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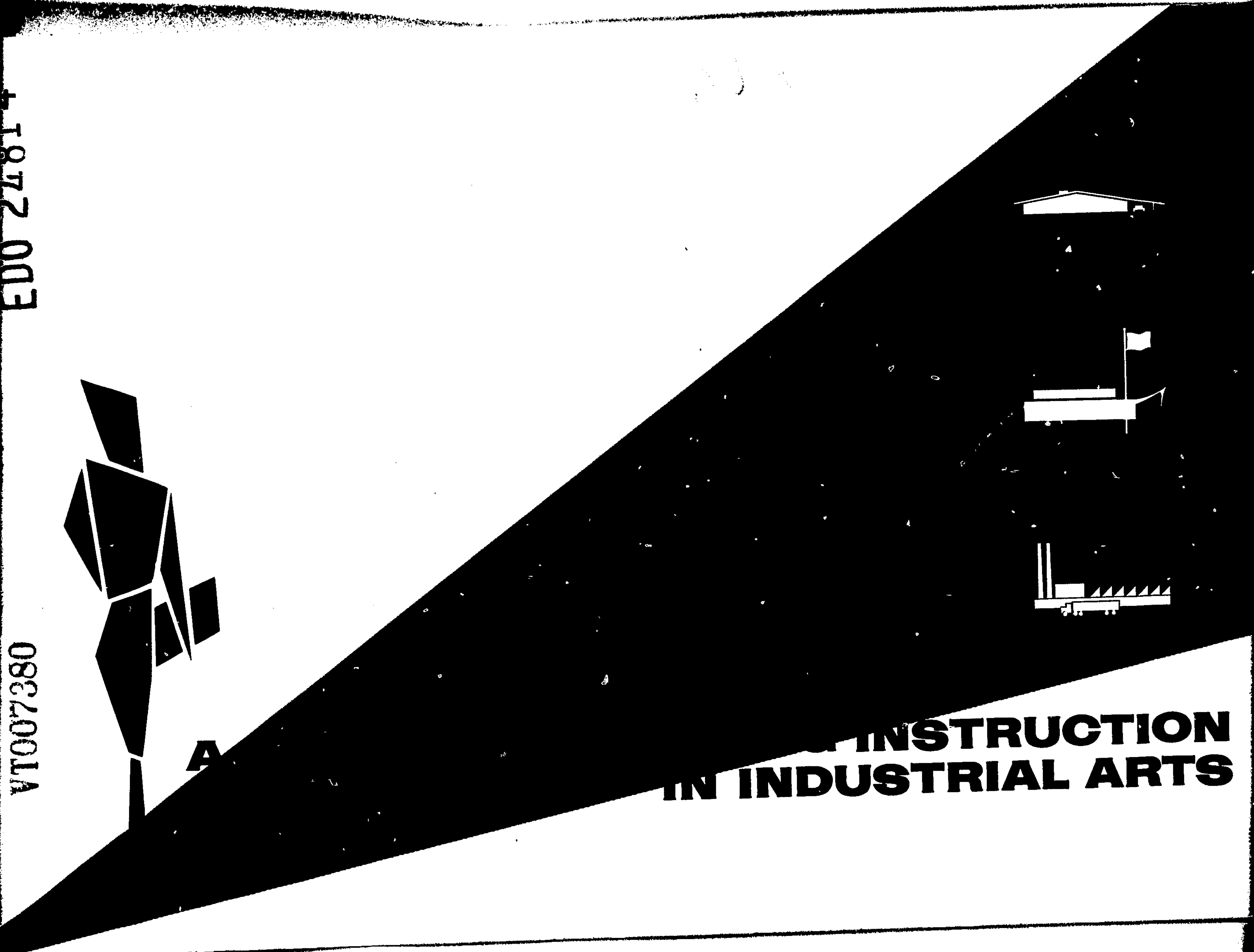
This guide was developed by a national professional association for use by teachers of industrial arts for the improvement of instruction. Contents of this fourth revised edition suggest possibilities of an organized program of industrial arts structured to provide for teaching concepts that more realistically lead to a fuller comprehension of present-day technology and better meet the current challenges and needs of youth. Section I treats the goals and objectives of industrial arts. Facilities for multi-field, single-field, and area-unit organizations are discussed in Section II. A structure and organization for efficient learning in industrial arts are presented in Section III, and Section IV gives the role of evaluation in industrial arts. (EM)



# A

# INSTRUCTION IN INDUSTRIAL ARTS

*A superior educational program today may be an inferior one a decade from now—unless bold imaginative steps to improve upon that program are continually taken. Today's failure to meet this challenge may very well perpetuate the status quo rather than lead to improvements or to the fulfillment of the purposes of our secondary schools in the twentieth century.*

*Curriculum development, content, organization, and educational practices cannot be based on static or retired concepts. There must be a constant quest for imaginative research and development aimed at improving our educational programs and closing the gap between life and what is being taught in our schools.*

*Today's vast and rapidly accumulating store of knowledge dictates that isolated facts no longer be taught. If the programs in our schools are to be meaningful, information must be organized in such a manner as to show the relationship of each fact to the total experience. This bulletin has been so organized.*

# A GUIDE TO IMPROVING INSTRUCTION IN INDUSTRIAL ARTS, a Revision,

*A Revision of:*

STANDARDS OF ATTAINMENT IN INDUSTRIAL ARTS TEACHING
IMPROVING INSTRUCTION IN INDUSTRIAL ARTS
A GUIDE TO IMPROVING INSTRUCTION IN INDUSTRIAL ARTS (FIRST EDITION)

# PREFACE

This edition of A GUIDE TO IMPROVING INSTRUCTION IN INDUSTRIAL ARTS has been prepared primarily to assist the teacher of industrial arts in improving the quality of industrial arts instruction.

