, attitude ratings, or psychomotor achievement. However, the study identified a significant relationship between attitudes toward work originally held by the students and their work habit skill development, as well as the increase in their positive attitudes toward work. It provided an admirably concentrated program

designed to effect change in an area of interest to many industrial arts educators. The fact that it was not successful in terms of the measured criteria indicated the long-term complexity of the problem.

Effects of Practice

By employing random treatment assignments to five groups, Asper (1969) investigated the effects of conceptual study as compared to practice (physical activity) on the learning of a manipulative skill. Both treatment groups received identical video-taped content information. Asper observed that while praxilogical learning increased with practice, the curvilinear relationship ceased to be significant as the percentage of practice approached 80 percent. He generalized that 60 to 80 percent practice time represented the optimum for praxiological learning.

The interaction of ability traits and the distribution of practice also was studied by White (1970). Senior high school industrial arts students were asked to learn a complex tracking task under varying conditions of distributed practice. White reported that short, massed practice sessions interspersed with long periods of rest to permit practice of the task over a period of several days yielded better results than fully massed practice in which the task was learned in a one-day period. Performance on a test of visual-spatial ability was a better predictor of success on the tracking task than was performance on a test of kinesthetic sensitivity.

EFFECTS OF INDUSTRIAL ARTS

Griffin (1970) identified the major relationships between high school grades (GPA) for mathematics, science, and industrial arts, and performance in industrial arts teacher education programs. He also investigated the factors of the number of industrial arts units taken and overall student scholastic ability. Record examination of 273 college student industrial arts baccalaureate graduates surfaced significant relationships among industrial arts teacher education grade point averages earned in technical courses and scholastic ability interacting with mathematics and science GPAs; mathematics and industrial arts GPAs; and professional courses and scholastic ability interacting with mathematics and industrial arts GPAs. Negative relationships were found to link the number of high school industrial arts units to college industrial arts GPAs.

Similarly, a negative relationship existed between GPAs earned in college professional courses and high school industrial arts grades. No other significant interactions were found.

In an attempt to assess the relationship between different amounts and types of high school industrial arts experience and performance in college four-year technology programs, Wells (1974) analyzed the records of 558 technology graduates and dropouts. He found no significant differences between the two groups of technology graduates, those without prior industrial arts high school experience and those with as many as five semesters of industrial arts, when compared on the basis of overall achievement in college, achievement in technology courses, achievement in technological laboratory courses, age upon entering the first technology course, and the number of units accumulated before entering a technology program. Nor were the effects of prior industrial arts experience significant in predicting the tendency to drop out or the number of semester units accumulated before dropping out of college. Wells, therefore, concluded that college technology students without industrial arts high school exposure achieved similarly to students with such exposure and that industrial arts exposure did not significantly affect the time spent exploring other college majors. He was able, however, to predict technology student achievement on the basis of high school GPAs.

Determining the influence of industrial arts on the career awareness of third grade students was the focus of a study by Goodness (1977). He found industrial arts to have a significant effect on career awareness as measured by the Worker Activities Test. He also indicated a significant difference between the amount of learning exhibited by high mental ability compared to low mental ability students. He concludes that mental ability had a greater influence on career awareness of third grade students than instructional strategy. Elementary education was also the focus of Chorost's (1976) assessment of the contributions of New York City's Career Awareness Program to reading and mathematics achievement. The instructional vehicles employed were the Publishing Activity Center and the mobile industrial arts unit. Teachers reported favorable results for both treatments; pretest and posttesting indicated career awareness increased with the use of the mobile unit.

Spencer (1969-1970) investigated the effects of industrial arts in terms of its contribution to secondary school students' understanding of industry. The study demonstrated that students who studied industrial arts scored significantly

higher on the Industrial Understanding Test than those who had not. However, a relatively large number of semesters of industrial arts exposure (five or more) was needed before significantly greater achievement was evident. Teacher emphasis on the objective was found to impact directly and positively on student understanding. The variables of general or unit shop exposure were not found to be directly related.

Like the preceding study, Pierce's (1973) investigation of the relationships between industrial arts and mechanical aptitude was not particularly supportive. Students with industrial arts experience, even those with longer or earlier exposure, revealed no higher mechanical aptitude than those without such an opportunity. While taking woodworking produced no increase in mechanical reasoning, space relation, or manual dexterity, participation in drafting helped space relation and abstract reasoning.

Jageman (1968) investigated the values of industrial arts experiences for mentally retarded girls and boys, ages 11 to 15. Subjects were randomly assigned to an experimental group which received a ten-week, 45-minute industrial arts experience; a comparison group received homemaking and maintenance experiences and a control group remained in their special classrooms. After ten weeks, no significant gains were noted in personal and social adjustment, perceptual-motor development, academic achievement, or work habits and attitudes among the groups. It may be that ten weeks is too soon for differences to emerge. However, most educators would like to feel that 37½ hours is sufficient for a program to make a difference, especially when the measures are undertaken immediately following treatment.

SUMMARY

Perhaps in no other section is the lack of an overall system or structure on which to frame research more obvious than in this one. The research investigating problem solving, organizational patterns, special needs factors, psychomotor behavior, and creativity all were major directions of research. Yet the studies in each area tended not to form a coherent or cumulative picture of what we know about learning in each particular sector. For example, the opportunities for researching the various organizational patterns of industrial arts, the differential effects of curricula ranging from specific to general, the comparative effects of curricula favoring breadth *versus* depth, and the various sequences of curriculum presentation all are largely unexplored

While a considerable number of studies did address psychomotor learning, they did so without significant reliance on an overall taxonomy such as is available in the cognitive domain. There appeared to be no widespread acceptance of any of the alternative psycho/sensory-motor taxonomies that presently exist. For a field that is so concerned with practice and "hands-on" applications of learning, it seems strange that this particular area has not been investigated more thoroughly.

Many of the variables in the context of learning processes were researched. Yet, in the absence of some overall research scheme, one cannot identify which relationships are yet to be researched. The mere quantity of the individual variables reviewed to date, and the possibilities broached by their permutations, points out rather clearly that research efforts have just begun. The challenge is to formulate a large scale picture of key variables that operate within the environment. However, while the proceding is imperative, it would be foolish for the profession to believe that a process that is so dependent on technological, situational, and individual characteristics can ever be fully explained in terms of a learning theory that neatly allows us to make necessary decisions that teachers have to make daily.

Our major concern is that many of the research efforts seemed to reflect common methodological errors. These errors include the failure to maximize the systematic variance, develop measures of sufficient sensitivity to measure anticipated effects, and design investigations in such a way as to yield answers to real questions. The result is that the profession has relatively little empirical evidence to support its aspiration. Clearly it is incumbent on those who guide and conduct research to tighten the controls and encourage more careful procedures.

Among the areas that would appear of most significant promise for future research is the one of laboratory-achievement links. In conjunction with this, the effects of practice need to be more carefully investigated, as do the overall effects of industrial arts.

What is the long range impact of our curriculum? The question is particularly difficult to construct and, certainly, it cannot easily be done in retrospect due to the difference between practice and what the best thoughts of the profession would suggest as being the ideal program. Since an ideal program is seldom found in reality, we cannot use extant measures to identify what the effects of such a program are, at least not in an *ex post facto* way. We would note that,

as in many other educational fields, the systematic study of the longitudinal effects of industrial arts is not being documented. With the increasing significance of the basic education thrust, it would appear that -- if, in fact, we can document longitudinal effects -- the significance of industrial arts would be enhanced in terms of contributing to technological literacy. We would then be on a more solid basis than we are presently with our exhortations and attempts at inductive reasoning. The challenge faced by the profession is simply to demonstrate that it, indeed, has the kind of impact that it claims to have.

INSTRUCTIONAL MEDIA, METHODS, AND MATERIALS

This section reviews studies dealing primarily with teaching techniques. This general area of research has been popular in industrial arts education during the last decade. Because of the breadth of the area, the variety of subject areas concerned, and the educational levels involved, selection and classification was extraordinarily challenging. Of necessity, individual studies received only brief mention; constraints of time, space, and accessibility served to limit the number of studies reviewed.

The reader is encouraged to check throughout the section for studies of interest, since the classification scheme may not generally be agreed upon. The primary categorizational approach has been related to methodology rather than subject matter. Consequently, individuals interested in research on ways of teaching drafting, for example, will need to review virtually the entire section.

Particular concern is noted regarding the sampling of studies to be reviewed. This section is heavily dominated by dissertations and most of the reviews had to be completed from the abstracts. Serious researchers in instructional media, methods, and materials will want to explore thoroughly those studies in their area of interest.

INSTRUCTIONAL METHOD

Different strategies for organizing the instructional setting have occupied the interest of industrial arts researchers for some time. Dukes (1974) found that achievement test performance could be increased by focusing student attention upon specific critical portions of the instruments during instruction on the micrometer and vernier caliper. On the other hand, in teaching orthographic projection, Papp (1969) reported that the whole method and the part method of solving these problems were equally effective in developing the ability to solve graphics problems and understand technical information and spatial relations. In teaching basic electronics, Chawhan (1973) found that students learned equally well with instruction which was based on prerequisite principles or conceptualizations. In contrast, Clark (1971)

presented orthographic projection to sixth grade students by two methods: (1) prerequisite information and principles and (2) visualization. The group receiving prerequisite principles achieved significantly higher cognitive test scores and required fewer units of instruction to attain the criterion level of performance. Specific recommendations for the organization of instruction can hardly be made on the basis of the contradictory findings of research in this area.

Zabcik (1969) utilized criterion programming to teach a college-level course in industrial materials and manufacturing processes. Instructors and students found the criterion programming procedures efficient in terms of the time required for learning; however, students reported that their interest declined when the entire course was organized to attain criterion performance levels. Conventional lecture-demonstration laboratory instruction and criterion programming were found to be equally effective teaching procedures.

Active participation in laboratory instruction is a traditional area of emphasis in industrial arts education. Asper (1969) found that increasing the percentage of overt (as compared to covert) activity increased praxiological learning. He recommended that overt activity should exceed 60 percent of instructional time; diminished effectiveness of added overt activity occurred when it exceeded 80 percent of instructional time. The importance of concentrated practice also was noted by Crystal (1975), who found that massed practice was superior to distributed practice in the development of manipulative skill. However, this difference was not significant at the retention level. Evidence reviewed here seems to support the conventional practice of emphasizing laboratory activity and practice in industrial arts education.

A frequently overlooked organizational variable is the level of control maintained by the teacher in the classroom and laboratory setting. Svendsen (1970) studied student control practices employed by successful industrial arts teachers and concluded that additional emphasis should be given to teacher-student relationships within the preservice and inservice teacher education programs. Considering the importance of classroom control, it is surprising that only one study was identified for review in this area.

Oakley reviewed research on compressed speech, described techniques for speech compression, and recommended that compressed speech be substituted for recorded speech in most mediated instructional presentations. The reviewers have

been unable to locate later examples of the use of compressed speech as a presentation technique in industrial arts education, despite Oakley's promising finding and the research in other areas using compressed speech (AIAA, 1971-1973g).

INSTRUCTIONAL MEDIA

Teacher recruitment has been a major problem in industrial arts education for some time. It was the subject of a methodological investigation by Young (1969), who compared the effectiveness of printed brochures and slide-tape sequences for presenting career information. Both methods were successful in increasing knowledge of industrial arts teaching and in improving attitudes toward the profession; they were especially effective for the higher ability level students. The methods did not demonstrate differential effectiveness. Morris (1971) developed guidelines for organizing pictorially programmed instructional booklets by administering a Q-sort instrument to eighth grade students. Actual student opinions on content, mechanical organization, and utilization of the booklets provided the basis for the recommendations of this unique study.

Slides and Other Media

Photographic slides have become common means of instructing in industrial arts education. Research in their effectiveness has occupied a number of individuals. Representative samples of their work are reviewed below.

Jenkins (1969) compared slide-tape presentations with teacher-presented demonstrations in teaching junior high school graphic arts classes. Performance on procedure tests was equal for groups treated by the two methods; the teacher-presented demonstration resulted in higher levels of learning of terminology and procedures and in superior performance in graphic arts operations. Amelon (1969) reported mixed results in a comparison of slide-tape instruction with group demonstrations requiring more instructional time.

Photographic slides and three-dimensional models are frequently used in combination, or they may appear to be interchangeable in some instructional situations. McCage (1970) used photographic slides supplemented by realistic models in teaching descriptive geometry at the college level. Students preferred the experimental method over conventional instruction, increased their ability to visualize using that method and

attained higher weekly quiz scores using the experimental method. The experimental method took additional time for presentation; however, this was considered worthwhile since increased learning and motivation were present under experimental conditions. Crowder (1968) developed slides and assembly models as an alternative to traditional general shop instruction. Initial learning and retention were higher when the experimental materials were used with public school students.

Films

A wide variety of film formats is now available in industrial arts education; several of these have been the subject of research. Filmed presentations were found to be equally effective as live presentations for teaching machine operations in terms of achievement, retention, and the need for instructor assistance (Cushing, 1971). Instructor-made films required less supplemental instruction than was needed when commercial films were used. Kruppa (1968) found instructional films generally effective in teaching introductory woodworking, though occasional differences among subgroups attained significance when overview-film demonstrations were compared with traditional teacher demonstrations.

Supplementing conventional instruction in electronics with eight-millimeter, single-concept films improved initial learning and retention (Dennison, 1970). Hess (1969) compared lecture-demonstration methods with single concept films in instruction in woodworking safety. When the overall safety unit was considered, the treatments were equally effective in terms of initial learning, retention, and the development of desirable safety attitudes. When the results were analyzed by individual machines, only one difference was detected: the film-lecture method led to higher levels of learning and retention of band saw safety theory. Morrill (1970) found initial learning and retention of instruction in a lithography unit equally effective when conventional instruction and filmstrips were compared.

Overhead Projector Transparencies

Perhaps the most basic educational technology device in use today is the overhead projector. Relatively little research has been done on the values overhead projectors have in the industrial arts setting. The use of transparencies for overhead projection as a supplement to oral instruction

yielded higher achievement test scores than those attained by verbal instruction alone (Fleming, 1969). Muns (1969) compared overhead projectuals and a transparent projection box as media for teaching orthographic projection in his study using college students. Conventional instruction was used with one group; the convehtional instruction was supplemented with overhead projectuals and the transparent projection box with the other group. The methods were found to be equally effective in teaching orthographic projection. In view of the contradictory findings, it appears that additional research should be done concerning the effectiveness of the overhead projector. In addition, research based guidelines for application in industrial arts are needed.

Programmed Instruction

One may question the inclusion of programmed instruction under the category of instructional media, since it implies a carefully sequenced series of information and experiences designed to lead the individual through the learning experience in the most efficient manner. Since a number of experiments compared programmed instruction with mediated instruction, the decision has been made to include it here.

Since its appearance on the educational scene, programmed instruction has stimulated researchers to a variety of studies concerning its applicability in industrial arts education. Pryor (1974) compared programmed instruction and conventional teacher instruction in teaching safety to secondary school students. In terms of initial learning, the two methods were equally effective. However, students who used the programmed materials demonstrated significantly higher retention of the safety information. Bockman (1971) found programmed instruction and lecture-discussion methods to be equally effective in terms of retention of metallurgical concepts among students in a college level course, despite some significant differences in initial learning attributable to the choice of method. Programmed instruction was considered to have substantial advantages in teaching groups composed of individuals with widely varying abilities. Smith (1970) compared programmed instruction (with and without supervision) with lecture-demonstration instruction in technical drawing. The three methods were equally effective in terms of initial learning and retention.

Programmed instruction also has been applied in other contrasts. For example, Seal (1969) compared programmed instruction keyed to single-concept films with traditional lecture-demonstration procedures in teaching beginning welding to

college students. While both methods were effective in attaining course objectives, the modified programmed instruction method yielded higher levels of welding performance. Warner (1960) reported that programmed instruction could be used effectively in teaching metalworking information units to junior high school students. Both students and teachers demonstrated positive attitudes toward the machine-presented lessons. Lundy (1968) found linear programmed booklets more effective than sound filmstrips in terms of initial learning in college freshman automotive electricity. The two methods were equally effective in terms of retention and when the results were analyzed by a subtest.

Multimedia

In many instances, researchers have attempted to evaluate the effectiveness of teaching strategies utilizing more than one medium. Some of these have been quite well integrated; others are aggregates of various methods. True multimedia research is still in its infancy in industrial arts, but a number of worthwhile studies are reviewed in this section. Henak and Wright (AIAA, 1971-1973g) described a system for utilizing teacher-prepared multimedia materials in a manufacturing course. Their system provided for the use of a wide variety of media to integrate concepts throughout the college level course. Rudisill reported the development and utilization of audio-tutorial instructional systems for an energy systems course. A team of 30 undergraduate students was found to be capable of producing effective instructional packages when they received appropriate guidance from practicing professionals. Field testing with junior high school students validated the audio-tutorial system (AIAA, 1971 - 1973g).

Audio-tutorial instruction, utilizing slides, tapes, and integrated sets of laboratory experiences, has found its widest application in electronics: Brown (1971) found audio-tutorial and conventional lecture-laboratory techniques equally effective in terms of student achievement in college-level electronics. However, the audio-tutorial technique resulted in a saving of instructional time. Reteria-Garrido (1974) compared the effectiveness of programmed instruction and audiovisual tutorial instruction for teaching electronics technology. Both instructional methods were equally effective when achievement was the criterion. The effect of the two teaching methods was not differentiated across ability levels.

In a related study, Kickefski (1975) found the audio-tutorial system to be an effective method to teach descriptive geometry concepts and principles. Students performed equally well when taught by the audio-tutorial system or by the traditional lecture-demonstration method; however, students preferred to learn by the audio-tutorial system.