The bulletin carefully avoids a "cookbook" format in seeking to be truly a *guide*. It has been designed to be flexible in its scope and broad in its treatment of industrial arts content, yet limited in detail. It is intended to serve as a guide for the teacher in the preparation of instructional materials suitable for his particular situation. Although broad in its coverage of the study of industry, it provides opportunities for the learner to understand effectively industrialism with all its implications —which are essential to everyone.

Although the areas of this publication are broad, it must be observed that industrial arts programs should continue to focus on those functions of industry considered most unique to the discipline. Further, while concepts or areas of study have been identified along with content applicable for achieving comprehension of these concepts, the material found in the bulletin is not intended to serve as a course of study but rather as a wide framework from which the teacher can develop individual industrial arts offerings.

Finally, while many functions and activities of industry, as stated in the bulletin, require knowledge and competencies that are unique to the discipline of industrial arts, others require knowledge found in related disciplines; therefore, it is essential that program development in industrial arts be characterized by close cooperative and articulated efforts of all those disciplines involved.

While the bulletin is different from previous editions, it is consistent with the general understanding and current philosophical trends of industrial arts today. Throughout the bulletin, emphasis has been placed on recent developments and ideas in order to make the revision as up-to-date as possible.

Contents of this new edition suggest possibilities of an organized program of industrial arts structured to provide for teaching concepts that more realistically lead to a fuller comprehension of present-day technology and better meet the challenges of our time and the needs of our youth. Attention has been given to various emerging philosophical approaches to industrial arts as well as careful consideration to updating goals and content.

The bulletin also has been planned to aid prospective teachers, supervisors, administrators, and others interested in this important segment of education.

The manuscript was prepared by the following members of the Revision Committee: Ernest L. Minelli, Central Michigan University, Mount Pleasant, Michigan, Chairman; Leslie H. Cochran, Wayne State University, Detroit, Michigan, Secretary; Arthur Ahr, The State Education Department, Albany, New York; Walter E. Burdette, Arizona State University, Tempe, Arizona; Joseph S. Chick, Pueblo Public Schools, Pueblo, Colorado; John T. Cunningham, Board of Education, Trenton, New Jersey; Estell H. Curry, Department of Vocational Education, Detroit, Michigan; Arthur J. Dudley, State Education Department, Albany, New York; John H. Ericson, Southern Illinois University, Carbondale, Illinois; Clyde W. Hall, Savannah State College, Savannah, Georgia; Frederick D. Kagy, Illinois State University, Normal, Illinois; William P. Klingensmith, Board of Education, Chicago, Illinois; John H. Koenig, Department of Education, Trenton, New Jersey; Roderick G. Kohler, Northern Illinois University, DeKalb, Illinois; Edwin L. Kurth, University of Florida, Gainesville, Florida; John R. Lindbeck, Western Michigan University, Kalamazoo, Michigan; Angus J. MacDonald, San Jose State College, San Jose, California; James O. Reynolds, Dayton Public Schools, Dayton, Ohio; Walter J. Robinson, Northwestern State College, Natchitoches, Louisiana; Gerald L. Sommers, Manitoba Institute of Technology, Winnipeg, Manitoba, Canada; George K. Stegman, Western Michigan University, Kalamazoo, Michigan; Joe E. Talkington, Illinois State University, Normal, Illinois; and, Marshall L. Schmitt, U.S. Office of Education, Washington, D. C., ex officio member.

The Committee wishes to express appreciation to others who contributed to the revision, such as: Ralph Bohn, California; Gardner Boyd, Missouri; James Brown, Colorado; Joseph Carrel, Indiana; Norman Delventhal, Michigan; Winsor Dunbar, Michigan; Peter Jackson, Missouri; John Jarvis, Wisconsin; William Kemp, Minnesota; Charles Meline, Illinois; W. R. Miller, Missouri; Z. A. Prust, Arizona; G. Harold Silvius, Michigan; Jacob Stern, Michigan; Robert Swanson, Wisconsin; and, Charles Thomas, Wisconsin.

In addition, we are indebted to the many AVA members who reviewed the manuscript.

The Committee, also, is grateful to Joseph Metcalf, Illinois State University, Normal, Illinois, for the cover design and art work found throughout the bulletin and to William J. Lewis, Central Michigan University, Mount Pleasant, Michigan, for his assistance in smoothing out the rough spots encountered during the writing.

Acknowledgment, of course, is given to those persons who initiated and prepared the previous editions. These editions have had a profound influence on the development of the industrial arts movement throughout the United States and elsewhere.