Self-instruction

A self-instructional system for teaching orthographic projection reduced the amount of time required for the subject to be conducted in the visual classroom approach. The achievement of the two groups was not significantly different (Freschet, 1969). Hird (1977), using college-level graphic communications students as subjects, compared traditional lecture-demonstration methods with an individualized system of presentation for a series of 25 units of instruction. The two methods did not differ significantly in terms of learning, time required, or the quality and accuracy of projects completed by the students. Hird recommended that the study be replicated using a larger, more diversified sample, with provision for studying the effects of instructional constraints upon overall achievement.

Self-paced instruction was more effective than the traditional method in teaching woodworking safety and reducing the instructor's time devoted to safety instruction. However, the two methods were equally effective in terms of the safety of the actual practices employed in the laboratory (Beckman, 1969). Self-instruction via programmed units and lecture-demonstration generally were found to be equally effective in increasing the ability to visualize spatial relations (Campbell, 1969). Hoch (1960) compared scheduled and nonscheduled administrations of a programmed text in teaching fifth grade students. The two methods were equally effective in terms of initial learning and retention. When the results were analyzed in more detail, no differences attributable to methods of instruction were identified between boys and girls or among either low or high ability level groups.

Videotape Recordings and Television

A live classroom demonstration was found to be more effective than videotape presentations in a college ceramics course when initial learning was the criterion; this difference was not significant when two-week retention was the criterion (Stafford, 1975). When the effectiveness of videotaped,

closed circuit television demonstrations was compared with the conventional presentations in teaching basic metal casting, Orr (1970) found the videotaped technique to be effective in reducing the number of casting attempts required to complete acceptable projects. In addition, the videotaped demonstration resulted in a savings of time. These findings are similar to those of Baron (1968) who found videotape recording to be as effective as conventional instruction in teaching a psychomotor task. The two were equally effective in communicating cognitive information to students of high ability. The videotaped presentation was less effective for lower ability students when the criterion was retention of cognitive information.

Relevant videotape recordings may be used to improve the effectiveness of substitute teachers who do not have subject matter expertise (Thatcher, 1970). In addition to effective teaching-learning performances, which frequently do not exist under substitute teaching situations, it was noted that discipline problems were substantially diminished when videotape recordings were available and used in the mechanical drawing classes.

Reinhart (1974) compared the effectiveness of slow scan television with conventional television as media for presenting principles of electronics. The slow scan television method yielded significantly higher post-test scores than conventional television. It was concluded that slow scan television could provide an effective and low cost method of teaching electronic fundamentals.

Simulation

Numerical control is an area where simulation appears to be especially promising. Umstattd (1970) found that a simulator could be used to provide effective learning conditions for college students in numerical point-to-point programming. He suggested that the simulator could be used for initial learning, practice, and in situations which did not include actual numerically controlled machine tools. Olling (1974) compared the effectiveness of computer verification and instructor verification of numerical controlled programs developed by students in mechanical technology. Performance on an achievement test and programming performance were criteria in the study. Since both groups performed equally well, it was concluded that a computer is not essential in teaching programming principles. Pine (1973) found simulation and nonsimulation equally effective in teaching numerical

control concepts to high school students. Achievement, program writing ability, and attitudes were not affected by the methods tested; however, teachers exerted differential effects on all three outcome measures.

In a study with high school students, Smith (1974) sought to determine if computer simulation games were effective in facilitating learning and if elements of the cognitive style of the learner could be identified as related to success in learning from games. Those whose individuality scores were high learned especially well through simulation games; all groups learned significantly through the games.

Laboratory Methods

A comparison of the traditional individual project method of teaching industrial arts and the enterprise method of group activity found achievement when the enterprise method was used (Gebhart, 1971). Retention was not significantly affected by the choice of instructional method. Brown (1977) compared the individual project approach with the exercise/experiment approach in secondary woodworking. The two methods of instruction did not yield differences in informational achievement, retention of information, or attitudes held toward woodworking. The project method resulted in a higher degree of student enthusiasm than was displayed in groups receiving the exercise/experiment treatment. Achievement, retention, and attitude toward the subject did not differ significantly across two treatments (project and exercise/experiment) used in a college-level wood technology course (Landers, 1972).

Lecture-demonstration techniques with separate laboratory work were more effective than either the laboratory or modified laboratory method when teaching college freshman engineering graphics students (Holt, 1970). Finch (1969) compared the effectiveness of equipment-oriented, textbook-oriented, and programmed self-instruction methods for teaching automotive troubleshooting. Knowledge and attitude measurements detected no significant differences among the methods. However, the method utilizing equipment required less time and yielded a higher level of troubleshooting performances than the other two methods.

In a study using freshman industrial arts majors in a design class, Kaumeheiwa (1969) found that the use of the actual concrete object and the use of an abstraction (verbal stimulus) were equally effective in producing fluency and flexibility of ideation.

The direct discovery approach was found to be more effective than direct detail in developing problem-solving competencies in basic electricity (Brenner, 1968). Training in listening was found to be effective in improving achievement and retention in college-level technical drawing (Broadhurst, 1969).

Competency-based instruction increased cognitive learning in ceramics in a comparison with traditional instruction at the university level. Products produced by the students receiving the two techniques did not differ significantly; students responded positively to the competency-based approach (Burnett, 1974). Schmidt (1974) found that behaviorally stated learning objectives in a college welding course led to significantly higher levels of knowledge. However, the performance test did not indicate a difference attributable to the behavioral statement of objectives.

When compared to traditional elementary education approaches, construction activities increased achievement scores of science students in fifth grade (Downs, 1968). Logan (1973) found that construction activity in a third grade science unit on simple machines increased achievement as measured by test scores.

Groves (1970) found that commercial background music tended to create an improved learning environment in college-level engineering graphics classes.

Instruction in the metric system may proceed by using the metric system exclusively or by relating it to the conventional system of measurement. Both methods are effective in terms of immediate learning; the exclusively metric method led to higher retention for students of high mental ability (Brooks, 1974).

Teaching Strategies

McLaren (1974) compared different teaching strategies, using selected industrial arts activities, upon the skill awareness of fourth grade students. Achievement and retention scores were influenced as much by a student's mental ability as by the teaching methods; no difference in accomplishment could be attributed to the choice of teaching technique. Lolla (1973) did not find different effects of methods of teaching tactual-visual perception to ninth grade students. In fact, the students with high visual imagery experienced a decrement in performance as a

result of the instruction. Criteria in this study were tests of mechanical reasoning and space relations. Written comments from the teacher to the student, whether positive or negative, did not change student attitudes of self-expectation in a study by Smart (1974).

Significant interactions were found between two personality variables (general activity and friendliness) and instructional method (programmed or instructor-led) in terms of cognitive learning (Haskell, 1969). Restraint, emotional stability, and masculinity measures were related to performance on the achievement test. The two methods of instruction (programmed and lecture-discussion) were equally effective.

Jasnosz (1969) found visual communications to be a more effective method of teaching design to industrial arts students than the traditional graphic arts approach.

MATERIALS

Written instructional materials were found to be more effective than lecture-discussion or laboratory activities in concept learning (Caley, 1969). Mastery of concepts from written materials reduced or eliminated the need for additional instruction through lecture-discussion or laboratory activities. Pufahl (1969) compared the relative effectiveness of three types of printed instructional material: text, text with achromatic visuals, and text with chromatic visuals. Students who studied text only materials spent the shortest period of time with them but scored lower on an achievement test. Students with the chromatic visuals scored highest but spent the greatest amount of time with their material. An interaction effect was detected: students with higher mental ability did better with black and white visuals; students with low mental ability did better with chromatic illustrations.

Developmental activities directed at the preparation of instructional resources approach were emphasized at times. For example, Allen and Hinrichs (1975) prepared a manual to assist the classroom teacher in organizing research and experimentation activities in industrial arts activities. A student workbook is included, as well as laboratory activities and content outlines for instruction. Baron et al. (1974) developed an 11-unit teaching guide for mass production activities in industrial arts classes. Preitz (1972) presented an integrated view of the role of instructional methodologies in the implementation of curriculum innovation. Mediated presentations and learning packages are an integral

part of the industrial arts teacher education program at the University of Alberta, both as techniques for imparting knowledge and as methodologies to be mastered as professional competencies.

The value of illustrations in instruction sheets was substantiated by Herr (1970) who used the sheets to supplement closed circuit television presentations in college-level graphic arts.

SUMMARY

Research in instructional media, methods, and materials in industrial arts education is almost impossible to summarize. We have attempted to provide relevant samples of the kinds of work which have been completed during the period under review. It has not been possible to draw substantial generalizations from the body of research.

The reviewers are led to comment that the design of research dealing with instructional media, methods, and materials needs to be strengthened if generalizations are to be attained in the future. Controls need to be applied with greater rigor, instructional treatments need to be developed with greater attention to theoretical concerns, and the conduct of experiments needs to reflect contemporary educational practice where this is possible. It also may be that this is an area where research needs to expand beyond the traditional dissertation involvement.

The selection of appropriate methodologies for specific purposes is a matter of interest to every educator. Maley has been a leader in designing industrial arts instructional patterns which apply a variety of organizational methods to their best advantage. His choices of methodologies are based upon a careful analysis of the content and purposes of industrial arts (Maley, 1973). The example provided to the profession by Maley is one which others could do well to imitate. Concerted long range efforts such as Maley's are needed to develop a coherent body of knowledge on the application of instructional media, methods, and materials in industrial arts education.

STUDENT PERSONNEL AND GUIDANCE

Considering the extent of the career education movement that emerged during this period, it is surprising that a greater number of studies investigating the guidance characteristics of industrial arts were not found. The studies that were identified related to occupational choice and student characteristics. Several dealt with guidance related effects of industrial arts, including career maturity, drop-out rates, and vocational performance.

OCCUPATIONAL CHOICE

Meehan (1974) investigated preadolescent precursors to occupational choice in order to determine the effects of twenty selected personal and environmental factors on student selection of eighth grade career exploration courses. He reported that such course selection was explainable, but only to a limited extent, by the effect of the selected factors. Furthermore, neither the target occupation's salary nor achievement on discipline subtests proved to be of significant use in predicting course selection. Crump's (1968) study of Arkansas' industrial arts program also was not particularly useful in explaining student decisions to enroll in industrial arts. He found the primary factor in such decisions to be student choice which operated independently of counselor and industrial arts teacher influence.

Using an indepth analysis of a smaller sample (n=181), West (1969) sought to determine the effects of an eighth grade IACP course on students' occupational choice and interest in work areas related to that choice. Traditional classes as well as students with no industrial arts exposure served as comparison groups. Ohio Vocational Interest Survey (OVIS) instruments provided data that, when adjusted for differences in ability and achievement, suggested that industrial arts did not have a significant influence on how clearly the students understood their interest in occupational work areas.

STUDENT CHARACTERISTICS

Comprehensive high school students enrolled in power-automotive courses were surveyed by Pendleton (1973) to determine their general characteristics. Major findings included the identification of primarily a white male student group with a below C grade point average. Family heads were mostly blue collar workers. Of relevance to guidance was the fact that student educational expectations were found to be related to the educational and work level of the family head. Salim's (1970) analysis of why students choose, or avoid, industrial arts also provided useful insights into the characteristics of the student body served. He found that aptitudes, vocational interests, and the formal education of the father each served to distinguish between enrollees and those not choosing industrial arts.

At the post high school level, Chen (1977) conducted a longitudinal study that documented the characteristics of 172 university industrial arts graduates. The research indicated that transfer students' overall performance was significantly better for their last three semesters than was their entry performance. Other significant relationships were found between the graduates' final GPA and student teaching grades and also with their service ratio (years of service divided by years since graduation). The latter characteristic did not vary significantly by source of student entry, transfer from within, transfer from outside, or freshman entry. Earlier, Jones (1972) reported on a descriptive study of the characteristics of teachers-in-training at Iowa State University. Most significant was his finding that (based on the use of the Minnesota Teacher Attitude Inventory, the Otis Quick Scoring Mental ability test, and several other measures) industrial education is not a "dumping ground."

EFFECTS OF INDUSTRIAL ARTS

Articulation between program elements frequently is spoken of in terms of being a desirable goal rather than a demonstrable effect. In a study that partially addressed the identification of such effects, Peterson (1973) compared the perceptions held by principals, counselors, and apprentices of various influences on individuals. While the results supported critics who claim that educators have inaccurate perceptions of students preparing for vocational areas, they also included a positive element, that educators and apprentices agreed on one factor: they perceived industrial

arts and business education as being the most valuable practical high school area to apprentices.

Stock (1974) also sought to document some of the effects of industrial arts on post high school vocational education performance. However, his data did not support the profession's contention that industrial arts has a significant effect on subsequent vocational performance. With reference to vocational performance, he reported that industrial arts experience, in general, did as much for the group that took industrial arts as the academic program did for the group which took it. The significance of such a finding needs to be interpreted in the light of the difficulty of distinguishing between some stated implications of industrial arts and vocational education at the high school level. For example, in the study by Pendleton (1973), the opinion that industrial arts and vocational education courses seemed more similar than different was expressed as an outcome of the observation that high school industrial arts instruction tended to be somewhat vocational in nature.

The literature reviewed did not seem to contradict the position that, in addition to an overstatement of the "effect potential" of industrial arts on subsequent vocational education performance, the case for industrial arts contributing to the occupational information and work attitudes of its students also has been overstated. Certainly West's (1969) comparison of industrial arts, IACP, and nonindustrial arts groups did not conclusively contradict such a position. Nor did Norton's (1974) study provide useful information to the advocates of industrial arts. His investigation of the effects of industrial arts on student attitude towards work resulted in the finding that industrial arts did little to affect student attitudes towards work. In fact, a sixth grade non-industrial arts group indicated a more favorable score than the traditional program. Two variations of the typical approach, the World of Work and a unified arts program, did not yield different results either. Such results can, of course, be attributed to weaknesses in methodology or instrumentation. However, one of Norton's findings suggested the presence of another confounding influence, namely, one of maturity and, indirectly, the out-of-school unintended learning that occurs. This may be inferred from reports that attitude towards work declined as grade level increased.

The importance of out-of-school influences was supported by Harbaugh's (1974) study comparing the career maturity

attitudes of IACP, conventional, and non-industrial arts students. Using Crites' Career Maturity Inventory Attitude Scale (CMI), Harbaugh indicated that, as contrasted to the type of industrial arts course work, parents' educational attainment was significantly related to career maturity attitude in a positive way. Using disadvantaged students experiencing two different treatment modes (pre-vocational exploration *versus* vocational training), a parallel study by Cicchetti (1974) essentially supported Harbaugh's findings. Again, the hypothesized effect of systematic treatment on career maturity as measured by the CMI failed to be supported by the data. However, an additional insight emerged in that, regardless of treatment or control, a significant linear relationship between the CMI pretest and reading achievement scores was identified. While Riner's (1978) study was similar to Harbaugh's and Cicchetti's, his analyses found small treatment attributable to career maturity gains. However, the percentages of variance accounted for do not provide any significant support for our profession's claims. Osgood's (1977) investigation documended a significant relationship between industrial arts experience and career maturity but not between industrial arts program influence and career choice. These four studies constituted a valuable beginning for understanding the influences of industrial arts. A detailed retrospective analysis combined with an orientation towards experiments would serve our profession well.

The effect of industrial arts compared to academic and vocational curriculum on the probability of dropping out was investigated by Gadbois (1968). After matching twenty-four students according to an overall dropout potential profile, students were followed through graduation. Gadbois concluded that vocational and industrial arts curricula had greater holding power than the academic tract. However, no distinction was possible between industrial arts and vocational education.

The assessment of Kentucky's practical arts program was conducted by Adams (1977) who measured teacher, student, counselor, and principal attitudes toward the practical arts program and student career development. She found that students with a practical arts experience scored higher on the assessment of the career development instrument than did those who were not in the program. Goodness (1978) also reported that industrial arts contributed to the career awareness of third grade students.

SUMMARY

One of the more comprehensive compilations of the industrial arts relationship to guidance and counseling is contained in the ACIAS (1971) booklet, *Guidance in Industrial Arts Education for the '70s*. It outlines guidance functions, school programs, teacher roles, materials selection, occupational orientation, and instruction in a terse, effective manner. Industrial arts teachers also will appreciate the list of resource agencies classified by subject area relevance.

For the most part, however, personnel and guidance related studies are surprisingly scarce. There have been relatively few studies involving vocational choice and industrial arts. For a field that has claimed to provide significant exploration and awareness level activities in career education (at least in four of the USOE clusters), industrial arts has not evidenced any significant degree of interest in terms of its impact on occupational choice of students who have experienced it. Neither of the two possible directions for such research have been explored to any significant extent. Both the contributions of industrial arts to occupational choice and the effect of occupational choice on industrial arts deserve greater attention.

Student characteristics have been the focus of a number of studies. However, we are left with an unclear profile of industrial arts enrollees. Are they like the norm of students in general or do they represent an identifiable subset? Their age, sex, and performance attributes are not easily discernable. In terms of the studies on the effect of industrial arts, particularly with respect to counseling and guidance, it seems appropriate to say that our profession, in fact, may have overstated its case. Many of the benefits attributed to industrial arts are not well documented, particularly as they relate to attitude and achievement claims. Perhaps this is true for other disciplines as well. Even if it were, what consolation would that be to our specific profession?

FACILITY AND RELATED STUDIES

Due to the central focus of applied learning in industrial arts, the facilities become an important part of the delivery system. The studies reviewed investigated facility-program interaction in terms of three major categories: facilities, equipment, and safety. Most studies were in the facilities category and dealt with planning, noise, and mobile approach.