The Revision Committee
*August 1968*

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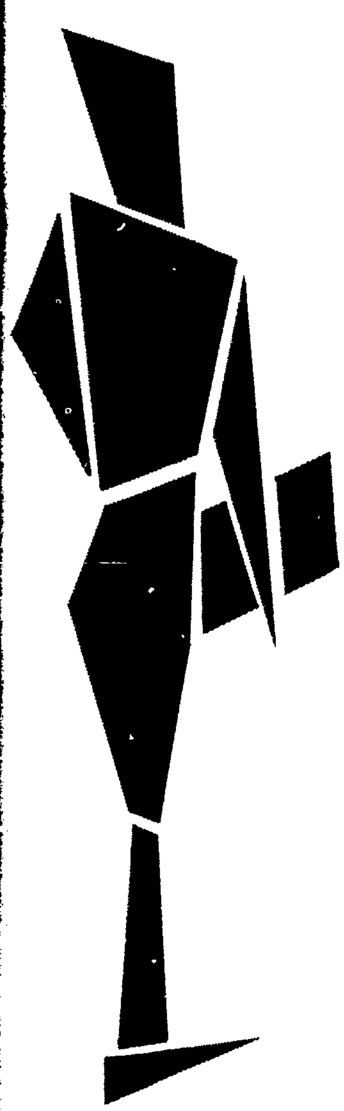
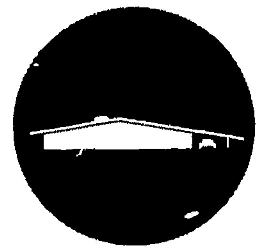
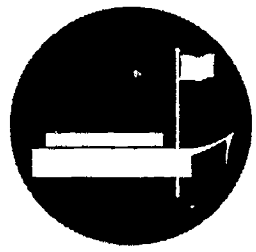
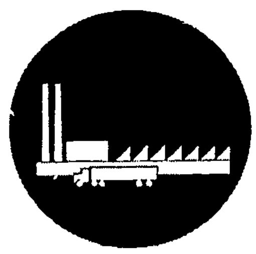


# SECTION I

# INDUSTRIAL ARTS EDUCATION







*Goals for Contemporary Industrial Arts Programs*

*Objectives of Industrial Arts by Operational Levels*

*Objectives and Behavior Changes*

*Toward the Attainment of Goals*

Since the technological foundation upon which industrial arts is based, or at least should draw its content, is itself in an exponentially changing state, industrial arts education then by its very nature must be in a continual state of transition.

Because the social and educational needs of any progressive society, nation, or community are continually in a state of flux, and if that society, nation, or community is to progress, constant reappraisal of its existing programs of education is always appropriate and necessary. It is therefore fitting that those concerned with industrial arts education should periodically undertake a realistic evaluation of its past and present goals with the clear intent of making industrial arts more meaningful in light of the emerging needs of our society.

The advent of new and rapidly advancing industrial processes has made many traditional subject areas of industrial arts obsolete in relation to contemporary industrial scenes throughout the country. It must be decided, therefore, if the cultural-historical, leisure time, hobby, and pre-vocational values are important enough to warrant continuing these traditional subject areas in their present forms, or should means by which they may be supplemented with new and more up-to-date subject content and subject areas be emphasized.

According to many experts, cybernation has created another problem which will strike at the fabric of our present way of life. If the future holds a promise of an industry capable of producing most of the consumer goods needed by the population while utilizing a small percentage of the available work force, the attitude of our society toward work may have to change or be changed. In our society of the future, it may be necessary, perhaps mandatory, that much of the population be educated toward a life of worthwhile-meaningful leisure.

Without stretching the imagination, one could look to a complete reorientation of the traditional Western sociological stratification which would provide work for the select few and leisure for the masses. Industrial arts, then, would find itself becoming more involved in areas of adult education in lieu of other objectives. In the same respect, it would seem possible that the traditional concept of industrial arts as a project-oriented program of early twentieth century custom manufacturing activities might give way to the concept of industrial arts as a study of the basics of modern technology. A new look at the needs of the North American people in these respects and the relationship of these developments to the industrial arts program is an immediate necessity.

True, many of the traditionally accepted goals and subject areas of industrial arts are under attack; many are still accepted as valid, and new concepts continually are being proposed. The goals presented here will be advocated not as a collection of all possible goals, but as a listing of the aims or goals that are relatively unique to the industrial arts curriculum. At the same time, an attempt will be made to view not what is being taught but to ascertain the instructional level and to whom the teaching i, being directed. In this manner, it may be possible to delimit the goals of this most important phase of general education and, rather than become all things to all people, perhaps achieve the best practical industrial arts program for the greatest numbers of the school population.

## *GOALS FOR CONTEMPORARY INDUSTRIAL ARTS PROGRAMS*

At a time when new discoveries and developments in the sciences and technology are perpetuating the educational lag, developing objectives for industrial arts needs real thinking and reasoning.

Many of the objectives and goals of industrial arts in the past were either repetitious or geared to the popular theories of psychology of the times. As a result, the program and its justification were open to criticism when such theories were either generally abandoned or simply discarded in favor of newer or more exciting theories of the learning process.

In essence, the question of legitimate goals and subject areas would seem to be unsettled at this time. The question seems, therefore, to resolve itself into two quite simple queries that are not so simple to answer. These questions are: (a) What is industrial arts attempting to accomplish in the school system, and (b) How does it propose to accomplish whatever it is that it is purporting to do?

If different results are to be achieved at the elementary, junior, senior, and post-high school levels, then it would seem only reasonable that the goals and subject areas as well as methodology employed should vary at these different operational levels. There are certain goals which are unique to the study of industrial arts and are not shared by other subject areas presently being taught in the school curriculum. At the same time, there are goals which are valid for all operational levels of industrial arts as well as for other subjects from elementary to post-high school programs.

An analysis of industrial goals developed in the past reveals that many of the goals were untenable, others controversial. To provide a sound program of industrial arts, clear, realistic goals are essential. These five are being advocated and are believed to be unique to industrial arts.

### GOAL I—*Develop an Insight and Understanding of Industry and Its Place in Our Culture.*

Since one of the predominant characteristics of our society is industrialism, is not an understanding of this aspect of our culture with all of its implications essential for all school youth. Properly conceived, experiences relating to industry and opportunities for each student to better understand the society in which he lives are part of the common learning and total development of the learner.

While the historical and social aspects of the evolution of our modern industrial complex are important phases of a study of this nature and while studies may be conducted through courses in the social sciences, it is difficult to understand the complexities of a modern industrial society only through vicarious experiences. It is reasonable to believe that a fuller understanding of the industrial revolution, modern mass production, and automation will occur if the student actively participates in meaningful experiences dealing with the complexities inherent in the manufacturing of consumer goods, utilization and generation of energy, and the servicing, testing, and repairing the products of modern technology.

Values derived from industrial arts experiences enable the student to understand better the technological society and himself as a member of that society.

GOAL II—*Discover and Develop Talents, Aptitudes, Interests, and Potentialities of Individuals for the Technical Pursuits and Applied Sciences.*

Students have a diversity of talents. Opportunities for students to discover abilities and develop to their fullest are essential to the basic education of all youth. Efforts should be made to allow for differences in abilities, interests, and needs, and to ascertain which learning experiences are the most significant for the success of each individual. Thus, a student can better assess his potentialities and interests when making an occupational choice, understand his environment, and condition himself to the rapidly changing demands of technology and society.

The ramifications of this goal long have been a major concern of industrial arts, especially on the junior high school level. In the past, a well-conducted and planned industrial arts program, without a doubt, has been instrumental in assisting youth to make occupational decisions. If it accomplishes nothing else, an industrial arts program can be considered justifiable on the basis that it does provide students with experiences which for the most part are unobtainable in any other high school subject.

GOAL III—*Develop an Understanding of Industrial Processes And the Practical Application of Scientific Principles.*

Experiences in industrial arts provide the student an opportunity to utilize his knowledge of science, mathematics, and other facets of general education in solving practical technical problems.

The field of industrial arts is concerned with the study of integration of physical, chemical, and other forces with the materials and processes of industry, coupled with an active interest in the creative use of design. Industrial arts courses have their content cast in science and mathematics.

A program of industrial arts fosters experiments, research, exercises, and opportunities for solving various types of technical problems as well as project making.

The storehouse of scientific information is becoming fuller and richer. Research and development is now an organized industry. The waiting time between discovery and practical usage is largely a thing of the past. The "lead time" between scientific discovery and practical production is reckoned in months rather than decades. This wedding of the technologies with science should be reflected in the curricula of public schools. Industrial arts can serve an important function in dispensing knowledge of practical scientific applications and in enriching the science offerings of the school curricula.

GOAL IV—*Develop Basic Skills in the Proper Use of Common Industrial Tools, Machines, and Processes.*

Industrial arts provides students with basic skills which are relevant to industrial occupations and later may assist the individual in successful occupational adjustment.

Many present day workers, and certainly a majority of the workers of the future, will be required to train and retrain for several different occupations during their working careers. A solid grasp of fundamental skills and knowledge concerning diversified areas is therefore essential if this retraining is to be accomplished rapidly and thoroughly with a minimum of occupation interruption and adjustment.

This segment of industrial arts instruction provides opportunities for developing manipulative skills, the very vehicle which students use to achieve their goals, understand industry, and discover abilities to develop to their fullest in the industrial fields.

Contact with and success in manipulative experiences involving industrial products, processes, and materials also can lead to a richly rewarding lifetime, leisure-time activity. The do-it-yourself trend which has become a modern phenomenon shows no indication of decreasing or abating as witnessed by the many new tools and materials developed for home usage and consumption. It would seem, therefore, that the safe and proper use and maintenance of such do-it-yourself devices would be a natural by-product in the education of both men and women in today's environment.

There is a great fear that industrial arts could become a theory-oriented course of instruction dealing only with the non-manipulative aspects of the practical arts. In striving for greater general acceptance of content by upgrading and updating the theoretical aspects of the curriculum, the important approach of learning-by-doing must not be lost. On the other hand, for too many years, emphasis on manipulative skills has reigned supreme and sometimes has become the end in itself of industrial arts education rather than a teaching tool to enrich and improve instruction in the total program. Somewhere between these two extremes, the modern industrial arts program must interpret for youth and adults the industrial world of today.

GOAL V—*Develop Problem-solving and Creative Abilities Involving the Materials, Processes, and Products of Industry.*

The problem-solving approach in industrial arts involves creative thinking and allows students to define and determine logical solutions to problems and to evaluate both visually and intellectually the effectiveness of their solutions.

These kinds of experiences provide environments where the scientific and technological minds begin to appreciate tools and machines, processes, and materials, and where opportunities are provided for augmenting knowledges and reinforcing beliefs.

The very nature of our laboratory setting makes possible a concrete, understandable approach to teaching problem-solving and critical thinking.

There are some who believe industrial arts programs tend to stifle and discourage problem-solving and creativity. There are other bold minds that prefer to strike out into the unchartered frontiers of knowledge. If creativity is to be fostered as the hope of the future, there must be a concentrated effort to recognize, encourage, and nurture inquisitive minds in the classroom and laboratory. This means a flexibility of methodology, a system of change to match changing conditions, and content to allow a certain amount of creativity and pragmatic problem-solving.

## *OBJECTIVES OF INDUSTRIAL ARTS BY OPERATIONAL LEVELS*

The objectives which are unique to the industrial arts curriculum are appropriate at all levels of the program. They might also be expressed in terms of the functions of industrial arts—namely, basic culture, exploration, technological orientation, avocations, basic skills, and prevocational problem-solving and creativity.