FACILITIES

Planning

One comprehensive treatment of this issue was compiled by Moon (1975), editor of the ACIATE's 24th Yearbook, *A Guide to the Planning of Industrial Arts Facilities*. Besides reinforcing the importance of the planning process, Moon and his contributors described the implications of new programs on facilities and facility evaluation procedures. Recognition of the link between environment and educational activity prompted Engelke (1973) to derive general industrial arts facility specifications from an examination of the physical, psychological, and educational needs of both students and teachers. In using data from industry, an earlier project by Moon (1968) addressed the same linkage. Van Dyke (1970) also pursued a related topic. While Moon surveyed manufacturing concerns, Engelke developed a list of educational, psychological, architectural jurors. Both studies evolved lists useful for education planners. The aspects of Engelke's two highest rated factors pertained to the desirability of providing a variety of space and a design that encouraged interaction between subjects. Moon's findings, in contrast, were reported as generalizations of contemporary manufacturing practice. Perhaps the most significant was the verification of a process classification using the categories of forming, casting/molding/shaping, cutting, joining, and auxiliary. Moon's and Engelke's lists of desirable facility characteristics were augmented by Van Dykes' call for provision of screens, carrels, television cables, and adjacent rooms for related instruction, demonstrations, and individualized learning.

The planning process itself was investigated by Smith (1969) who

attempted to determine the role of industrial arts teachers in new facility planning as perceived by teachers, superintendents, teacher educators, and architects. Not unexpectedly, the educators as a group agreed to a greater extent than the architects, who reported limited industrial arts teacher involvement in the past and pointed out their inadequate preparation in planning for innovations. The architects, however, felt that industrial arts teachers should review and evaluate the architects' plans, but at the preliminary stage. In contrast, the educators indicated that it would be essential for industrial arts teachers to be involved in determining the educational objectives of the industrial arts department; the courses offered; the course activities; the approximate square feet needed in each instructional area; the number, location, and type of electrical outlets, and the types of shops to be planned (general, comprehensive, or unit). Also treating the planning process, Rebhorn (1973) outlined a very systematic yet humanistic approach. The six-step sequence entailed the development of an educational overview, the identification of activity spaces, evolution of spacial relations diagrams, building design, equipment layout, and detailed specification of equipment, materials, and supplies. Stallsmith (1973) also addressed design solutions to the imperatives of curricula flexibility and Anderson (1973) summarized middle school laboratory design trends. In introducing the American Council of Industrial Arts Supervisor's new *Guide to Preparing Educational Specifications for Secondary Industrial Arts Facilities*, Steeb (1976) effectively summarized the concept of such specifications as the first phase in facility planning.

Wiggins' (1978) study was the most comprehensive survey of teacher education physical facilities. Using a standard evaluative questionnaire, he collected data from twenty-six industrial arts teacher educators in Arkansas, Missouri, Kansas, and Oklahoma. He found that considerable renovation was necessary and that the facilities were not presently meeting student needs. The data also indicated a diversity broad enough to preclude regional correlation with quality or the establishment of a standard facility for this area. Recommendations included effort toward constructing a new facility evaluation instrument and the establishment of advisory councils.

In terms of usability, the reports by Wenig (1969) and the University of North Dakota (1978) represented very valuable sources for the practitioner. The former presented a brief overview of key facility planning guidelines. The university presented detailed specifications for planning facilities and equipment additions. Bro's (1979) report

also contained a succinct outline of essential facilities information.

Noise

The phenomenon of noise and its effects received considerable scrutiny by industrial arts researchers. Bailey (1974), Hicks (1974), Monfette (1974), and Rost (1974) all investigated this topic. Perspectives ranged from compliance with Occupational Safety and Health Act regulations (Monfette) to the effects of hearing protectors on teacher student interaction (Rost). The former study, concentrating largely on vocational facilities, demonstrated that ambient sound levels hindered normal speech communication in nearly all facilities. Two types of programs, welding/cutting and aircraft maintenance were in violation of OSHA provisions. Carpentry, auto body, and diesel mechanics programs had levels near the limit. Hicks' (1974) investigation of Utah's industrial education laboratories confirmed the existence of a potential safety and health hazard by finding that, while most laboratories were in compliance, many exceeded the maximum allowable limits. Furthermore, the finding of a disparity between teacher opinion and actual measured noise levels was highlighted. Somewhat contradictory, Bailey's investigation of secondary woodworking laboratories pinpointed the surfacer, cutoff saw, and table saw as being in excess of 90 decibels. However, based upon the assumption of a one-hour class length, Bailey concluded that the exposure received by either students or instructors (with five classes per day) would be considered safe. Interestingly, since some of the studies identified noise variability as a factor of machine condition, one is tempted to wonder about the generalizability of the results or if machine variance (error) or brand variance exceeded systematic variance. Despite such unanswered questions, Jacobson and Shadowens' (1977) rather definitive noise analysis concluded with the view that there is an immediate need to institute hearing safety measures. They wrote, "Industrial arts teachers and educational administrators should begin to teach hearing safety...and it should be a requirement that all personnel wear appropriate safety devices" (p. 24).

Rost's (1974) study of the effects of hearing protectors on teacher-student interaction is valuable because it addressed the criticisms of some traditionalists that newly imposed safety regulations interfere with the instructional process. Using Loepps' (1970) industrial arts Interaction Analysis System, Rost established that

the use of hearing protectors did not significantly alter the amount of teacher-student communication. Cliffe (1978) provided useful information as to how teachers can actually implement hearing safety. The desirability of such action was documented by Jewell and Wenton's (1978) report on the effects of noise on reading comprehension and task completion time. While we may be extending ourselves by including this vocational laboratory study, because the nature of noise emanating from vocational or industrial arts laboratories is likely to be similar, the study was included. The findings were that as noise intensity increased, reading comprehension decreased and the time required to complete the assigned task increased.

Mobile Facilities

Because of the expense of equipping technologically appropriate facilities, some attention has been paid to the use of transportable facilities. In this way, schools could avoid duplication and, at the same time, could offer a wider variety of learning experiences. Schwalm's (1969) evaluation represented an early assessment of the effectiveness of such an approach. In terms of student and teacher performance, the laboratories were an unqualified success, according to the researcher. It should be noted that this project represented one of the few industrial arts efforts supported by the Elementary Secondary Education Act. George (1973) then comprehensively described a system of rotational team teaching using mobile facilities. Laboratory design, personnel needs, instructional methods, and content considerations were all outlined in this highly speculative article.

Several insightful, and some contradictory, findings were reported by Damon (1974) as a result of evaluating the effectiveness of mobile fluid power laboratories in Minnesota and Wisconsin. Most importantly, the data demonstrated that significant learning took place and that the mobile program was more effective than those with limited institutional bases. With respect to the financial aspects, however, it was reported that the mobile program represented no significant financial advantage over other delivery systems, when compared on a sixteen school basis. Despite this aggregate finding, the mobile approach represented a significant advantage to any given school. Given the rapid obsolescence of fixed facilities, Damon speculated that the mobile approach could prove to be the most reasonable over a period of time.

Equipment

Three studies addressed the issue of equipping industrial arts facilities. Tuttle (1974) analyzed digital logic training systems, Brook (1977) evaluated laboratory electronic systems and Homoly (1975) pursued the feasibility of fabricating semiconductor devices. The former pointed out that digital logic training systems are one of the most valuable vehicles in teaching digital logic circuitry. He developed a list of criteria to be used in the selection of such systems. Rather than dealing with extant hardware, Homoly developed a unique approach to semiconductors by piloting methods of fabricating these in existing industrial arts laboratories. Included with his dissertation is a monograph detailing the procedures he developed which were reported feasible in terms of time and cost demands. A quasi-experimental comparison of commercial and teacher-developed electronic instructional systems was conducted by Brook (1977). With criterion objectives pertaining to integrated circuit concepts, the data warranted a conclusion that both systems were effective.

A fourth equipment study involved a comprehensive installation of a total laboratory package of thirty-eight mediated self-contained modules. While using many traditional smaller tools and machines, these modules represented a drastic change in the nature of the laboratory. Additionally, their curriculum was significantly targeted toward career education's exploratory objectives. Jervig's (1978) evaluation of the system which was installed in eight junior high schools indicated that it functioned well, students participated positively, and a single teacher could manage the facility. Some need for revision was noted, as was the need for comprehensive preparing of students and instructors.

With the national impetus towards metrification, Lindbeck (1976) outlined the costs of drafting, wood and metal working, and graphic arts metrification. Developed as part of the National Center on Metrification's program these aids supplemented the Center's curriculum units.

Safety

Charlesworth (1968) presented a constructive approach to accident prevention in a dissertation safety manual. He emphasized methods of dealing with human factors, identified as the cause of most accidents, and suggested that observant instructors can correct unsafe acts before injuries occur.

He also advocated safety education programs that teach students to "foresee and forestall" danger. To encourage such approaches, he recommended that the usual negative reporting of safety statistics be refocused to stress the positive side of enumerating accidents prevented and protection received.

A program similar to that recommended by Charlesworth was prepared by the California State Department of Education (1978). The document was designed to enable administrators and teachers to develop a safety education program that conformed to state requirements. The guide provided information as to the applicable laws and regulations, facility and equipment requirements, and teacher liability. Additionally, it supplied a facility safety inspection list and an outline of an industrial education safety instruction program. Similar information was compiled in Bro's (1979) handbook on organization and administration of industrial arts.

In recognition of the industrial arts teacher's increasing vulnerability to legal action, Kigin (1973) investigated the sources of, and remedies for, teacher liability and a summary of related state regulations and court cases. While these are now dated, they represented a significant point of departure that should be updated continuously. Of approximately the same vintage as Kigin is St. John's (1971) review of the status of legal requirements for eye protection in each state of the union. Related preventative concerns, but in this case referring to particulate contamination, were embodied in Worthington's (1971) article. While exhaust equipment was found to reduce air contamination, considerable differences in machine effectiveness were noted, as were the effects of other factors than ventilation.

SUMMARY

The relatively small number of studies included in this area is surprising, considering the facility and equipment intensive aspects of industrial arts. The planning process was among the better documented areas, for surely the size of investment represented by an industrial arts facility demands careful planning. Evaluative procedures and checksheets also were in evidence. However, in the absence of any documentary research reports, we are left to speculate as to the supportability of these checksheets. How are such lists validated? The relatively small numbers of status studies that actually described the condition

and extent of K-12 industrial arts facilities also is surprising. In addition, standardized lists of equipment were not found in general use.

In terms of anticipated research, we found more than the expected attention devoted to the effects of noise. Conspicuously absent, however, were investigations of the effects of supply and budget quality; light, color and air quality; laboratory arrangement; and the impact of equipment on learning. Nor has the identical element approach to laboratory equipment been subjected to experimental verification.

Safety, as might be expected, received some attention but less than we would consider appropriate. Fire and carcinogenic hazard status studies were two untouched areas. Actual safety statistics and incidents of accidents also were found to be absent in the literature. The reviewers' personal knowledge of a new system currently being implemented in New Jersey will allow educators to be alerted to such descriptions in the future. However, with millions of youngsters participating in industrial arts nationwide, the absence of normative data seems professionally irresponsible.

It would not be fair to end this summary on such a negative point. A most positive resource to the field must be mentioned. The NAITTE's *Accident Prevention Manual*, edited by Strong (1975), represented a significant contribution to the safety in our profession. The contributing author's treatment of safety design, accident prevention, light, arrangement, equipment, guarding, and other related matters compel our attention. The book should be mandatory reading for all.

EVALUATION

The studies on evaluation were divided into major categories: the development of tests/instruments, interaction analysis, program evaluation techniques, and the effects of evaluations. Only studies with a major rather than incidental emphasis on evaluation were included.

TEST DEVELOPMENT

Researchers reported efforts to develop tests and evaluative instruments in the areas of basic psychomotor skills, power/automotive mechanics, drafting, and construction technology. Additionally, the most difficult task of instrumenting the concept of technological literacy was begun by Shepherd (1978). A thoughtful exposition of criterion - referenced measurement, its development, uses and potential abuses was compiled by Day (1975).

Anderson (1970) sought to validate a battery of power performance tests to predict the job performance of blind students; essentially it was a test of their basic manipulative abilities. The results validated the use of the battery as a success predictor for sheltered workshop tasks; however, the four tests did not differ from existing speed tests.

Various approaches to power/auto mechanics were tried by Cooksey (1973) and Williams (1974). Cooksey validated a cognitive achievement test for students preparing for industrial arts teaching. Williams pursued the link between cognitive testing and job performance by developing a paper and pencil automotive mechanics achievement test that would substitute for performance testing. The results indicated that on-the-job success could not be predicted, regardless of paper and pencil test success.

The general area of drafting served as the framework for research by Biewald (1969) and Krantz (1970). Both sought to demonstrate techniques that would predict the ability of students to solve visualization problems. Biewald, who developed a test of five basic ideas of orthographic projections, reported results from a national sample

that were highly favorable in terms of reliability (.93), validity, suitability, and equivalence. Less conclusive findings were reported in Krantz's attempt to develop a design test to evaluate student ability to solve problems visually, intellectually, and manipulatively, using geometric forms. While he found that the test was able to predict college student performance, the test contained an inconsistency with respect to the performance of upper ability students.

As part of the large scale IACP effort, Young (1968) developed a construction industry interest inventory. The revised instrument was felt to be of use to counselors and job placement advisors. Young pointed out the feasibility of developing an interest inventory that dealt with industrial technology through the incorporation of a manufacturing scale.

Recognition of the evoluti n of industrial arts into a more broadly based techno gy is dealt with in Shepherd's (1978) investigation of tle's Experiential Inventory. Shepherd's work establi d an important cornerstone in the effort to measure a technological literacy. However, he pointed out that considerably more developmental efforts were necessary.

The potential value of a standardized industrial arts examination was not lost on the Educational Testing Service. In the late 1960s, ETS developed a set of examinations labeled the Cooperative Industrial Arts Tests. [Note: A specimen set is included in the ERIC system, 1969.] These examinations provided for an individual test for the subject areas of woods, metals, electricity/electronics, and drawing, as well as one general industrial arts test. While some norms have been reported, the standardization and validation of these tests have not been their strength.

A more successful ETS effort is reported by Wasdyke in the AIAA's (1971-1973) pamphlet, *Focus on Undergraduate Teacher Education*. Dealing with the industrial arts portion of the National Teacher's Examination, Wasdyke briefly chronicled its development. In a companion article, Dyrenfurth (AIAA, 1971-1973) explored the possible impacts of this examination. Six years later, these authors deliberated the rationale and the professional control mechanism required for a standardized national industrial arts examination (Dyrenfurth, 1979).

INTERACTION ANALYSIS

Both Loepp (1970) and Fahrlander (1972) developed interaction analysis instruments that allowed systema .c recording and analysis of teacher behavior in technical facilities. Loepp specifically designed his instrument for industrial arts situations; Fahrlander used the larger scope of vocational education and practical arts programs. The former's validity and usefulness were established in the original study as well as by Kruger (1971). Both Fahrlander's and Loepp's techniques demonstrated potential for analyzing teacher behavior, identifying its causes, and characterizing the quality of observed interactions. In the light of the need to establish the profession's benchmarks, Kruger's study presented a particularly useful description of what actually transpired between teachers and students in industrial arts settings.

PROGRAM EVALUATION

Program evaluation represented a completely different application of evaluation methodology than those reported in the preceding sections. Of the studies assigned to this category, three (Stangl, 1968; Burroughs, 1970; Warrick, 1956) identified evaluative criteria for secondary school industrial arts programs. Borum (1969) documented the comprehensive evaluation of a single pretechnology program. In addition to these developmental efforts, the Arizona State Department of Vocational Education (1969) provided an evaluation checklist for intermediate level industrial arts. Dyrenfurth (1970) attempted a critical evaluation of the University of Alberta's Industrial Arts Research Program. The first-mentioned study is noteworthy because its checklist embodied the evaluative areas of curriculum, organization, instruction, student evaluation, equipment, materials, teacher qualification, and facility. Dyrenfurth, on the other hand, attempted a multipronged approach that combined interview, documentary, observation, and analytical techniques to a departmental research program.

Each of the criteria development studies used essentially a similar methodology of abstracting recommendations for the literature and revising and validating the tentative criteria by means of a jury. In contrast to the perspectives of Burroughs and Stangl, Warrick used a jury representative of the national perspective. Both Borum and Stangl grouped their criteria into the areas of curriculum, physical facilities, and teacher preparation. As a result of both developmental procedures and trial applications, each

reported the development of instruments useful in the evaluation of secondary school industrial programs. Additionally, the trial applications would seem to provide evaluative descriptions of the status of industrial arts in South Dakota (Burroughs) and Colorado (Stangl). A distinctly different, nonnormative approach was employed by Borum's case study of the evaluation of a single pretechnology curriculum. Employing a wide range of data inputs, he presented an indepth documentation of the program using an organizational framework for the analysis of innovations that he attributed to Miles. The study subsequently was designed in terms of a format that would be useful to guide the school principals' decisions and actions.

A different set of evaluative approaches is presented by Loveless (1972) and by the critiques of industrial arts' high school programs contained in Lockette's (1973) ACIATE Yearbook. Loveless, for example, identified student interest, economic feasibility, and course nature as the key criteria for program evaluation. Haynie (1978) supported other efforts in program evaluation in his AIAA presentation. In doing so, he analyzed several prominent existing models before arriving at his view of this process. Specifically, he pointed out the importance of identifying exactly what needs to be evaluated, being cost-effective, and developing mechanisms that will encourage the use of evaluation data for program improvement. Nowhere is attention directed so much on these and related issues as in the accreditation process. Intended as formative evaluation, this nationwide effort exists at public and private schools and postsecondary institutions. In spite of impressions that all versions of accreditation are facing careful scrutiny, little or no research involving industrial arts and accreditation came to our attention. The most significant document was the set of standards and guidelines for undergraduate teacher education programs originally developed by the ACIATE's Accreditation Committee (1973). Important because they represent standards for quality undergraduate programs, the areas in which guidelines were developed are as follows: curriculum goals, specialty content, general studies, teaching and learning studies, practicum, resources and facilities, organization, faculty, student services, evaluation, and planning.

Innovative programs also have generated evaluation studies. Methodologically, some of these were suspect, due to the inherent tendency of innovators to focus on development and implementation rather than careful evaluative research. The reader should note that the aforementioned IACP was a

notable exception. Additionally, the American Industry System also documented careful evaluation procedures (Nelson, 1969) that deserve the scrutiny of serious curriculum researchers. We would note that it seems not entirely coincidental that these two projects involved the greatest critical mass of support among innovative programs.