While the five goals, indicated in the preceding section, are considered basic to industrial arts, supplementary objectives should be developed for the various age and grade levels. Stress and emphasis on the different objectives naturally will vary at each grade level and with individual abilities, interests, and needs. In addition, teachers must be reminded continuously that students have their own goals, both immediate and long-range, and that many times these are in wide variation from those of the teacher.

Industrial arts exists at the elementary, junior high, senior high, community college, and undergraduate and graduate levels of the university. It is possible and quite common for an individual to have his first course in industrial arts at any one of these various levels. This seems to be an indication that there is little to distinguish the program at the various levels other than the chronological age of the students. This would seem a rather harsh indictment, but all too often this indictment is quite valid. In too many cases the "window sticks" simply grow larger, in a figurative sense, as higher operational levels are reached.

Although the industrial arts curriculum may give this appearance, certain objectives are emphasized more at one operational level than at another, while others have only limited applicability at the same level. The teacher also considers such factors as the student's maturity, needs, abilities, interests, and capabilities in order to select and develop appropriate content to meet the specific requirements.

In general, then, the basic direction of the industrial arts program is as follows:

*Industrial Arts in the Elementary School (Grades K-6).* Industrial arts experiences in the elementary grades are closely correlated with the basic units of the elementary schools so that the results will be an integrated program of education. Through the use of easy to form materials, the children have an opportunity to express themselves creatively in the construction of two and three dimensional objects. From such endeavors, they not only benefit from the sheer joy of working with materials but also from the many opportunities for self-expression and self-discovery. In addition, considerable insight and interest are developed in manipulative activities which parallel those in their parents' "world of work."

Usually the children work in the classroom under the direction of the elementary teacher, however, some schools provide a special room for individual and group projects. As a supplement to the regularly assigned teacher, specially trained consultants or resource teachers are employed to assist and direct teachers and pupils alike.

Since the curriculum in the elementary school is not based on ground-to-be covered or separate subjects but on child growth and development, industrial arts at this level should be part of a physical amalgamation of all subject areas and should be considered perhaps as a method rather than a separate subject viewed in its own entity.

Thus, the elementary school industrial arts program attempts:

1. To support, enrich, and vitalize the academic curriculum and make general educational experiences more meaningful to the students.
2. To develop cooperative attitudes and self-reliance through problem-solving situations.
3. To develop an understanding and appreciation of the dignity of honest work.
4. To learn how to modify materials to meet students' needs by using elementary tools and materials.

*Industrial Arts in the Junior High School (Grades 7-9).* The junior high school industrial arts program is the most diversified of all and offers youth a variety of experiences in organized laboratories. Under the direction of specialized teachers, the students are provided with basic exploratory experiences in using many of the tools, materials, processes, and products of the major industries. Through experiences in drafting, woodworking, metal working, industrial crafts, graphic arts, electricity-electronics, and power areas, the students can develop an appreciation of industrial design, good craftsmanship, safe work habits, orderly procedures, and an understanding of common tools, machines, and devices.

These exploratory experiences with materials and broad exposure to basic fundamentals of industry and technology constitute the primary aspects of the industrial program at the junior high school level. The program includes opportunity for all youth in planning, experimenting, and working in the major activities of industrial arts. Opportunities to study the underlying functions of industry and to explore their inter-relations are all part of the total program.

As a result, the student can assess and understand his interests, abilities, limitations, and potentialities in our industrial society. From this type of a general education program, guidance for all youth can be provided on both educational and prospective occupational levels.

In general, then, the junior high school industrial arts program attempts:

1. To provide all students with the opportunity to explore industry and the world of work.
2. To provide opportunities for attaining knowledge of industrial vocations and related avocational pursuits and hobbies.
3. To improve the competence level of the students in regard to the choosing, buying, and using the goods and services of industry.

*Industrial Arts in the Comprehensive High School (Grades 10-12)*. In the senior high school, industrial arts makes a unique contribution to the total school educational program as it interprets the functions, technology, and occupational opportunities of our modern industrial society. It provides the student with the opportunity to study about industry, materials, fabrication procedures, methods of communication, energy and propulsion, and personal services as they relate to the industrial and consumer use of finished products. Students see and experience the unity or wholeness of modern industry.

The industrial arts program at the senior high school level enables a student to go in one of two directions. The first, a lateral curriculum approach, enables the student to explore further additional kinds of work in which he may be interested or which are suited to his objectives. The second, a vertical curriculum approach, offers the student an opportunity to concentrate and specialize in a selected field of industrial work. As a result, for some students the program provides a broad general background, while for others it provides pre-occupational experiences. Regardless of whichever path the student may select, numerous opportunities for experimentation, problem-solving, the application of scientific principles, and the integration of physical, chemical, and electrical forces dealing with the materials and processes of industry are made possible.

In addition, the professional background and practical experiences of the industrial arts teacher qualify him especially well to offer guidance and counseling to industrially-oriented students.

More specifically, the high school industrial arts curriculum attempts:

1. To provide adequately for basic instruction to meet the needs of at least three types of students: (a)

students to explore more deeply the avocational, cultural understanding, and consumer aspects of American industry, (b) students planning to pursue advanced study and careers in the areas such as the applied and technical sciences, and (c) those who will be entering the labor force before graduation or immediately after.

2. To provide practical situations dealing with the industrial world of work and provide understandings of the competitive nature of industry and business.
3. To provide basic skills which are useful in a variety of occupations or for occupational adjustment.

The modern industrial arts program challenges the superior student, provides constructive experience for the average student, and encourages the slower and reluctant learner.