EFFECTS OF EVALUATION

Of the seven studies in this category, five were variations of meta-evaluation, that is, the assessment of evaluation itself. Each of the five used a comparative approach in which two techniques (dichotomous ends of an evaluative methodology) were investigated as to their differential effects. All but one (Landecker, 1969) dealt with college level students and only one, Campbell (1976), provided a synthesis of grading practice research.

Test difficulty was investigated in a power mechanics course by Daines (1968). Gains associated with low difficulty testing were significantly higher. This approach also was demonstrated to be effective in terms of high ability students. Low ability groups did not record significant differences attributable to test difficulty. Lyons' (1969) study of the effect of conceptual emphasis indicated that this variable did not significantly manifest itself on posttest achievement in electronics. A study of similar nonequivalent control group design by DeLaura (1974) explored the achievement and attitudinal effects of criterion-referenced, as compared to norm-referenced, measurement. The study concluded that criterion-referenced measurement techniques were superior in terms of student achievement of objectives. Beyond the similarities of A *versus* B comparison methodology, the studies by Daines, Lyons, and DeLaura all investigated student attitude towards the evaluative variable. Despite the variability of the effects of the independent variables, it must be noted that none of the studies reported a student attitudinal variation attributable to test differences.

Holland's (1973) comparison of the effect of the insertion of evaluative items into instructional audiovisual programs, however, resulted in attitudinal differences in favor of their incorporation. While performance also was significantly higher (4.7 percent) for groups taught with such items included, retention was not systematically affected. A study to investigate the effects of delayed-response learning guides, as contrasted to immediate-response teaching tests, was conducted by Landecker (1960). Both experimental methods

resulted in significant achievement gains over a control method of conventional instruction. Attitudes reported by the students, however, generally favored the learning guides.

Competency-based teacher education was the focus in Branch's (1974) comparison of student-managed and faculty-managed assessment. Specifically, she sought to assess the validity of each technique as applied to microteaching performances. While some conflicting results surfaced, the researcher tentatively accepted the hypothesis that student-peer panels can assess microteaching competencies as validly as faculty.

In a study that approached the test characteristic-effect linkage from a unique perspective, Lawson (1973) investigated the test preference of undergraduate industrial arts majors. He sought to determine whether there was a relationship between the emphasis of teacher education programs (traditional *versus* contemporary) and a graduate's preference for standardized achievement items of equivalent emphasis. ETS's Cooperative Industrial Arts Tests and the IACP Achievement Tests served as sources for both sets of items. While some mixed results were reported, the researcher reported the existence of a direct relationship between program emphasis and question preference. In general, however, respondents who indicated career goals at the junior high school level rated the contemporary content higher.

SUMMARY

Considerable strength was evidenced in the field's attention to program evaluation. Considering the evolutionary stage we are in, this represented a commendable characteristic. Another relative strength was the development of suitable interaction analysis systems. Together these areas represented both macro and micro-focused attention to quality that is vitally necessary to effective solution. Unfortunately, however, despite collections such as the AIAA's special issue of *Man/Society/Technology* (1974), there is not yet a critical mass of evaluation research. The lack of standardized tests to measure achievement of any of industrial arts' key objectives is noticeable. For example, where are the tests to substantiate industrial arts' contribution to avocational education, career education, technological literacy, consumer education, industrial understanding, and basic skills? Have procedures for such affective and attitudinal characteristics as teacher

commitment been developed? Despite the existence of many very interesting studies, we have observed a rather fragmented and *ad hoc* approach to evaluation.

TEACHER EDUCATION

Depending on one's viewpoint, the number of reported research studies on teacher education may be interpreted with varying degrees of desirability. On one hand, it is a characteristic of a true profession to strive to improve practice through R and D. However, contrasting views exist. Perhaps these views are best stated by these questions: Why is there a predominance of college level studies? Why are there not more studies of practice at the K to 12 levels? Such considerations seem worthy of the attention of those who initiate, guide, and conduct research in this area.

The large number of studies in this section necessitated the use of a systematic structure in order to deal with their commonalities. One such system is presented in Ray and Streichler's (1971) ACIATE Yearbook. However, instead of their goal, content, and method approach, the reviewers chose to use a somewhat arbitrary organization corresponding to the chronological sequence of progress through teacher education. This is outlined below:

- Recruitment
- Organization and Administration
- Undergraduate Programs
- Student Teaching
- Graduate Programs
- Program Evaluations
- First Year Teachers
- Inservice Education

RECRUITMENT

Until recently, the profession has not shown great concern regarding numbers of students preparing to enter it. Perhaps

this was due to a favorable supply and demand ratio or because its attention was, in fact, concentrated on matters of quality. With the rising number of states reporting teacher shortages and the increasing competition for students, recruitment is receiving greater attention. Larson (1969) solicited the opinions of teacher educators to determine the variables that have the greatest influence on recruiting prospective industrial arts teachers in electronics. The only significant predictor was found to be the overall number of industrial arts majors in teacher education. Therefore, in order to increase the number of prospective electronics teachers industrial arts departments were advised to increase their overall enrollment. In addressing the "within department" attractiveness of electronics, Larson pointed to the desirability of projects and an accompanying emphasis on current technology as a prime motivational area.

Jenkins (1975) studied the role of industrial arts teachers in the recruitment of prospective teachers. The study also provided current information describing the general influences on student enrollment as industrial arts majors. In order of decreasing influence, people of importance to industrial education enrollees were parents or relatives, student peers, teachers, industrial representatives, and counselors. For those who had industrial arts in high school, the industrial arts instructor was the most influential person.

Chen's (1977) study of university graduates revealed an alternate set of influences that differentiated between type of enrollee. For those who transferred from within the university, counseling center input and interviews with industrial arts faculty and friends were the most important influences. For those who transferred from other institutions, the last two of the preceding items were most important. For freshman entry students, high school industrial arts teachers and courses were the prime influences.

Since Larson earlier noted that approximately half of the industrial education majors entered college in a curriculum other than industrial arts and one quarter made the decision to pursue industrial arts at the end of their freshman year, Chen's insights are particularly valuable. Larson summarized the most effective recruitment practices as follows: the encouragement of hobbies related to industrial education, and participation in industrial arts fairs and contests. Despite Larson's findings, it seemed obvious that at some time other techniques will have to be employed. The use of slide-tapes for recruiting was researched by Eversoll (1971). His programs presented occupational information relevant to a career in teaching industrial arts. The data indicated

that slide-tapes can be used to alter attitudes and transmit knowledge of industrial arts teaching to students. It also indicated that the technique was more effective without distractors built into the program. In another media study, Weir (1970) evaluated the recruiting effectiveness of two alternative forms of printed devices. While the measured effect, as well as the between-treatment differences in effect, were small, Weir recommended a newsletter recruitment format. In contrast to Weir's delimited study, Foley's (1967) national survey asked 444 college students and department chairmen to identify the most effective recruiting practices, including contracts with industrial arts teachers, high school visits by faculty, career days, project contests, and contacts with counselors. Foley's handbook also listed some of the reasons for choosing an industrial arts major, e.g., personal enjoyment of such activities, satisfaction from teaching, contribution to students, enjoyment of youth, fringe benefits, and employment conditions. Since twelve years have elapsed since this study, a replication would be useful.

The study of the relationships between various characteristics and ultimate success in industrial education is, of course, related to recruitment. Investigations by McWethy (1973), Kilbourne (1971), Griffin (1970), and Wargo (1968) pursued this topic. The former determined the effects of high school size and course program on college success. While results did not support high school size as a significant factor related to success, the number of high school semesters of industrial education demonstrated the expected positive relationship. McWethy also identified the frequency of student major change as being negatively related to overall success but of little relationship to industrial education GPA. Kilbourne's study of high-risk students, as identified by admissions personnel, concluded that most will become relatively successful and that they typically reported satisfaction with the value of their college experience.

Griffin's examination of the relationships between high school courses and achievement in industrial arts teacher education surfaced some unexpected correlations, for example, an inverse link between the number of high school industrial arts courses taken and teacher education GPAs. A positive relationship also was identified between mathematics and industrial arts grades for high and medium ability students and a negative one for low ability students.

Employing an analytical orientation more than a recruitment one, Wargo studied the relationships between undergraduate attitudes and their achievement orientation. He found that

industrial arts students with one or more years of work experience were significantly more oriented towards luck, control, and effort than acceptance and ability. Students with higher GPAs were more oriented toward effort than luck.

Sex equity concerns also contributed to the increasing attentic on recruitment. Baron (1974), Aagaard (1975), and Kane et al. (1976) each discussed female recruitment. These studies have been described in the section on human resources.

Population demographics and their effects on industrial arts were explored in the Mississippi Valley Conference's 1978 meeting. Stephens (1978) summarized some rather startling and far-ranging statistics; Conley (1978) outlined teacher education faculty implications and the findings of a related survey; and Goetz (1978) presented recommendations for the retention of industrial arts preservice teachers.

Certification is a major professional concern related to recruitment. McClean and Nagel addressed it in their 1973 Mississippi Vally Conference assignments. The former outlined differences in certification between industrial arts and vocational-industrial teachers; the latter broached the issue of state *versus* national certification standards. With industrial arts' increasing liaisons with state vocational education departments and with the increasingly evident industrial arts teacher shortage, these topics are urgent professional concerns, if we are to maintain quality and identity.

Quality also was the concern of Feirer and Lindbeck (1971) in their description of partnership possibilities between two- and four-year institutions in the preparation of industrial education teachers. Two articulation schemes, the partnership and the pyramid models, were advanced. The former involved joint advanced planning of insitutional contributions to an overall program. The pyramid program, in contrast, simply capped a two-year technical associate degree with an additional two-years of professional and academic courses as necessary. Dean and Lathrop (1971) also provided a perspective, based largely on the California experience, on the preceding topic of articulation. In fact, they extended the discussion to involve guidelines for an overall state system of articulation. Eddy (1971), Littrell (1971), and Atteberry (1971) shared further points on these issues.

ORGANIZATION & ADMINISTRATION

More than any other document, the National Status Study of Industrial Arts Teacher Education (Chaplin/ACIATE/NAITTE 1972 and 1974) provided an analytical overview of the profession's rejuvenation vehicle. In order to do that extremely comprehensive document justice and to provide the best picture of our profession's teacher education component, the reader is encouraged to consult the original report, available from AIAA, NAITTE, or ERIC.

Despite the fact that leadership of teacher education typically is considered a hallmark of success in the higher education career ladder, few studies dealt with this topic. These ranged from studies of articulation among programs (Dirksen, 1969) to those dealing with personnel (Brenckle, 1968; Ward, 1974). In order to develop guidelines to assist transfer students, Dirksen analyzed linkages between two year and four year colleges. He determined that two year colleges limit industrial arts programs and that both two and four year colleges would be more effective if they were to engage in joint planning, counseling, area school linkages, and exchange visits. Two year college offerings of four six-hour industrial arts area blocks of study were recommended, as was the publishing of lists of courses acceptable toward transfer into four year industrial arts major programs.

Personnel concerns served as the focus of both Brenckle's and Ward's studies. The former surveyed state directors in order to identify standards used in the selection of industrial education instructors for the junior college. He found that vocational certification standards as well as the basic core of terminology varied greatly among states; the latter varied particularly among state departments, junior colleges, and four year teacher training institutions. This variability certainly must make the task of providing and placing junior college instructors an urgent need identified by Brenckle, more difficult. An additional relevant finding was that industrial arts teacher preparation was an acceptable qualification for junior college instructional positions, providing such candidates had the job experience required for state vocational education certification. A different approach was employed by Ward (1974) in his efforts at developing a profile of the characteristics of industrial teacher education personnel employed by traditionally black institutions. Well documented in terms of descriptive statistics, the faculty was described as 98 percent male with low mobility outside of the southern geographic region;

doctorates were held by 19 percent, master's by 72 percent, bachelor's degrees by 6 percent and 3 percent were without degrees.

Russell's 1978 Mississippi Valley Conference presentation focused on personnel aspects of teacher education. His presentation provided a thoughtful review of the literature's recommendations for workshops and seminars, mini-sabbaticals, retreats, media centers, peer-evaluation, student evaluation, task reassignment, conference attendance, and work experience.

The impetus for individual professional development effort often is thought to result, appropriately, from a variety of faculty evaluation techniques. Swanson & Sisson (1971) described an appraisal system that not only integrated student, faculty, and chairman ratings into an effective whole but that subsequently documented an open and viable method of using the results to guide salary, promotion, and retention decisions. Of course, this provocative system, as with all other forms of evaluation, does evoke some crucial issues (e.g., Fentress & Swanson, 1975) which while they may temporarily be resolved at a given institution -- are still a long way from universal acceptance.

UNDERGRADUATE PROGRAMS

Descriptions

The AIAA (1971-1973 b, i) published two booklets, *Focus on Change in Teacher Education* and *Focus on Undergraduate Teacher Education* that contained individual treatments of a crossection of topics related to industrial arts teacher education. Program strengths and weaknesses, internships, the National Teachers' Examination, implementation of change, and departmental profiles were treated by the various authors. However, despite these complilations, descriptive approaches characterized the bulk of the studies that pertained to undergraduate programs. Most represented single investigations of a topic with only "open education" pursued by more than one researcher.

Betts (1975) determined the extent and method of implementation of selected innovative industrial arts programs. His respondents indicated that the IACP was the most widely implemented (55 percent) and the American Industry Project followed with 14 percent. He also indicated that contemporary teacher education programs centered on materials and processes, graphic communication, and power and energy. Due to his finding that innovative programs were used primarily for

exposure purposes, and then only for relatively small amounts of time, he concluded that there has not been extensive utilization of such programs in undergraduate teacher implementation.

The results of a major team effort, headed by Rudisill (1974), toward assembling an innovative industrial arts teacher education program were contained in an AVA presentation. Of special interest is the creative synthesis of essential facility, curricula, and methodological innovations in a manner that mutually reinforced each. It seems clear that at least this one institution (University of Northern Iowa) achieved the implementation that Betts identified as lacking.

A unique fellowship program at West Virginia University resulted in developing a program that its proponents claimed should be the target of our nation's premier institutions. In *Industrial Arts Teacher Education Fellowship Program in the Technologies: 1969-1970*, the fellow proposed not only a rationale and structure of a model program for the education of teacher-scholars in technology, but they also presented a model of technology as a base for industrial arts teacher education. The model's various components included the general cultural core, technology core, professional preparation, multidisciplinary thrusts, and learning center efforts. More visionary than most, the model presented by Devore and his colleague served the profession by illuminating one of our alternative futures. Readers are advised to regard it in this light rather than a blueprint for implementation.

Trott (1978) conducted a unique nationwide investigation of industrial arts teacher education. His respondents, AIAA Teacher of the Year award recipients, were asked to identify common teacher education patterns, comment on the adequacy of preparation, rate the importance of teacher education components, and comment on student teacher preparation. Trott also noted what should be a highly challenging finding to our profession, namely, that there were several areas of undergraduate teacher education that were inconsistent with the demands of employment. Despite this, most components were rated as very important. The data also indicated that student teacher performance was somewhat marginal.

Open education was first explored by Zurbuch (1973) in his study of the acceptance it received by industrial arts teacher educators. Subsequently, Rumble (1975) developed a teacher education guide that had applicability to industrial

arts. The historical and documentary approach by Zurbuch was particularly interesting in that, contrary to the relatively recent emergence of the concept, industrial arts teacher educators were found to have held such views for some time. Zurbuch concluded that industrial arts is best when conten' is drawn from technology and its methodology from open education. This view seemed to be accepted by Rumble, as attested by the development of a course designed to aid the implementation of open education concepts by industrial arts teachers. This course, developed out of a systematic literature review and by interviews and surveys, incorporated the essential findings of his developmental efforts. As such, it was based on incorporating industrial arts into the elementary school open education classrooms and their use of the widest variety of materials and activity. Emphasis, however, was placed on the technologies concerned with manufacturing and a thematic approach was recommended. A comprehensive synthesis of the open access curriculum as well as many of the points raised by Zurbuch and Rumble also was presented in Anderson's (1978) ACIATE Yearbook.

A nationwide survey of industrial arts teacher education program use of microteaching was conducted by Cattle (1974). The returns indicated that only 56 percent utilized the technique, that the majority using it were in methods courses, and that respondents indicated microteaching was an important phase of preparatory programs. Typical microteaching episodes involved the presentation of a live or videotaped model (most often a demonstration), a recording of a student-delivered microlesson with 12 peers, and subsequent critiques by the student teachers, college supervisors, and "pupil" peers. In some cases, students actually followed through on such critiques. A related, but more broadly designed, study was conducted by Frye (1971). He surveyed teacher education to identify the use of innovative instructional methods. His data characterized the profession as rather conservative with only the "innovations" of videotape usage, microteaching, early field experience, and interaction analysis showing substantial use. He justifiably recommended that more emphasis should be placed on these and other innovations.

Also using a nationwide sample of industrial arts teacher educators, Beed (1970) established guidelines for industry-teacher education internships. These guidelines subsequently were rated by a sample of industry. Recommendations for such guidelines included evaluation based on a combination of letter grades and narrative statements by both school coordinators and industrial supervisors, regular seminars conducted by coordinators and supervisors, regular reports by

interns to both parties, and regular visits of interns by the school coordinator.

Other forms of industry education cooperation were described by Parks (1969). From responses to a nationwide survey of college industrial education department chairpersons, twelve methods were selected for indepth analysis. In terms of recency and depth, the gap between knowledge and skill taught by teacher education departments and those possessed by industrial workers was noted. Fortunately, he also discerned a cooperative attitude on the part of industry as well as student belief that such effort (particularly the associated written work) was useful. Administrators pointed out the difficulties of staffing and the necessary released time as their major problem with the approach.