*Industrial Arts in the Community College and Technical Institute.* Industrial arts programs at this level contribute to the liberal education and technical competencies of students. Technical courses provide a sound base for those interested in industrial education. Service courses to the institution as well as to the community in the form of a wide variety of adult courses also are provided. In general, the curriculum attempts:

1. To provide courses needed to augment other instructional areas in the institution.
2. To provide adult education and community service programs which will act as "centers" for training in worthwhile use of leisure time.
3. To provide the technical courses for the initial training of industrial arts teachers.

*Industrial Arts in the University.* Most university industrial arts programs serve the needs of three distinct groups: (a) prospective teachers, (b) liberally educated students, and (c) students in related areas. The primary function of undergraduate industrial arts, however, is the preparation of industrial arts teachers. As such, the curriculum usually is divided into two areas, one being courses related to the development of skills and technical know-how, and the second being courses in the professional realm.

Graduate study beyond the baccalaureate level which leads to a master's or doctor's degree usually consists of some skill development, additional professional courses, and increased emphasis on research.

These programs attempt:

1. To provide, in addition to the practical laboratory courses in undergraduate work, the professional education courses for initial and in-service training of industrial arts teachers.
2. To provide graduate level instruction for those who will be assuming leadership functions in the field of industrial education in the public schools, community colleges, technical institutes, and universities.
3. To serve as centers for research and dissemination of materials in the effective teaching and organization of subject materials in the field of industrial education.
4. To provide basic experience and understanding for individuals interested in related technologies, such as management, production, and technical sales.

## *OBJECTIVES AND BEHAVIOR CHANGES*

The scientific revolution of today has caused a renewed interest in learning designed to produce general understanding of the structure of a subject matter. This structure refers to learning how things are related in a meaningful way. The true meaning of facts lies in their relatedness rather than in their mere existence. Memorization of facts without associating them to realistic situations is no longer an accepted practice. Current educational theory emphasizes the understanding of fundamental principles and ideas. This learning generally is referred to as behavioral concept development.

The selection and use of acceptable concepts is a tremendous shortcut to the student's learning and other activities. Learning general or fundamental principles insures that memory loss will not mean total loss, and what remains will permit reconstruction of the details when necessary. The clarity and completeness of a student's learning concepts are two of the better predictors of his success in school work, because meaning is fundamental in most school learning situations.

One task of the teacher is to help the student perceive the value of socially desirable goals within his range of ability. Each person lives in a continuously changing world of experience of which he is the center. He relates to experiences as he sees or judges them to be. Because no two persons have had identical past experiences, they will not view reality in the same way. This theory applies to teachers as well as students. Each will have his own concept of what is good or bad. As an example of this principle, consider several industrial arts teachers or students as they relate to or view Goal I—*"Develop an Insight and Understanding of Industry and Its Place in Our Culture."* Some with experiences closely associated with industry might view this goal quite differently from those with no personal experience of an industrial situation. This does not imply that one is right and the other is wrong. It merely points out the fallacy of a guide of this kind being prescriptive and listing certain activities and experiences which will satisfy this goal. The GUIDE is merely attempting to communicate the intent of each of the five goals; how a teacher satisfies each goal will depend upon his past experiences and his creative ability.

Most of the activities of humans are learned, including opinions and ideals as well as their overt behavior. This learning takes place at home, on the street, in the school, and elsewhere. Schoolwork is only one part of the educational world of a student. If the teacher is to guide the learning of individuals effectively, he must constantly be aware of these differences and have a variety of techniques to arouse a desire to learn in each individual. Industrial arts has a mission to arouse the interest of the student with ideas dealing with industry and technology. A natural setting for providing for these individual differences is found in the industrial arts laboratory.

Probably the most common educational objective in American education is the acquisition of information or knowledge. The two words are often used interchangeably. Acquisition of information may only involve the psychological processes of remembering. However, knowledge may involve the more complex processes of relating and judging. The new industrial arts is based more upon a knowledge of modern technology than information about modern technology. Because of the simplicity of teaching which relates and evaluates information, this objective frequently is emphasized out of proportion to its usefulness or its relevance for the development of the individual. Similarly, because of the complexity of teaching which concerns imparting and evaluating knowledge, this objective is often de-emphasized or ignored.

An analysis of any field of study will probably indicate an objective of skill development. Skill learning involves a great deal of trial and error. This is an awkward and ineffective method but often one of necessity. Improvement of this condition is brought about by suitable instruction. However, the emphasis n skills should always relate to the overall learning process nd the basic intent.

Skill development is typically thought of as a degree of erfection concerning manipulative activity. Psychologists give his area the classification of the psychomotor. There are two ther areas where a person can develop a degree of skill—they re classified as cognitive and affective. The cognitive deals ith recall, reasoning, problem-solving, and, to some extent, reative thinking. The affective is concerned with the changes in nterest, attitudes, values, appreciation, and adjustments. Ideally, student is developing a degree of skill in each of the three lassifications when he participates in the activity provided in he industrial arts laboratory.

Industrial arts is known generally for its ability to reward student on a "does do" basis as opposed to a hypothetical could do" situation. It is therefore important that the student e able to generalize from what he has learned to an immediate se or application. This calls for discovering application of nowledge beyond the situation in which the learning has ccurred. Learning in this manner also aids in retention. It ay be obvious that the conceptual approach crosses boundaries eretofore delegated to a fragmented structure of subject atter, such as boundaries of materials. Students often need ssistance in testing their concepts in a broader fundamental tructure. These concepts are validated more thoroughly through ractice in a variety of deductive situations. This variety also ill affect the permanence and breadth of concepts by its reinorcement and usefulness. A simple example might be the oncept of measurement. A student who understands the use of common ruler, with proper instruction, should be able to ransfer this relationship to an architect's scale, a centimeter cale, or a printer's line gauge.

Teaching procedures which encourage discovery and generalization have been found to be superior to drill. Sheer repitition and drill may destroy the desire for understanding as well as curiosity, imagination, and creativity. Problems are solved in the industrial arts laboratory by the discovery of the relation between elements of the situation which will satisfy the requirements of a problem. In so doing, the student is not only developing a mastery of the fundamental ideas of industrial arts but he also is developing a desirable attitude toward learning. As the schools continue to move toward a high priority for the problem-solving objective, more activities are needed to satisfy this objective. A student should have a wide range of experiences so that he may make contributions to the solution of problems. An activity becomes a learning experience only when it draws the response of the student. The more positive the feeling of the student toward the activity, the more permanent the learning. Too often students in classes are told to watch and listen without an opportunity to act upon what they have observed. Industrial arts in the future, as it has in the past, will be known for its role of making the student an active participant rather than a passive spectator. The element of change will be the activities of experiences which will reflect the intent of the stated five goals.

## *TOWARD THE ATTAINMENT OF GOALS*

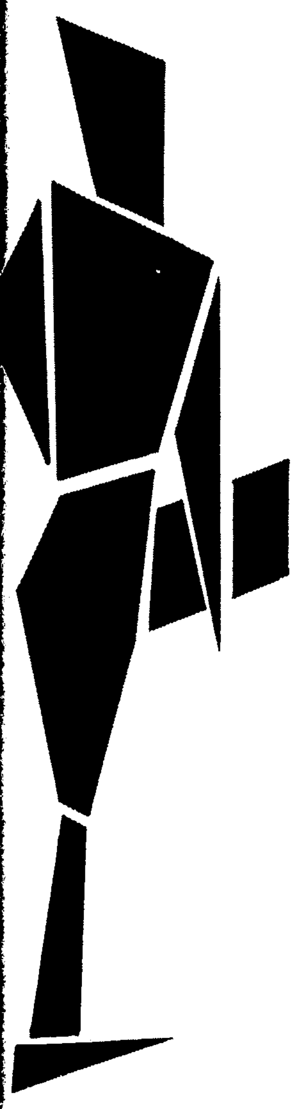
At the present time, it is generally conceded that at the junior high school level industrial arts is, for the most part, fulfilling its goal. On the high school level and above, it would seem that sweeping changes should occur. And, while some excellent programs exist at the elementary level, much remains to be accomplished.

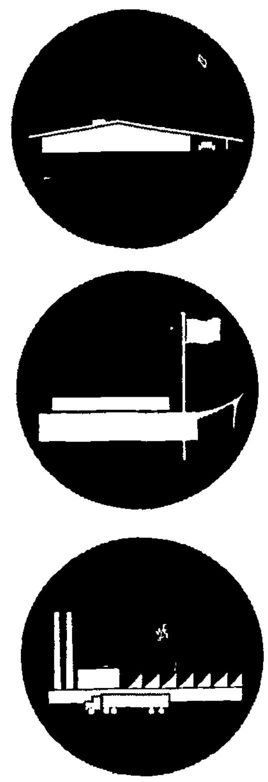
The modern industrial arts program must be designed to challenge the superior student, provide constructive experiences for the average student, and encourage the slower and reluctant learner. This means that future instructors will need to utilize many new methods of teaching. Programmed instruction to speed up and render more efficient the instructional techniques, teaching teams to broaden the offerings, and more challenging group problem-solving are but a few of the newer techniques that must be applied to everyday classroom instruction. A lock-stepped, each-one-make-one curriculum cannot provide for individual differences, needs, and aspirations of students.

If change and improvement are to be accomplished, and this should be done as soon as possible, teacher education in the field of industrial arts would seem to hold the key. If industrial arts is to move ahead with a modernized program and updated methodology, teachers must be educated within programs which place stronger emphasis upon relating subject content, employ newer instructional techniques, and provide a better understanding of the complexities of modern industry and technology.

## SECTION II

# SCHOOL FACILITIES FOR INDUSTRIAL ARTS EDUCATION





*Multi-field Industrial Laboratory*
*Single-field Industrial Laboratory*
*Area-unit Industrial Laboratory*

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# SCHOOL FACILITIES FOR INDUSTRIAL ARTS EDUCATION

Industrial arts is a planned program of educational experiences requiring special facilities. There are, in general, three types of industrial arts laboratories currently found in our schools. The two most common types of industrial arts laboratory organizations are the *multi-field industrial laboratory* and the *single-field industrial laboratory*. Although not found in as many schools, a third organization, the *area-unit industrial laboratory*, is also used. Each has its own features and applications.

## *MULTI-FIELD INDUSTRIAL LABORATORY*

The multi-field industrial laboratory is organized to provide sufficient equipment and facilities necessary to offer adequately, experiences in a number of industrial fields. Examples of industrial fields commonly involved are: drafting, graphic arts, metal working, electricity-electronics, woodworking, power, and industrial crafts. The multi-field industrial laboratory may have provisions for instruction in all or several of the industrial fields as well as subdivisions or clusters represented by each field. The selected activities are usually conducted in one laboratory and by one instructor or a team of instructors.

The most common objectives of multi-field industrial laboratories are to: serve boys and girls at any grade level, offer opportunities for experimentation and fabrication, acquaint students with a wide variety of industrial processes within selected fields, and assist in occupational guidance.