Still another link between industry and higher education is represented by the implementation of industrial technology programs by many existing industrial education/arts departments. Robinson (1973) documented the rise of such programs and, additionally, sought to clarify the concept of industrial technology. The latter phase was guided by a nine-member panel of experts and resulted in positing what Robinson termed a mature model industrial technology program without specialization.

Competencies

Competencies and competency-based instruction were addressed by many researchers in what amounted to a significant proportion of the profession's response to the imperatives of accountability. Popovich (1973), Ashcom (1974), and Sipes (1975) developed and validated various lists of competencies and Corwell (1975) developed materials to translate an introductory teacher education course into a competency-based mode. Of these studies, Ashcom's represented an exhaustive chronicling and documentation of a large scale project in Pennsylvania to produce an inventory of generic entry level teacher competencies. Although not directly related to industrial arts the focus on generic competencies argued for its inclusion in this review. Readers with a direct interest are advised to see Koble's (1977) report on the extension of the study to industrial arts. Popovich's validation of vocational and applied arts teacher competencies, or Sipe's identification of competencies needed by vocational educators who teach the handicapped. The reports by S. Brooks (1974), the Industrial Teacher Education Competency Study Committee at the University of

Wisconsin-Stout, Bensen, et al., (1974), and the New York State Industrial Arts Trial Certification Project (1974, a and b) provided additional resources. A compilation of these and other related efforts were presented in the ACIATE yearbook on competency-based industrial arts teacher education (Brueckman and Brooks, 1977).

Koble's listing of specific industrial arts teacher competencies in each of the four cluster areas of industrial materials, power technology, visual communications, and professional concerns deserved careful attention. Miller's (1971) United States and Canadian survey of functional competencies, Maley's (1978) inventory of appropriate industrial arts teacher behavior and/or skills, and the Pennsylvania project together constituted a substantial basis for consensus on what teacher education programs ought to be striving for. Miller found close agreement between educators and supervisors on the importance of functional competencies. Of these, personal qualities and behavioral characteristics were rated of primary importance, competencies pertaining to teaching methods were ranked over course content and information. Maley's report listed the capabilities essential to teaching industrial arts but did not attempt to prioritize them. Instead he suggested use of the inventory for planning industrial arts teacher inservice, self-evaluation, and teacher education program and course restructuring efforts. Along these lines, Miller's recommendations should be most carefully noted, namely, that teacher educators develop valid entry techniques related to necessary outcome competencies.

Professional aspects of the industrial arts teacher's arsenal of competencies were cataloged in detail by the committee at the University of Wisconsin-Stout. Brooks (1974), in his overview of the New York State Industrial Arts Trial Certification Project, identified the overall instructional competencies required of teachers, as rated by 1524 industrial arts teachers. The top four overall competencies were: to stimulate and maintain student interest, to perform basic manipulative skills, to provide activities which allow students to develop creative abilities, and to develop and use a variety of instructional materials. In related works, the project released detailed lists of technical competencies for the junior high school level, including forest products, ceramics, graphic arts, electricity, manufacturing, drawing, and -- for the senior high school level -- plastics, technical drawing, forest products, power technology, metals technology, and electronics.

Attention also should be given to Popovich's results (1973) which reported no differentiation between competencies required by industrial education teachers of vocational courses as contrasted to those whose programs were exploratory in nature. This finding would tend to support the evolution of comprehensive, all service area, programs of vocational teacher education that include industrial arts. Another significant finding was that the identified competencies were used to similar degrees by teachers of varying years of experience. Somewhat parallel to these findings, with respect to the similar nature of vocational and exploratory teacher competencies, was Sipes' conclusion that vocational and special educators ranked model teacher competencies in a similar fashion. Overall, however, despite this congruence, Sipes (1975) concluded that vocational educators were found to tend toward subject orientations as contrasted to the student orientation of special education teachers.

An effective summary of the efforts toward competency-based teacher education is provided by Brueckman and Brooks' (1977) overview in the ACIATE Yearbook, *Competency-based Industrial Arts Teacher Education*. The sections on the foundations of CBTE, affective aspects, measuring competencies, preservice and inservice implementations, and the imperatives generated by CBTE address the major issues of this new thrust.

We cannot, however, totally disregard the impression that competency identification processes invariably lose the vital aspects that make good teachers a *synergistic* product of their individual competencies, as contrasted to an *arithmetic* sum of these same competencies. Stadt and Kenneke (1970) in an ACIATE monograph, *Teacher Competencies for the Cybernated Age*, seemed to embody this concern in their work. Contrary to the implications of its title, the monograph contained no catalog of delineated competencies. Instead, competencies were addressed in terms of appropriate responses to technological impacts on man and society and by presenting some desirable characteristics of a teacher education program.

STUDENT TEACHING

Surprisingly, only two dissertations directly treating student teaching surfaced. They were Poleszak's (1964) comparison of the expected and actual outcomes of student teaching and McCrystal's (1973) study of the role of cooperating teachers. The former study verified the cooperating teachers' pivotal role throughout the experience, a role that was analyzed further by McCrystal. The latter study developed a matrix descriptive of cooperating teacher

roles as viewed by college supervisors, student teachers, and the cooperating teachers themselves. A detailed analysis of specific student teacher events, activities, and decisions was presented according to a normative-deviant classification scheme.

Concerned with identifying necessary student teacher competencies, Copeland and Bame (1979) also conducted a national Delphi study to this end. The detailed list of competencies that resulted promises to be of great use in evaluating student teachers. Miller's (1968) report on student teacher supervision via video tape also provided another unique idea, namely that of interaction analysis of the taped segment. Because of the techniques' objectivity, it was found that student teachers tended to accept constructive criticism more readily.

GRADUATE PROGRAMS

Gavin (1968) surveyed industrial arts department chairpersons deans, school supervisors of industrial arts, and industrial arts teachers in order to ascertain the desirable characteristics of master's degree programs. The major finding was that such programs should emphasize the development of teaching proficency in industrial arts and it should include both technical and professional courses. The courses should comprise at least one-half of the master's program. More recently, a carefully conducted needs assessment approach to the revision of a master's degree program was documented by Baker and Mayer (1978). Their findings supported Gavin's, with the addition of a perceived need in the career education-related aspects of industrial arts.

Wright (1973 b) presented an introduction to a series of studies designed to lead to a revamped industrial education master's degree program at the University of Wisconsin-Stout. The result was a generalizable model for the professional aspects of master's degree programs. In contrast, Barella (1975; 1976) employed follow-up methodology to evaluate graduate opinion of an assistantship-masters degree combined program. The respondents indicated general satisfaction with their experience, although they noted the lack of provision for planned teaching experience. Considered of most benefit to career development was the opportunity for professional association with the faculty. Respondents also emphasized the desirability of a written mission statement specifying the functions and objectives of the master's

degree program.

Involved at masters and doctoral levels, graduate assistants played a significant role, particularly in teaching. The characteristics of such efforts were reported by Gurbach and Harris (1973). While investigating the problems associated with graduate assistants, the study also presented a positive picture of how the requirements and collegial acceptance contributed to anticipated careers of the assistants. To increase the accessibility of such graduate assistantships, the New Jersey Industrial Arts College Student Association (1979) surveyed and published the location, requirements, and characteristics of assistantships available in the nation.

At the doctoral level, Nielsen (1969) prepared a comparative analysis of industrial education programs including industrial arts, trade and industrial, and industrial-technical education. He reported that the differences that existed in the scope of industrial education at the doctoral level were not so pronounced *between* industrial arts, trade and industrial, and industrial-technical education as they were *within* areas. He reported a similarity of curriculum patterns, as well as freedom to build programs on the basis of individual need. The traditional difference between Ph.D and Ed.D. programs, the language requirement, was reported to be modified by a substitution of other proficiencies. Almost all admission processes involved standardized tests; however, responses indicated that the use of test scores varied widely. Liu (1975) also researched doctoral programs with the intent of establishing a list of professionals at that level. He surveyed undergraduate, graduate, and administrative faculty. Extensive agreement on the list was established; a central core of the thirteen most highly and consistently rated competencies was developed.

In summary, the reader should become familiar with two comprehensive treatments of graduate education: AIAA's (1971-1973 h) *Focus on Teacher Education Graduate Programs* and ACIATE's (1974) monograph, *Graduate Programs in Industrial Education*. These documents contained treatments of graduate program objectives, specific reviews of program characteristics, and the like. The ACIATE's monograph also included a review of research on graduate education, a status report of graduate programs, and Poor's insightful approach to humanizing graduate schools. That concept was implicit in Wright's (1976) item on improving graduate education and Dyrenfurth and Miller's (1979) presentation of putting purpose into nonclass experiences of graduate students. They documented the profession's views that graduate education

involves more than the mere transmission of skills and knowledge. Role models, aspirations, and interpersonal influences are crucial concomitants in the process.

PROGRAM EVALUATION

The profession's commendable self-scrutiny is seen in a number of evaluative studies. Most dealt with undergraduate programs and a smaller number with graduate programs.

Undergraduate Studies

Follow-up surveys of baccalaureate students was the central focus of studies by Lindall (1968), Winters (1970), Edwards (1971), Ross and Steward (1977), Weiner (1971), Hein (1969), Innis (1971), Larkin (1977), and Gifford (1970). Conventional questionnaire methodology was used primarily, although Gifford took the further step of seeking administrator input on a systematic basis. Typically, the studies surveyed all baccalaureate or in some cases, postbaccalaureate graduates of various institutions. Ten years was the span most frequently used, although Gifford surveyed fourteen years of graduates. The findings generally dealt with course evaluations, percent of graduates in teaching and/or industry, departmental needs, additional education, salaries, and problems experiences. Some of the major findings were as follows:

- While dollar advantage nearly always favored the nonteacher, when computed on a monthly basis, the difference was not very large (Innis, 1970).
- A need was seen to revise professional industrial arts courses (Gifford, 1970; Lindau, 1968; Weiner, 1971).
- Recommendations were made that departments implement new or develop existing technical areas (Gifford, 1970; Lindau, 1968; Winters, 1970; Edwards, 1971).
- The greatest proportion of graduates gave an above average rating to industrial arts program objectives, goals, and courses (Weiner, 1971).
- The identification by graduates of an anticipated future need for general education, speech, mathematics, health, and composition courses (Weiner, 1971).

- Assessment of the program as deficient in terms of facility, equipment, and course offerings (Edwards, 1971).

Two other studies (Zoppetti, 1970; Gheen, 1970) pursued analytic approaches to assessing program impact. The former determined freshman and senior student growth in understanding of American industry at five cooperating institutions. Such growth was found to vary significantly among insititutions seniors at doctoral granting institutions scored higher than those at ones offering exclusively bachelor's and master's degrees. Gheen investigated the equally difficult effect of teacher training programs and sought to determine the extent to which college industrial education programs were preparing teachers to develop the creative talents. Using a Creative Expression Scale, he found that creative stimulation was statistically substandard and that greater creativity was encouraged in nonlaboratory classes compared to laboratory-based experiences. He concluded that industrial arts teachers were not being adequately trained to develop students' creative abilities and, therefore, suggested that similar inadequacies generally existed throughout the profession.

Larkin (1977) approached follow-up evaluation in a slightly different manner. He attempted to determine differences in evaluations between an institution's graduates and its faculty. The findings indicated agreement on the achievement of objectives pertaining to the relationship between people, society, and industry; the influence of industry; the opportunity to pursue interests and develop technical skills; develop an appreciation for craftsmanship, and provide occupational and avocational information. The two groups differed significantly on their assessments of the objectives of demonstrating problem-solving skills, safe work habits, and effective work practices.

Graduate Studies

Graduate programs provided the focus for studies by Riddle (1973), Dale (1975), Bettis (1973), Sakiey (1973), Devlin (1971), and Moreland (1970). The former's was a follow-up of *all* graduates at East Texas State University since 1955; Bettis, Devlin, and Moreland surveyed only the *doctoral* graduates of The Ohio State University, Texas A & M University and Colorado State College, respectively. University of Wisconsin-Stout master's degree and specialist graduates were the focus of Dale's study. All reported generally

favorable responses and overall graduate satisfaction with their programs. Moreland and Devlin concluded that respondents valued the opportunity for interaction among themselves and with faculty as the highest level experience. While both reported program reputation as being crucial to respondent enrollment decisions, Devlin and Bettis indicated that the amount of financial assistance also played a role in such decisions. Riddle reported the need for a greater emphasis on public relations and communication with graduates; the desirability of facility, equipment, and instructional media improvement; and an increased tailoring of courses towards greater utility to those graduates seeking industrial careers.

Also useful for analytical purposes were the descriptive data in many of these studies, e.g., Bettis' unexpected determination that graduate teaching experience (before or during their doctoral studies) consisted of 8.8 percent elementary school, 75 percent secondary school, and 71.3 percent college teaching. Additional valuable insight was that graduates rated course work as contributing most to their professional development; they perceived research associateships as effecting this characteristic more than teaching assistantships.

Sakie's (1973) study represented a different approach in that, contrasted to the comprehensive evaluations, he assessed the effectiveness of a single component, the doctoral internship. Another difference was his methodology of seeking evaluative responses from supervisors rather than from students themselves. The 68 respondents supplied input that allowed him to conclude that the program was meeting its stated objectives.

Methodologically, both the graduate and undergraduate evaluations were more alike than not. No major differences emerged. Perhaps the technique of surveying employers represented the most unique characteristic. We are forced to wonder whether more effective and/or powerful techniques actually exist.

FIRST YEAR TEACHERS

In recognition of the inadequacies of a closed system model of a four year teacher education program, problems of first year teachers are being investigated. Typically, the objective is some combination of modifying the training program or instituting some form of transitional program in order to make entry more effective. The studies of Starr (1974),

Alexander (1974) and Shackelford (n.d.) were geared to such objectives.

Starr identified beginning teacher competencies in terms of knowledge, skill, and behavior. However, these were stated as generalized competency statements; as such they are perhaps better suited as criteria for program self-evaluation. Alexander's (1974) study, on the other hand, listed the ten most critical and ten least critical first year teacher problems which surfaced from a national survey. Cooperative effort among teacher educators, school administrators and school boards, and teachers are required to address the following problem areas: insufficient money for materials and machines, insufficient storage and working space, lack of contact with board members, inadequate entrance and increment salary, initiating and operating industrial arts clubs, lack of library materials and references, assignment of inappropriate (special education) students, lack of time for maintenance, and working within the limited budget.

INSERVICE EDUCATION

Two categories of inservice research were identified. The first represented developmental projects on the design of models and the identification of needs, e.g., O'Tuel (1969), Culbertson (1975), McEntire and Hukill's (1977), Sireno et al. (1976), and Ely (1973), and to some extent, Teig (1975). On the other hand, Harder (1970), Bates (1969), Crouch (1968), Hyder (1971), Rubin (1972), and Glenn (1975) were evaluations of the effects of inservice efforts.

Culbertson presented the most comprehensive model which, while aimed at community college occupational instructors, contained many elements for the inservice education of industrial arts teachers. Culbertson's conclusions were that inservice roles were not distinct but rather overlapping. The roles of teachers and inservice leaders were similar and yet, since conventional teacher education programs did not focus on education, they were not completely appropriate models for the inservice training of community college and technical institute instructors. An interesting approach would involve the application of Culbertson's model to the needs of occupational teachers identified by Ely (1973). Of relevance to industrial arts was the latter's finding that there was substantial overlap in the identified needs of teachers in the service areas surveyed. Ely reported considerable differences between teachers and supervisors and that respondents presented classroom management, planning, and

professional development as the most urgent needs.

With Culbertson's model and Ely's key needs, O'Tuel's (1969) earlier study is of increasing value. He recommended several desirable characteristics of the inservice process, e.g., that instructors perceive it as part of their basic needs, that it utilize group dynamics, that it result in integration of departmental activities, that teachers be involved in the planning, that it incorporate realistic innovations, that participants understand what resources are available, and that it incorporate problem-solving activities.

The studies of Sireno and McEntire et al. provided descriptive information of selected practice in Missouri and Arkansas, respectively. The former described methodology, practicum activities and participant pretest and posttest data which was useful in that it documented a procedure designed to enable industrial arts teachers in integrating occupationally oriented activities into their existing programs, thus qualifying them for vocational funding. In contrast, McEntire's program was worth noting mainly because of its methodology rather than content. It described an education-industry exchange program providing nonvocational industrial arts teachers with skill training to enable them to teach trade and industrial subjects. Although two models were developed, little success was reported. The researchers noted that this was due to the expense and length of such a program and the lack of desire of industrial arts teachers to retrain. Fortunately, the researchers' attempt to convert craftspersons and skilled workers into teachers met with more success.

Perhaps the most systematic inservice effort, and certainly the largest, was the IACP's workshops. Hyder (1971) evaluated the 1970 series of nine summer workshops. His 154 respondents provided findings that demonstrated a significant increase in teacher knowledge of IACP content and process, an expected finding when one recognized the "something *versus* nothing" nature of such methodology. More interesting was his finding that there was no significant difference in job satisfaction between participants who subsequently elected to teach the IACP program and those who did not.

Of the studies investigating the effects of inservice education, two pertained to NDEA institutes and three to individual institution efforts. In the first category, Bates (1969) dealt with the institute on creativity. While he suggested that considerable effects resulted from the program, they were difficult to define. In contrast, Crouch (1968) ascertained the impact of all 1967 NDEA institutes. The findings and excellent response rate (more than 90 percent)

enabled him to conclude that the institutes affected both instructional program and the extent of participatant involvement in extra-instructional professional activities.

Glenn's (1975) investigation of the effects of an inservice program to encourage the utilization of democratic classroom procedures was not as positive. These indicated no change in verbal interaction patterns. However, experimentally treated teachers did improve their scores on the Teaching Situation Reaction Test. Harder (1970) compared the effectiveness of two inservice approaches: individualized and institute programs. While generally the findings supported the institute approach, additional factors were important; for example, subjects from larger communities scored higher than all others. Perhaps the most unusual methodology, that is for industrial arts, was employed by Rubin (1972) in her study of an institute to assist teachers in working with culturally deprived youth. She concluded with the optimistic working hypothesis that the institute constituted a beginning step and the relevant skills can be developed.

SUMMARY

Both strengths and weaknesses characterized the research reviewed in this section. This uneven picture is the result of some good efforts; e.g., the investigation of the factors affecting enrollment, and some weak areas; e.g., the attempt to identify factors in predicting postenrollment success. Despite the fact that we seem to have some opinion-based knowledge of key recruitment factors, empirical verification appears lacking. Additionally, the quest to identify factors contributing to industrial arts success were hampered by the error effect of maturation. The end result is that not even previous industrial arts experience was found to contribute to subsequent success. This, of course, challenges the notion of prerequisite coursework that is supported by the traditionalists.

Other gaps in the literature focused on student teaching, certification, articulation, and methodology. These topics appeared to be underrepresented in terms of research. Few studies, for example, addressed certification issues, a critical concern for teacher education particularly when one views the current struggle over the control of the profession. Furthermore, one of the studies that focused on such questions seems to have considerable potential for wreaking havoc along the industrial arts-vocational education front. Actual performance requirements for these two, frequently dichotomized,

service areas were found to be quite similar. Articulation, particularly between industrial arts and vocational education, also was one of the identified research gaps. A further weakness was the very conservative nature of the approach to methodology. In terms of teacher education being an effective example of what is known of methodology, we apparently could be indicted for gross negligence. These weaknesses, however, should be construed as providing considerable opportunity for carefully targetted research. Furthermore, because these areas clearly interface with vocational education, they qualify for vocational Research Coordinating Unit (RCU) support.

Despite these somewhat critical observations, we also noted some significant strengths. Specifically, Chapin's documentation of the status of the teacher education profession provided a very descriptive benchmark. Other healthy signs included the vital treatments of topics by the members of the Mississippi Valley Conference. While, unfortunately, the tradition of this group precluded widespread dissemination, their efforts represented a significant contribution. Similar strengths, more often in a traditional rather than innovative vein, were found in the numerous follow-up studies.

Even more significant is the tremendous amount of effort devoted to competency-based instruction. The carefully developed lists of competencies and their accompanying specifications provided a clear picture of the goal teacher education programs we are addressing. Graduate programs received significant attention, as have the problems of first year teachers. Our knowledge of effective inservice education methodology has been greatly advanced by such systematic efforts as the IACP.

Overall, teacher education research represented some strange contrasts. However, a considerable number of building blocks exist. Effective research can be built upon such a foundation. While we are a long way from ground zero, we are confronted by how much we still do not know.

ADMINISTRATION AND SUPERVISION

Administrative research relevant to industrial arts education focused on attitude and role studies, administration procedures and preparation.. While numerous dissertations were reviewed, the most cogent overview of administration and supervision was provided by the AIAA's (1974) booklet, *Recommended Qualifications, Duties, and Responsibilities for State and Local Supervisors of Industrial Arts*. It included recommendations for practice in the areas of qualifications, administrative responsibilities (executive, personnel, budget), supervisory responsibilities (program, support), and public relations (school-community relationships and communication).

ATTITUDE STUDIES

Six doctoral studies formed the largest portion of this research. They were in the areas of career education, vocational education, and industrial arts education. Principals were the most frequently surveyed group. Other administrator/supervisors, school board members, counselors, teachers, and legislators were surveyed in some studies.

Career education was the focus of the attitude determination studies of Phillips (1975) and Jones (1974). Of relevance to industrial arts was Phillips' findings that the legislators, school board presidents, principals, and teachers indicated that the world of work was not sufficiently present in existing high school courses (69 percent) and that career education should be taught in existing courses (73 percent). Both Jones and Phillips reported overall positive attitudes on the part of each responding group. While Phillips identified a significant relationship between the respondents' level of education and their attitudes, Jones discerned relationships between length of service and such attitudes.

Companion studies by Milam (1968) and McNeil (1968) asked principals to identify their perceptions of vocational education. Both studies involved schools in the Auburn Universities Project in Secondary Education. The results of both surveys of principals in six different States revealed their opinion that the instructional staff was the strongest program item and facilities the weakest.

Attitude toward industrial arts was the prime concern of Mason (1970) and Brandstatt (1975). The former surveyed principals and counselors; the latter, school board members. Both studies reported an overall favorable attitude toward industrial arts. Brandstatt identified the sex of responding board members as influencing expressed attitudes (females were most positive). Mason found a positive relationship between such attitudes and the size of the respondent's school enrollment, their undergraduate major, the extent of supervision of industrial arts in their school, and their exposure to an experience with industrial arts. Brandstatt did not substantiate the commonly thought of positive effect of previous exposure to industrial arts in terms of the responding board member's high school courses.

In the elementary grades, the principals and teachers surveyed by Tuckey (1978) revealed a positive attitude toward industrial arts activities. The subjects, compared to some of the preceding reports indicated a significant understanding of elementary school industrial arts, its potential, characteristics, and contributions to career education.

ROLE PERCEPTIONS

The role perceptions of both industrial arts supervisors and department chairpersons were investigated by Hall (1974) and Hayden (1973), respectively. Both studies involved principals and teachers; however, Hall included supervisors, whereas, Hayden added department chairpersons. Hayden's major findings were that, despite their agreement regarding the ideal role of industrial arts chairpersons, there was disagreement between teachers and principals regarding the actual role of the chairpersons. This dissonance is heightened by the opinion of the chairperson in that they agreed with both teacher and principal groups. Hence, much conflict potential existed in light of the disagreement of teachers, chairpersons, and principals regarding their perceptions of the actual and ideal roles for such persons.

Hall's similar study of the role expectations for industrial arts supervisors yielded results more consistently in agreement across the surveyed groups. While a large degree of response variation existed, Hall concluded that there were no systematic differences attributable to respondent categories. While not directly concerned with industrial arts, Magisos' (1968) analysis of the factors associated with state vocational education supervisors' role perceptions was reviewed due to its significance as a benchmark for comparing the perceptions of industrial arts supervisors. The two populations may, in fact, overlap in light of the increasing likelihood that industrial arts supervisors

were found to be housed in state vocational departments. Magisos reported that state supervisors were found to value dynamic behavior (as contrasted to tractive on the scale developed by Rice). He also reported that incumbents at higher job levels were found to be more dynamic. In comparison to tractive supervisors, the more dynamic ones were reported to have significantly more formal education, college degrees, returns to college (after entering the profession), and a higher perception of their salaries. More dynamic supervisors were found to be females, to have lived in smaller communities during their schooling, and to work in state vocational divisions without personnel selection policies.

ADMINISTRATIVE PRACTICES

Shearer (1973) investigated the influences and forces affecting industrial arts supervision over the past fifteen years. His review and jury process identified ten validated forces which were then rated by fifty-two state supervisors of industrial arts. Responses indicated that 74 percent of the supervisors had no mandated obligations to provide special supervisory services for industrial arts but were providing it under regulations for general education. Additionally, the ratings revealed positive effects attributable to eight of the ten forces with no influence assigned the remaining two.

Fruits (1975) and Riotte (1974) both dealt with local administrative practices relevant to industrial arts. Whereas the latter did so in terms of legal-fiscal bases, the former pursued the relationship of personal and situational variables related to supervisory roles of industrial arts department chairpersons. A survey of a random sample of 77 Indiana industrial arts chairpersons yielded results that demonstrated significant relationships between both personal and situational variables and administrative responsibility. However, situational variables appeared to have more influence than personal factors; in fact, accumulated credit hours in administration/supervision were not so related. Fruits reported that industrial arts department chairpersons tended to assume more responsibility for planning, communicating, and organizing duties than for supervising, coordinating, or evaluating duties. Kinzey and Fruits (1977) subsequently published a detailed list of industrial arts department chairperson (school level) duties as ranked by surveyed chairpersons. Price (1977) augmented this with a description of anticipated change in the roles of such chairpersons. Kinzy (1976) also provided a useful summary of research pertaining to industrial arts department heads.

Hiring practices were the focus of Van Metre's (1974) study. He investigated the feasibility of student teaching video tapes as an aid in the selecting of beginning teachers by school administrators. He concluded that such tapes were feasible and that administrators were interested in their use. Directly related to the inflow of new professionals is the means of employing them. Bernabei (1973) illustrated the more progressive approaches to differentiated staffing and its effects on educator roles.

In contrast to the public school focus of the preceding studies, Gullickson's (1974) research pertained to accounting and budgeting procedure at the college level. He established a set of direct program costs applicable to large scale (4,185 FTE) programs. He calculated fixed costs per course to be $125.27; $6.75 was the mean supply cost of technical courses per student. Gullickson determined the total average cost per technical activity laboratory student to be $132.02. Interested readers will want to note his use of total expenditures, variable supply costs, total enrollment, semester enrollment, percentage of enrollment-in technical activity course offerings, total course offerings, average technical course enrollment, fixed costs (instructional, administrative, and support staff salary, student wages, authorized travel, fixed supplies, maintenance per department student), and laboratory fees. Gullickson's purpose was to generate a comprehensive overview of the financial aspects of a large university industrial arts and technology department.

Steeb (1976) reported the results of a survey designed to determine the status of industrial arts in vocational education state plans. Since such inclusion opens the way for industrial arts funding with federal vocational education money, it served as a useful indicator of the degree of success the profession has achieved in convincing vocational educators that industrial arts can contribute to their programs. Steeb noted that thirty-eight states included industrial arts in their plans, but not all allocated federal dollars to it. Some, in fact, merely mentioned industrial arts without showing any allocation of federal or state dollars. While this may be tokenism, to be sure, at least it is a start. It is a start that provides hope for beleaguered industrial arts teachers and administrators who daily face the economic crunch described by Campbell (1976). However, the fact that the 51 response or coping options which Campbell presented include many undesirable ones demands that industrial arts teachers increase their advocacy roles as well as their efficiency. Readers interested in program funding will wish to review the special issue of *Man/Society/Technology* (AIAA, March 1976) and its treatment of federal, state and local funding levels.

Due to the nature of the legislative process, some of the information may now be superceded; nevertheless, the contents provide an effective foundation for understanding this issue.

Another important perspective on industrial arts teacher education departments was introduced by Deane et al. (1974) in their symposium that examined the role of department environment. Essentially, the impact of size was reviewed, as well as those less tangible influences that size may engender. Warner's (1978) Mississippi Valley Conference presentation on how the role of college and university industrial education department chairpersons has changed due to negotiated contracts also was a valuable contribution. His paper included treatments of the extent of collective bargaining, factors prompting such contracts, and the factors affecting the chairperson's role.

ADMINISTRATOR PREPARATION

Administrative internships, their status, design, and objectives were investigated by Krug (1974). His particular reference was to those available as part of industrial or vocational education doctoral programs. The disparate finding that, while 62 percent of programs offered internship opportunities, only 29 percent of the enrolled students actually participated was explained by a lack of acceptability of such experiences to students and educators. Such unacceptability was inferred despite reports of a wide variety of credit hour and length of time options, as well as faculty endorsement of the approach, particularly when it resulted in the opportunity for increased contact with field agencies. Also reported was the finding that the internship focused upon school-community relations and curriculum development; as such, it met the needs of interns.

A different aspect of administrator preparation, proposal design, was studied by Friedman (1978). His dissertation involved the development of a handbook and multimedia materials designed to train personnel in the preparation and submission of proposals under the Vocational Education Act.. While not specifically including industrial arts, since this act does enable support of industrial arts, the techniques outlined were adaptable to industrial arts specialists. Because of the relatively recent emergence of this funding vehicle, the profession's advocates are advised to assimilate the manual's skills into their arsenal.

SUMMARY

Several conclusions emerged from these studies. From our perspective, it seemed quite clear that the administrative role perception studies in industrial arts generated results essentially similar to those in other educational areas. Differences in role perceptions did exist by organizational level; the interaction of personal and situational variables probably precluded meaningful generalizations. It also seemed that, as in other educational areas, considerable attention needs to be focused on the development of public understanding of what this profession represents. The current TV campaign to raise public sensitivity to their EQ (economic quotient) is an example of what is needed in industrial arts. Additional visibility through the AIAA, an NEA affiliate, also is likely to be valuable.

Administrative topics that signify useful research possibilities include status studies of industrial arts dollar allocations, supervisory activity, and the effects of administrative stress. A useful example of the former would be the development of normative industrial arts cost data for the various educational levels. A similar status study of the extent to which industrial arts supervisor duties and responsibilities are consistent with the AIAA's recommendations also would be desirable. Finally, with the current high levels of administrative stress, a study is needed to systematically explore the effects of stress in terms of administrator, faculty, and student impacts.

PROFESSIONAL CONCERNS

As a function of our profession's gradually increasing maturity, there have been a slowly increasing number of investigations into the dynamics and characteristics of the field. The job satisfaction studies of Kenneke (1968), Anderson (1969), Imphong (1974), and Talbot (1974) represented an introspective look at professional roles. In addition, Messerschmidt and Barnhardt (1972) described the development and results of an initial job satisfaction scale for industrial arts teachers. The Kenneke, Imphong, and Talbot studies look at the causes and correlates of industrial arts/ industrial education teacher job satisfaction. Kenneke's and Talbot's studies identified a positive relationship between satisfaction and pupil achievement. Additionally, Kenneke identified working conditions, teacher-student relationships, and faculty interaction as sources of reward. Talbot, however, seemed to relegate the importance of working conditions and physical plant concerns as secondary to pupil achievement. After allowing for the variabilities of interpretation, it seemed that both studies identified factors directly related to the teaching-learning environment as being the chief sources of dissatisfaction (e.g., economic considerations, working conditions, and school administration). Kenneke's study also is of value in that he describes the differential satisfaction/dissatisfaction characteristics of typical categories of teachers.

Anderson's research is a variation on Kenneke's theme in that he compares the attitudes of those leaving the profession to those who remained. As anticipated, his work disclosed significantly different attitudes on the part of both groups, as well as the proportion that leavers represent. Anderson's sample (in Michigan) indicated that leavers represented 15.5 percent of the total industrial education profession; of these, 5 percent reported they would leave education and 10.5 percent reported they would remain but not teach industrial education. Invariably, the comparison between reasons for leaving, as identified by this study, must be compared to the previously discussed sources of satisfaction/dissatisfaction. Unfortunately this comparison did not yield clear results, since Anderson's identification of poor salary, lack of professional commitment, the falseness of the school situation, and the inadequacy of being employed for only ten months

were not directly comparable to the sources of dissatisfaction in Talbot's and Kenneke's work. However, it may be that the leavers' construct of the teaching environment (the chief source of dissatisfaction) was subsumed by what they term "lack of commitment" and "falseness of the school situation." The sources of dissatisfaction were congruent to the extent that this overlap existed. A more recent report (Kaufman & Buffer, 1978) reviewed industrial arts teacher educators' satisfiers and their counterparts. A national random sample of over 200 indicated that academic freedom, children's educational benefits, national supervision, and considerate colleagues all rated as very important work characteristics. Another perspective into the psyche of those practicing the industrial arts profession was provided by Herbert's (1978) overview of the personality characteristics of industrial arts teachers. His study provided useful comparative data for two groups: a randomly selected set of industrial arts instructors and a set of national teacher of the year awardees. In general, the award recipients were more industrious and precise, while --at the same time-- less aggressive and autonomous. Since many confounding variables impinged on the results, and since the specific methodology will be of interest, readers are encouraged to consult the original source as well as a subsequent article by Dugger and Herbert (1978) which dealt with teacher personality research.

ASSOCIATIONS

Several studies focused on the profession's associations. Krause (1970) chronicled the history of the Michigan Industrial Education Society. Kinzey (1973) documented key events in the emergence of the American Council of Industrial Arts Teacher Education. Interviews, a review of the archives of ACIATE and other organizations, and reviews of early records were used to track the development of ACIATE from its formation in 1950 through 1973. The work of the organization in promoting publications of interest to the profession was examined in detail. Additionally, the awards program of the organization was reviewed and its role assessed. Gilgannon (1975) attempted to determine the perceptions of American Vocational Association members regarding the association's function. Function was rated in terms of opinions on collective bargaining, state and national legislation, communication with members, intra-disciplinary affiliation, accreditation, and certification. Also related to the AVA's effectiveness, Garrison (1977) studied factors that influenced membership in the states. He concluded that differences in services may explain varying membership conditions. The differences were categorized by

cost-benefit, association structure, and professional activities. Verification that such services are the sustaining force of state associations was observed in *Ten Years of Service to Industrial Arts Education in New York State* (NYSIA, 1973). The review documented the critical incidents and actions of a vital association. Wutti (1968) investigated state level industrial arts associations with the objective of developing a description of their size, dues, officers, committees, publications, and conventions. Because the study was conducted so many years ago, a replication is in order. Also concerned with state associations, but in terms of their leadership, Dyrenfurth et al. (1978) summarized necessary state association leadership activities. This AIAA presentation combined case study and investigative approaches in the development of a set of recommendations regarding the survival of industrial arts, the needed leadership activities, the development of an industrial arts advocacy, and the careful sequencing of preservice professional development. Student associations represent a different form of professional organization; Dennis (1978) outlined the implications of USOE recognition of the AIASA and the opportunities this affords for the enhancement of industrial arts.

Another comprehensive study of professional associations was contained in the ACIATE's Twenty-eighth Yearbook (Martin, 1979). The authors described the roles and aspirations of the AIAA, its councils and affiliates, as well as the Mississippi Valley Conference. In addressing another facet of the professionalism, the yearbook contained a section on the contributions of professional journals in industrial arts. Because journals and effective communications are the hallmarks of viable professions, Eggers (1970) evaluated a prototype industrial-technical periodical for use by industrial arts teachers. His nationwide survey of American Council of Industrial Arts Teacher Educators members and general industrial arts teachers and students (ninth grade) produced positive results. All teachers and two-thirds of the students indicated a desire to use a publication similar to the prototype. Of particular note was the endorsement of the concept of condensing articles from other publications.

Similarly, O'Neill (1971) saw value in college faculty having access to usable materials. He attempted to develop a system that would enable faculty to exchange information about locally produced instructional materials. Responses to his survey suggested that the administrators of industrial arts teacher education programs felt that such an information system was feasible. Robinson's (1973) Mississippi Valley

Conference presentation provided survey results on departmental newsletters and also focused largely on faculty communications.

Improved communications, albeit communication with those outside the profession, also was called for by Sucharski (1975). He pointed out an urgent need for promotion of a clearly defined working image of industrial arts and recommended that this be a responsibility of professional organizations. Subsequently Lovedahl (1977) pursued the vehicle of film as a communication technique designed to enhance public knowledge of and attitudes towards industrial arts. He evaluated the effectiveness of a film developed for this purpose commissioned from the Ohio Industrial Arts Association. Responses from 305 subjects verified that attitudes and knowledge were both favorably affected by viewing it. While socioeconomic factors had no significant influence on the way attitudes were altered, sex, experience, and parental status had an influence, particularly in the cognitive dimension.

A different vehicle was pursued by Hall (1970). By reviewing newspaper coverage and by surveying 272 industrial arts teachers, college faculty, and college and secondary school students, he explored the effects of the Central Kentucky Student Craftsman's Fair on industrial arts. He reported that all students earning more than one ribbon reported taking two or more credits in industrial arts. While students received extra help during classes, contrary to popular belief, little help was received after the regular school day. Respondents also felt that the industrial arts program improved as a result of this activity. Hall (1971) also reported on the effects of industrial arts contests on publicity. He found that in areas where contests were held, not only did industrial arts receive more exposure, but the exposure was greater after the fair was inaugurated than in the previous decade.

LEADERSHIP

The development of a continuously expanding and increasingly vital leadership cadre is mandatory in a healthy profession. Rosser (1978) provided a particularly telling analysis of research into professionalism. Records of state level activities designed to encourage leadership were compiled by Dyrenfurth and Bender (1974), Dyrenfurth (1978), and Walencik (1979). Each of these leadership development projects attempted to bring established and emerging professionals together in an atmosphere that was both reinforcing and challenging. The important premise was bringing together the state's leadership cadre with the nation's outstanding authorities on issues crucial to the advancement of industrial

arts. Every means possible was employed to get the participants to believe that their efforts could, indeed, effect change.

Mohan, in the ACIATE's 28th Yearbook (Martin, 1979) also dealt with the topic of leadership in industrial arts, but from a generic perspective. The tenets he presented were fundamental to all such efforts: on a national, state, and local level. Mohan's (1976) dissertation also provided insights into the leadership of the profession and was a useful review of this topic.

Related to leadership development efforts designed to enhance individual self-image and propensity to initiate action has been the effort at studying the future. The ACIATE devoted its 25th Yearbook, *Future Alternatives for Industrial Arts* (Smalley, 1976) to this objective. The yearbook has made a major contribution toward helping the profession's leadership acquire this vital set of insights on the implications of the future.

Research Activity

Establishment of a systematic research effort has been a significant challenge to the profession. While individual needs are relatively easily established, it is considerably more difficult to prioritize them, particularly on a national level. Householder (1969) Buffer and Campbell (1976), Nelson et al. (1977), and Finch et al. (1978) have sought to make gains in this direction. The background for these studies was established during the early 1960s. One context evolved largely from the American Educational Research Association's *Review of Educational Research* (1962, Volume 32, No. 4). This document synthesized the major research findings since 1956 in vocational, technical and practical arts education. ACIATE auspices helped bring two additional yearbooks to fruition. Porter edited the 1964 issue, *Classroom Research in Industrial Arts;* Rowlett edited the 1966 issue, *Status of Research in Industrial Arts.* As their titles imply, the former provided teachers with a guide to conduct action research; the latter synthesized industrial arts research. Fortunately, the classroom research thrust still is being encouraged, as may be seen in Lolla's (1978) treatment of the problems and possibilities of such activity. The Fall, 1968 issue of the *Journal of Industrial Teacher Education* also evidenced the overall concern for research. It was precisely this research-valuing era that began its decline in the skepticism of the late 1960s and early 1970s. Such decline notwithstanding, the momentum developed was sufficient to lead to a National Conference on Research in Industrial Arts. This conference was described by Suess (1969 b). The presentations by Suess (1969 a) and Householder (1969) were related documents. Other

citations demonstrating outgrowths of the research valuing era include Hanson's (1968) treatment of research methodologies, Tuckman's (1968) description of research and the role of the researcher, Tomlinson's (1968) and Ianni & McNeill's (1968) debate on the research role of USOE, the AVA research committee's (1968) position on research, and Howe's (1968) prescription for the important dissemination functions of researchers.

While it is our interpretation that the overall value placed on research has diminished significantly, perhaps it is a sign of the profession's increasing maturity that the "acceptance on faith" stage of the importance of research is now past. Buffer and Campbell (1976), Nelson et al. (1977), and Finch et al. (1978), in fact, may evidence the profession's new commitment to the advantages of rigor, system, and critical analysis. The elements of the proposed system of Nelson et al. (1977) to structure industrial arts research on a national basis are directed to such objectives, as is Wheeler's (1973) guide to the types and evaluation of research in industrial arts. Miller's (1973) article on the related curriculum development implications of research in career education also evidenced similar intents.

Identification was the chief mission of the 1976 NAITTE Research Committee's agenda. Finch et al. (1978) reported the results of a study designed to identify and categorize research needs of NAITTE members. Subsequently, the committee sought to discover relationships between identified needs and key demographic variables. The sample (400) yielded a return of 280 members, with the largest proportion in industrial arts (38.6 percent), followed by trade and industrial (21.8 percent), technical education (6.8 percent), and various combinations (31.2 percent). A relatively low total of respondent time was reported allocated to research (20 percent) and to helping students do research (10.2 percent).

Establishment of criteria and careful analysis did not yield needs identified as *very* important, although the relationships between teacher and student performance and between teacher education and teacher performance were identified as the highest ranking *important* research needs.

Factor analysis resulted in the surfacing of the following three clusters that described research needs: concern for evaluation (process and criteria), desire for research documentation of competency-based education, and desire for guidance on how to conduct research, write proposals, and administer the projects. The researchers concluded that the population's research needs were homogeneous, regardless of department size or geographic regions.

Research needs, of course, imply that researchers are able to address them. Wright (1977) sought to provide some descriptive statistics of the doctoral degrees awarded over a ten-year period. Some 1651 degrees were awarded by 52 institutions. Grounds for optimism for an increased research capability on the part of our profession may be justified on the basis of Wright's finding that industrial education doctoral production has exceeded the growth rate of other educational fields.

Insights into the factors that contributed to the initiation of research effort were identified by Ponder (1979) and Jelden (1976). Jelden provided the would-be researcher with a valuable overview of data storage and retrieval systems. In doing so, he eased considerably the neophyte's task in obtaining the prerequisite information necessary to begin effective research. Ponder, on the other hand, attempted to identify conditions that encouraged research efforts. Using careful analytical procedures, he concluded that a researcher's primary employment responsibilities and the employing institution's publication requirements were significant influences in producing research, at least as manifested by publications in refereed and nonrefereed journals. Ponder noted a positive correlation between refereed publications and favorable attitude toward research, an attitude not evident with non-refereed publications. Of course, attitude and incentive, as treated by Ponder, are only part of the research initiation and dissemination effort. The knowledge of the means by which the latter can be accomplished also is necessary. To this end, Bradley's (1975) article is particularly useful.

SUMMARY

The professional concerns in this section were classified by four topics: job satisfaction, associations, leadership, and research. Many of the topics in the previous sections also related to these concerns of teachers, supervisors, and administrators.

After a flurry of interest from 1968 to 1974, job satisfaction studies have been dormant recently. In view of the current attention being focused on teacher stress and burnout, replication of these studies seems appropriate. Such studies will likely document crucial insights that might be used to negotiate for improved industrial arts teacher working conditions. The very real industrial arts teacher shortage perhaps can be combatted in this way.

Professional association affairs have not been well documented. Perhaps we have been too self-conscious in addressing matters that appear somewhat selfish. Clearly, however, the means by which the profession serves its members by enhancing their capability to serve their clients is a legitimate research goal. Additionally, studies of professional communication mechanisms also are in order, as are systematic analyses of the impacts of the newly emerging American Industrial Arts Student Association activities.

Because of the complexity of what we could depict as an "alphabet soup" of acronyms and a tangle of affiliation networks, it is safe to characterize the typical practitioner's knowledge of the profession's associations as incomplete, at best. For these reasons alone, the studies cited in this section will serve an important function. Additionally, a very important contribution to this goal is available in the form of the ACIATE's 1979 Yearbook. The editor is to be commended for this most significant contribution. It is our responsibility now to insure that the book receives appropriate exposure. One way to achieve this would be to use it in the increasing number of state leadership efforts. This relatively new thrust is producing desirable impact in curriculum, access to vocational funds, public recognition of industrial arts, and so on. Most importantly, however, such leadership activities build professional cohesiveness. They also encourage practitioners to develop an increased sense of control over their professional destinies. This is the hallmark of a true profession.

This brief summary also must call attention to a true profession's concern for system and order. The dissillusionment following the mid-1960s' perhaps unreasonable expectations of research has led to a new emphasis on rigor. Recognition of the complicated, "one-piece at a time" pattern of knowledge development is exemplified by the calls for an overriding structure. It is hoped that this review and synthesis will be of assistance in this regard.

SUMMARY AND RECOMMENDATIONS

OVERVIEW

Summarizing this review is a challenging, and inherently dangerous, task. Second-order summaries are typically fraught with over-generalization. In addition, because of the reviewers' reliance on abstracts and summaries, the reader should consider the following comments as tentative. Another reason for caution is due to the inevitable errors of selection. While every attempt was made to systematically tap key resources, invariably some studies may have been overlooked. To the extent that these could alter the findings, an allowance will need to be made in interpreting the conclusions.

To begin, however, it is necessary to reemphasize that research is conducted to provide information and insights to increase the profession's effectiveness. As such, research is inherently useful -- or it has that potential, provided it is used. This caveat seems to be neglected occasionally. Consider, for example, Householder and Suess's (1969) reference to the AVA's Research Committee's 1968 statement recognizing "the responsibility of the professional association to stimulate and facilitate research and research related activities... (and) that the attainment of that objective would require a continuous flow of information between researchers and practitioners and substantial long term financial support" (p. 44).

Despite recognition of the need for a two-way exchange of information, the amount of application or use made of research is suspect. For example, the National Academy of Science (NAS, 1976) report on vocational education research pointed out that even with 250 million dollars spent, widespread impact has not been documented. Rupert Evans, in chairing the Academy's panel, indicated that the panelists were disappointed in their findings, particularly since they obviously believed that vocational education R and D is beneficial. The panelists, however, were required to reach this unpopular conclusion, since they found few objective impact studies. Since it is likely that the same characteristic is shared by other educational R and D arenas, industrial arts research probably

deserves the same criticism. It may be that Evans and his colleagues identified the cause for such criticism in that they allowed that federal R and D funding priorities have been more politically than rationally determined--in the professional sense.

Nevertheless, positive aspects also deserve mentioning. Clearly, there have been an increasing number of research efforts. Furthermore, it is our impression that besides an increase in the total number of individually conducted studies, the amount of research each individual conducts also has increased. Consider that Householder and Suess (1969) complimented the profession with the following observation:

> Industrial arts appears to have come of age academically and intellectually. The profession has matured to the point where it is willing to undergo a careful self-appraisal of its basic beliefs, fundamental practices, and educational procedures (p. 44).

Also, by reviewing the NAS report, one can identify excellent research summaries of vocational education R and D in major priority areas such as career development and guidance, students with special needs, student characteristics, teacher education, instructional techniques, curriculum development, labor market supply and demand, and administration and evaluation of vocational education. While the former made no specific mention of industrial arts, such studies provide essential information for the practice of industrial arts, as well as other practical arts fields. Furthermore, industrial arts research is in a position where both macroresearch and microresearch can make useful contributions. Macroresearch, of course, refers to broadly conceived efforts which, despite some specific lack of control, yield a large scale perspective. This perspective may subsequently be used to identify hypotheses for testing by means of tightly controlled conditions.

AN ANALYSIS

Some descriptive statistics are appropriate. The totals on the various analyses do not equal one another because these statistics were compiled at different times, due to the stringent publication schedule. This reflects the on-going growth of the review and synthesis and should not be interpreted as inaccuracy on the part of the compilers. Because table 1 was compiled last it represents the most comprehensive stage of development.

At this point, the reviewers also must acknowledge the capable assistance of William Dunlap, Paul Noble Young, and Howard M. Ponder. The first two are doctoral students in the University of Missouri-Columbia's Industrial Education Program; the latter is a recent graduate of the same. In addition, Patricia Love, Ann Klopp, and Gordon Thomas contributed extensively to this compilation.

This review compiled approximately 870 studies, reports, and articles. Table 1 illustrates the relative proportion of effort that the profession invested into each major topic over the period studied. The emphases, in descending order, were: curriculum, teacher education, educational programs (status studies), and history and philosophy. The deemphasis on evaluation, facility, guidance and counseling, and human resources research also is apparent. Two additional caveats are important: (1) the research emphases reflect--to some degree--an interaction with the organizational scheme chosen by the reviewers and (2) the selection process variables undoubtedly injected some error variance into the analysis.

Despite these cautions, the statistics provide an insight into the character of the profession's efforts over the past twelve years. By observing the annual overall totals in table 1, it is reasonable to conclude that research requires something on the order of five to six years to enter the mainstream of professional awareness. However, a rival hypothesis also exists, namely, that 1973/1974 represented the major watershed between research-valuing and relatively nonvaluing eras.

Table 2 illustrates the nature of the research conducted; table 3 shows the extent of agency involvement. Industrial arts research, in terms of the bibliographic evidence available, still seems to be heavily dominated by doctoral dissertations. Other types of research have only recently begun to approach degree-related research. This is a healthy trend for the profession.

Another sign that augurs well is the widening of the research base, i.e., who does it. Table 3, on which the foregoing is based, may at first glance seem misleading because of what appears to be the dominance of major universities (doctoral-granting ones). However, it is our impression that if such a table were compiled for each of the earlier reviews and syntheses, not only would a much smaller and less diverse involvement among agency types be evident but also the "within type" range would be considerably smaller.

Table 1. Review and Synthesis of Research in Industrial Arts: 1968-1979

	Citations by Topic and Year													
	pre-68	68	69	70	71	72	73	74	75	76	77	78	79	Total
Introduction.	1		1											2
Selection Strategies.	1	1	1	1	1	1	3	1	1	1	1	1	1	15
Commentary.														0
Total	2	1	2	1	1	1	3	1	1	1	1	1	1	17
History, Philosophy Objectives														
History of Industrial Arts.	3	2	1			1	2	2	2	2	1	1	1	18
History of Technology			1									1		2
Historical Studies in Retrospect. .														0
Philosophical Foundations			2	5	1	4	1	1		4	3	1		22
Emerging Fronts		1	7	4	3	1	3	4	1	2	1	4		31
Philosophy in Retrospect.				1				1			1	2	1	6
Found. Indus. Arts: Our Objectives.		3		5		2	3	2	3			1		19
Summary				2	1									3
Total	3	6	11	17	5	8	9	10	6	8	6	10	2	101
Human Resources Related Studies														
Equity.	1	1	1	1	3	1	1	2	1	3	2	1	1	19
Recruitment									1	1				2
Manpower and Industry Needs				1										1
Summary													1	1
Total	1	1	1	2	3	1	1	2	2	4	2	1	2	23
Education Programs														
Special Needs		2	1	3			1							8
Status Studies: General.	3	8	7	8	6	7	7	6	5	5	6	5	5	78
Status Studies: State Specific . .		6	3	1			2	1	1		1	1		16
Foreign Programs.		2	2				1	3		2				10
Summary														0
Total	3	18	13	12	6	7	11	10	6	7	8	6	5	112

Table 1. - *Continued*

Citations by Topic and Year

	pre-68	68	69	70	71	72	73	74	75	76	77	78	79	Total
Curriculum														
Comprehensive Efforts		4	1	9	2	3	4	2	5	1	2	2		35
Curriculum Process	1	4		4	5	3	5	1	2	3	3	3		34
Industry-Education Analysis		2	2	2	1		2	3	1					13
Instructional Units		9	4	6	9	2	3	1	2	3	6	5	3	53
The IACP			2	3	3	2		1		2	1			14
Eval. of Curr. Impl. Effectiveness		1	1				3	1	1			1		8
Summary														0
Total	1	20	10	24	20	10	17	9	11	9	12	11	13	157
Learning Process Variables														
Problem Solving			1				2							3
Organizational Patterns	1	1							1					3
Special Needs Aspects			2	1	1	1	2				2	3		12
Domains of Performance														0
Sensory-motor	1		4	2	2	5	1	1	4			1		21
Creativity		1												1
Rel. Among Learning Proc. Var.		1	2				1	1		1	2		1	9
Transfer				1										1
Lab. Achievement Links		1	1				2	2				1		7
Effects of Practice			1	1										2
Effects of Industrial Arts			1	1	1		1	1		1	1			7
Summary														0
Total	2	4	12	6	4	6	9	5	5	2	5	5	1	66
Instruc. Media, Methods, Materials														
Instruction Methods			3	1	1		2	1	1					9
Instructional Media			1		1									2
Slides & other media		1	2	1										4
Films		1	1	2	1									5
Overhead Proj. Transparencies			2											2

Table 1. - *Continued*

Citations by Topic and Year

	pre-68	68	69	'70	71	72	73	74	75	76	77	78	79	Total
Instruc. Media, Methods, etc. (*cont'd.*)														
Instructional Media (*cont'd.*)														
Programmed Instruction.	1	1	1	1	1			1						6
Multimedia.					1		1	1	1					4
Self-instruction.	1		3								1			5
Video Tape Rec. & TV.		1		2				1	1					5
Simulation.				1			1	2						4
Laboratory Methods.		2	3	2	1	1	1	3			1			14
Teaching Strategies			2				1	2						5
Materials.			2	1		1		1	1					6
Summary.							1							1
Total.	2	6	20	11	6	2	7	12	4	0	2	0	0	72
Student Personnel and Guidance														
Occupational Choice.		1	1					1						3
Student Characteristics.				1		2	1				1	1		5
Effects of Industrial Arts		1	1				2	4		2	1			11
Summary.					1									1
Total.	0	2	2	1	1	2	3	5	0	2	2	0	0	20
Facilities Related Studies														
Facilities		1	2	1			4		1	1		2	1	13
Noise.				1				4			2	2		9
Mobile Facilities.			1				1	1						3
Equipment.								1		1	1	1		4
Safety		1			3		1					1	1	7
Summary.							1							1
Total.	0	2	3	2	3	0	7	6	1	2	3	6	2	37

Table 1. - *Continued*

Citations by Topic and Year

	pre-68	68	69	70	71	72	73	74	75	76	77	78	79	Total
Evaluation														
Test Development.		1	2	2	2	2	3	1	1			2	2	18
Interaction Analyses.				1	1	1								3
Program Evaluation.		1	2	2	2		2					1		10
Effects of Evaluation		1	3				2	2		1				9
Summary														0
Total	0	3	7	5	5	3	7	3	1	1	0	3	2	40
Teacher Education					1									1
Recruitment		1	2	2	3	4	3	1	2	1	1	3		23
Org. and Administration		1	1		6	2		1	2			1		14
Undergraduate Programs.														0
Descriptions			1	2	2	1	3	2	2			2		15
Competencies				1	1		2	5	3		3	1		16
Student Teaching.	1						1					1	1	41
Graduate Programs		1	1		1	1	3	1	2	2	2		2	16
Program Evaluations/Analyses. . . .														0
Undergraduate Studies.		1	1	4	3						4			13
Graduate Studies				1	1		3		1					6
First Year Teachers.								2						2
In-service Education			1	2	2	2	1	1		3	1	1		14
Summary														0
Total	1	4	7	12	20	10	16	13	12	6	11	9	3	124
Administration and Supervision. . . .								1						1
Attitude Studies.		2		1				1	2			1		7
Role Perceptions.	1	1					1	1						4
Administrative Practices.							2	4	1	4		1		12
Administrator Preparation								1				1		2
Summary														0
Total	1	3	0	1	0	0	3	8	3	4	0	3	0	26

Table 1. - *Continued*

Citations by Topic and Year

	pre-68	68	69	70	71	72	73	74	75	76	77	78-	79	Total
Professional Concerns		1	1			2		2				4		10
Associations		1		3	3		3		2			2		14
Leadership								1		2	2	2	2	9
Research	3	14	1				2		2	1	2	2	1	28
Summary														0
Total	3	16	2	3	3	2	5	3	4	3	4	10	3	61
Summary and Recommendations	4	1	3							5		2		15
Total	4	1	3	0	0	0	0	0	0	5	0	2	0	15
Overall Total	23	87	93	97	77	52	98	87	56	54	56	67	24	871

Table 2. Citations by Year and Type*

	Dissertations	Funded	Other	Total
Pre-68	4	3	16	23
1968	47	2	23	72
1969	59	5	22	86
1970	47	4	30	81
1971	33	3	25	61
1972	12	6	17	35
1973	42	3	33	78
1974	57	4	21	82
1975	26	4	18	48
1976	1	9	31	41
1977	14	4	32	50
1978	12	5	43	60
1979 (partial year tally)	1	4	14	19
Totals	355	56	325	736

*Note: Citations were classified into types by bibliographic evidence, i.e., mention of funding source, dissertations, and the like. Because it is recognized that this method imposes some limitations, the reader is urged to consider the data as tentative.

Table 3. Agency Involvement

Type of Agency	Number of Cited Studies	Number of Agencies
Major Universities*	563	68
Universities and Colleges*	66	25
Associations	71	6
State Educational Agencies	23	--
Local Educational Agencies	15	--
Research Organizations	6	2
Misc. and Undetermined Type	31	31
	775	

*Note: Distinctions were made on the basis of AAUP categories as used in the annual survey of institutional salary levels in the *Chronicle of Higher Education*.

The broadening research constituency not withstanding, considerable evidence exists to suggest the ongoing vitality of several key institutions. In the research cited, six institutions emerged as leaders: The University of Northern Colorado (58 citations, 7.5% of this review's total), The University of Missouri-Columbia (55, 7.1%), The Ohio State University (42, 5.4%), Texas A & M University (40, 5.2%); and The University of Maryland (24, 3.1%). The foregoing, of course, refers only to quantative, not qualitative, measures. The statistics also refer only to institutional activity directly related to industrial arts. It is likely that the order would change were vocational education research included.

WEAKNESSES

Generalities

The original charge carried with it the obligation to identify weaknesses as well as strengths. With the most sincere intent, then, the following impressions were felt to constitute the relative weaknesses over the past twelve years.

While the quantity of items precluded detailed analysis of experimental rigor, the reviewers were sufficiently alert to the existance of this problem. This seems to be a persistent problem, for Householder and Suess (1969) also mentioned it. Specifically, it appears that the selection and use of appropriate research design remains difficult for industrial arts researchers. Today, as before, the sampling techniques incorporated in some research greatly restrict the generalizability of the findings. An erroneous tendency to consider comparison groups the equivalent of untreated control groups represents another general weakness, particularly in studies focusing on instructional methodologies.

Focusing now on a finding that parallels the National Academy of Science's panel, the impact of industrial arts on learning process variables is not well documented. In the light of vocational education's increasing embrace of certain general education thrusts, this lack of documented impact is particularly disquieting. Furthermore, the record of performance that does exist in industrial arts is a rather insular one, one that evidences little communication between the realms of "academic" and vocational research (Petty, 1978).

As identified in a number of the section summaries, the absence of an overall framework to guide developmental efforts is clearly an important weakness. While the National Academy of Science panel's observations in 1976 clearly evidenced agreement with the reviewers' position, unfortunately they found themselves unable to design an overall federal coordination mechanism for vocational education R and D. Another directly related problem includes the practice of emphasizing a priority area for a short period of time and, then, shifting emphasis. This practice, when combined with difficulty in communication between researchers and Washington administrators, leads to "wheel spinning" in our profession.

As might be correctly inferred from the preceding, there is another area of weaknesses in industrial arts research. For example, Streichler's (1966) observation that industrial arts research exhibited a great variability in quality still appears to be accurate. His caution to guard against lowering of research standards deserves careful attention.

Another cause for concern is the lack of professional identity. In both the National Academy of Science (1976) and Petty (1978) reports, considerable discussion of vocational education R and D is presented. Industrial arts, however, is neglected. No mention is made of this field, despite the facts it represents a legitimate service area, involves an estimated 60,000 teachers and benefits approximately 6 million students. More importantly, industrial arts' contribution to technologically related education programs, particularly those before significant occupational selection has begun, has been almost ignored by vocational education R and D. Nor apparently have industrial arts researchers actively participated in the vocational research forums at least to the extent that their efforts would evidence some significant visibility in vocational education research reports.

The Gap

The most serious weakness is the lack of treatment of the leadership-practitioner gap. Clearly, the acceptance of new industrial arts objectives is as suspect now as it was when Streichler (1966) first commented on it. It is difficult to draw support for such newer objectives as technological literacy from the research literature. Furthermore, the leadership development engaged in by graduate programs has, by and large, skirted this gap. Despite exhortations to the contrary, the profession seems to have trained relatively few thrusts on the challenge issued by Schmitt and Pelley (1966),

namely, that "the current industrial arts curriculum does not even measure up to the program recommended by the profession ten to twenty years ago" (p. 30).

Curriculum

Foremost among the weaknesses identified in curriculum studies are those pertaining to the lack of coordination in development efforts and the subsequent dissemination of their products. Coupled with a rather obvious professional parochialism, these deficiencies result in frequent duplications of effort and equally frequent gaps in curriculum coverage. Further compounding these problems is the fact that the philosophical assumptions underlying the derivation of industrial arts content from industrial sources remains unexamined.

Methodologically, both field testing and learning process research require some attention. Both often employ a "something versus nothing" design that seeks to determine whether treated groups are enhanced in some treatment-related characteristic compared to those that have not been so treated. One is forced to wonder what such "researchers" expect. Additionally, beyond the design difficulties already elaborated upon, an instrumentation problem also exists. Despite the fact that validity and reliability frequently were addressed, sensitivity was not. Hence, the reviewers often were left with the impression that research was being conducted with "wooden yardsticks in the quest for thousandths of an inch."

Another surprising weakness was that the curriculum supporting aspects of equipment research remained almost a void. Similarly, safety statistics, fire prevention, and carcinogenic concerns were conspicuously absent.

Evaluation

Fragmented development best represents the reviewers' interpretation of the work in industrial arts evaluation research. There were very few overall cluster-based evaluative instruments. National testing and/or program evaluation also was lacking. What is needed is a critical mass of evaluation research. Specifically, the absence of any systematically validated and longitudinally verified instruments keyed to our profession's principal goals seems inexcusable.

Administration

The limited numbers of administration-oriented studies served as an initial clue to the weaknesses in this arena. Relatively few investigations into the effect of varying organizational patterns was evident. While research identified conflicting role expectations, little effort apparently was invested in correcting distorted perceptions. Another weakness exists in the lack of normative studies regarding actual administrative practice. Without such information, administrators can only resort to personal preference and subjective inclination.

Impact

Without fear of overstatement, the lack of any critical mass of studies that deal with industrial arts' impact on occupational choice and other prevocational contributions is tragic. The absence of a detailed composite description of students also is serious. In the face of these deficiencies, we can only conclude that industrial arts consistently has overstated its case, particularly with regard to its impact on students.

STRENGTHS

Because of their direct involvement and personal identification with industrial arts research, the reviewers were pleased to note that the review process also surfaced some obvious strengths. Since these sharply contrast with the previous section's catalog of weaknesses, the reader is encouraged to note the "jigsawing" effect of interlacing strengths and weaknesses.

Generalities

The reviewers are pleased to comment favorably on the overall increase in the presence of industrial arts research. They also concur with Streichler's (1966) commendation of the *Journal of Industrial Teacher Education* as a significant mechanism to encourage research. The reviewers also find that the gradually increasing proportion that nondegree related research represents of all industrial arts research is encouraging, as is the trend to action research. In these ways the reviewers replicated Householder and Suess's (1969) conclusions. Furthermore, two additional conditions exist which justify optimism. The first speaks to the potential research quality our field is now capable of in terms of increasing ability to control experimental conditions

(Householder and Suess, 1969). The second is based on the rather obvious diversification of the types of people who actually engage in research effort (National Academy of Science, 1976).

History, Foundations, Philosophy

In balance, this area of research should be classified as a strength. Long range overviews of key milestones in the evolution of industrial arts have been provided. As a result, the profession has an appropriate sense of its roots. In contrast to this perspective is the relative weakness in documentation of intermediate history, that is, the chronology of lesser events, and -- more importantly -- of the dynamics of the evolutionary processes that lead the profession from one major milestone to the next.

Another area in which the profession can take great pride is the ongoing discussion of the technological thrust in schools and society. The program proposals, curricula, and situational analyses have been unparalleled. Unfortunately a serious lack of implementation remains a cause for concern. Nevertheless, the necessary prerequisite steps have been taken. Within our profession's technological area of strength, one other small thrust remains to be addressed systematically, namely technology education legislation or legislation that subsumes a major role for industrial arts as it *could* become. The foundations have been established. What is needed is a targetted effort to generate the visibility, excitement, and rationale that ultimately will yield a technology education bill or a special title within an omnibus law.

Career education has served as a useful catalyst for considerable research in industrial arts. Most commendable was its tendency to draw educators across discipline areas. Furthermore, it typically provided a framework to guide many program decisions regarding the actual implementation of industrial arts in a number of schools. In this way, career education enjoyed the hallmark of a well-articulated philosophy in that it served to guide decision-making.

Curriculum

Three strengths emerged from curriculum related research. The first was the development and documentation of a multifaceted array of processes and techniques. A large variety of such approaches have been described which provide professionals with

useful tools. Among these contributions are the system-based and competency-based approaches.

The development of instructional packages, units, and systems represents a second area of strength. The acknowledged leader here has been the Industrial Arts Curriculum Project (IACP). Both in its systematic incorporation of desirable development practice and in subsequent follow-up and evaluation, those associated with this project have established a standard for all to aim toward. Another hallmark of the IACP is its success in converting ideals to practice. The reviewers' impressions that more students have experienced IACP exposure than any other innovative curricula supports the previous observations.

The profession's increasing number of state-wide teacher team efforts at generating guidelines is a third area of strength. Recognizing, as the IACP has, that implementation is one of the significant criteria that can be applied to a curriculum, these efforts are based on the premise that teachers need to be involved in the curriculum development process from the beginning. Independent development followed by a "sales" approach was found not to work. Researchers also are discovering that team efforts have many spin-off benefits that greatly strengthen the professional presence in a state.

Beyond the strengths described above, the reviewers also identified a number of strengths that tend to be singular in nature. Among these was the finding that industrial arts served useful purposes for a variety of special needs students. Such populations were capable of benefiting from industrial arts. Conversely, industrial arts has the capability of delivering useful services.

In the psychomotor domain, considerable research efforts have addressed specific microportions of this area of performance which is so fundamental to industrial arts. Fortunately, the evolutionary stage has been reached wherein professionals are testing the existing taxonomy as a whole and are, in fact, positing alternative ones.

Facility planning, process-related studies have been conducted to the degree that they constitute another area of strength. Related to this is the NAITTE compilation regarding safety recommendations and practices.

NEEDS AND RECOMMENDATIONS

One of the pressing needs faced by the profession is a way to identify and access the research being conducted. The specific surveying of RCU directors regarding industrial arts related projects would seem to be an initial step. Both the AIAA and the AVA-IAD research committees could address this task.

A more consistent federal R and D effort is also needed, particularly in terms of the accessibility of funds to industrial arts. It almost goes without saying that the amount of federal research dollars needs to be increased. Because of the previously mentioned insularity of industrial arts and vocational education research, there also seems to be legitimate grounds for recommending more interdisciplinary efforts. Behavioral, social, and educational researchers would guard against the professional egocentrism that is sometimes apparent.

In terms of the overall research effort, we believe that the quest for a comprehensive system to guide industrial arts research is appropriate. If industrial arts research is to outgrow its relatively fragmented nature, an overview needs to be established to guide further research. Combined with this is the pressing need for replication and validation of some of the cornerstones of present practice. The development of specific reviews and syntheses of individual areas with industrial arts will be necessary in order to accomplish such verification. For example, each section of this review might serve to initiate a definitive treatment of that subject.

Status Studies

While this review has attested to the strengths of existing status studies, it also needs to repeat the challenge for longitudinal ones. Furthermore, comprehensive nationwide statistics are lacking. Only recently is there any grounds for optimism in this area (Dugger et al. 1979). This is a reference to the USOE-funded project to develop a data-based set of national standards for industrial arts. Because of its centrality to the profession, this project deserves our attention.

Analysis of the existing status studies indicated a serious need for a systematic synthesis of their findings alone. Such integration would yield a valuable picture of the actual practice of the profession. One outgrowth of such a project would undoubtedly be a drive to eliminate the present gap

in our knowledge of existing and/or exemplary rural and urban practices. Another urgently needed status study is an analytical description of industrial arts certification requirements.

Impact Studies

Perhaps the most important of all areas of needed effort is in impact research. Without better documentation of our effects, the practice of industrial arts -- as we know it -- will inevitably disappear. Indeed, it may even be that impact research is necessary to allow the opportunity for industrial arts to become what it can be. The profession must be able to demonstrate its contributions to the country's bank of human resource capital. It must be able to answer questions regarding its effects on the eventual employment of its students. As with vocational education, industrial arts needs to be able to cite evidence relating to its economic impact, its effect on school to work transitions, its power in retaining potential dropouts, and its cost effectiveness. Of course, it must be able to document its contributions to each of its traditional goals in a like manner.

Professional Studies

A variety of needs have surfaced in this area. The most obvious is the need for the profession to make itself understood, particularly with respect to its aims and procedures. Industry, administrators, students, parents, and the public all require an accurate perception if our profession is to be effective.

Various means of fostering state association leadership activities need to be evolved and more effort needs to be addressed to the other facets of association work. Increasing the quality of communication between member and association is one such imperative.

Professional concerns regarding the job satisfaction and job conditions associated with industrial arts teaching also need research attention. These findings need to be incorporated into contractual and policy guidelines that affect the practice of industrial arts in a positive manner.

Individual Needs

Because, unfortunately, the idea that teachers tend to teach as they were taught has some truth, the conservative nature of industrial arts teacher education methodology is somewhat

disquieting. Research is needed on the ways faculty can be encouraged to adopt a greater variety of teaching strategies.

There also is a need for more effective evaluation of inservice education. Perhaps then some of the *post hoc* aspects of such evaluations will be mitigated. Assessments of the cause of, and corrections for, the incorrect understandings of industrial arts by various responsible administrators also is important. Methodologies with increased precision and sensitivity will need to be employed to provide answers, as contrasted to the tendency to show a typical "valuing" of everything.

Intermediate historical documentation has been mentioned. Such efforts seem to offer particular promise at the local and subregional level. Another logical study would entail a synthesis of industrial arts R and D detailing its capabilities with special needs learners.

In summary, the reviewers have been favorably impressed by the body of research reported during the period under consideration. The magnitude of the reviewing task has necessitated compromises in selection strategies, thoroughness in examination, and detail in reviews. The breadth of the task has seriously restricted the ability of the reviewers to synthesize generalizations in many areas. It is to be hoped that researchers in industrial arts education will continue to improve the quality of their work. It is imperative that more detailed reviews be conducted with increased frequency.

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