Multi-field industrial laboratories are also referred to as comprehensive general shops.

## *SINGLE-FIELD INDUSTRIAL LABORATORY*

Single-field industrial laboratories are organized to provide experiences limited to a cluster of related areas associated with a specific field or to a closely related group or family of industries such as the graphic arts industry. Examples of various single-field industrial laboratories are: drafting, graphic arts, metal working, electricity-electronics, woodworking, power, and industrial crafts. Each field comprises clusters of related areas. Examples of experiences that can be offered in a cluster of related areas comprising the field of metal working might include: sheet metal, bench metal, art metal, welding, metal machining, and foundry. Experiences that can be offered in a cluster comprising the field of graphic arts include: silk-screen rinting, linoleum-block printing, typesetting, presswork, pho-ography, and bookbinding. The activities of this type laboratory nd facility itself are limited to one field of work and its related reas.

The most common objective for organizing the single-field ndustrial laboratory is to offer new experiences and greater epth of understanding in a cluster of related areas associated ith a specific field. Additional common objectives also may nclude those listed for the multi-field industrial laboratory.

Likewise, the single-field industrial laboratory has many eatures of the multi-field laboratory, but the activities and acilities are limited to a single-field of work.

The single-field industrial laboratory is often referred to s a limited general shop.

## *AREA-UNIT INDUSTRIAL LABORATORY*

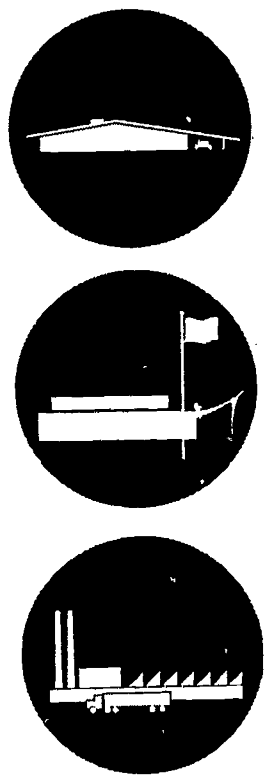
Area-unit industrial laboratories are organized to offer instruction in a single industrial area or unit within an area. Welding is an example of an area within the metal-working field that would provide experiences in an area-unit laboratory. Further specialized needs within the welding area may be provided for in separate units such as acetylene, arc, MIG, and TIG. All would be offered in the same area-unit industrial laboratory. Two additional examples of areas within the instructional fields of metal working, each providing experiences in separate area-unit industrial laboratories, are machine tool and sheet metal.

The prime objective of organizing the area-unit industrial laboratory is to offer extensive specialization in industrial occupations, areas, and/or units. The organization requires a separate laboratory for each area of instruction.

The area-unit industrial laboratory is commonly known as the unit shop.

## SECTION III

# INSTRUCTION IN INDUSTRIAL ARTS EDUCATION



*Structure for Industrial Arts Educatio*

*Organization for Learning*

*An Example*

# INSTRUCTION IN INDUSTRIAL ARTS EDUCATION

A democracy demands of its education both quantity and quality. Having largely met the challenge of quantity education, attention has been turned to improving the quality, now more difficult than ever. Change in our schools in recent years has been toward a greater and renewed emphasis on content. While the trend continues, emphasis is on curriculum content that is organized into fairly broad fields rather than on specific fixed or ground-to-be-covered instructional units. It is generally recognized that changes in industrial arts education likewise would involve a critical examination of its content and organization, including a new look at its body of knowledge and educational practices.

In view of this and the complex character of its body of knowledge, what then are the appropriate units of instruction for industrial arts? If traditional approaches and offerings are no longer appropriate to the challenge, what is?

Whereas the typical industrial arts offerings have been based upon curriculum reflecting trades, today's demands require an approach aimed at organizing basic concepts common to, and drawn from, all disciplines or areas of knowledge related to the total institution of industry. In general, then, the structure should reflect that body of knowledge known as the social institution of industry from which the instructional content for industrial arts education should be derived. Such a basic structure thus provides a sound basis for the selection of content for industrial arts.

It must be stressed, however, that any framework for an organized study of industry must categorize understandings rather than categorize isolated facts. If our programs in industrial arts are to provide learners with meaningful and lasting experiences, concentration upon the understanding of concepts, rather than emphasis on specifics should be our goal. This approach to learning is sound. Knowledge must be organized in such a manner as to provide an understanding of concepts and to show the relationship of each individual experience to the total experience. The material in this chapter is so organized.

## *STRUCTURE FOR INDUSTRIAL ARTS EDUCATION*

Any body of knowledge should provide human beings with understanding, and further, it must possess a framework or structure that can be identified and expressed in some form.

Structure, as used here, is that body of identifiable knowledge related to the total institution of industry and expressed in terms of descriptive concepts involved.

Properly conceived, then, a program of industrial arts provides opportunities for students to study all facets of industry and to explore their interrelationships. Students should see and experience the unity or wholeness of contemporary industry and should develop an understanding of this aspect of our society with all its implications.

The structure for instruction in industrial arts thus reflects knowledge inherent in the structure of industry itself and its related associations and is divided as follows:

**INDUSTRIAL ARTS:** INDUSTRY/FUNCTIONS AND PRODUCTS/PERSONAL, SOCIAL, AND ECONOMIC SIGNIFICANCE

INDUSTRY AND CIVILIZATION

- Historical View of Man and Industrial Technology
- Evolution of Modern Industrial Technology
- History of Materials
- Technical Heritage
- General Education

THE INDUSTRY

- Relative Importance
- Historical Background
- Opportunities
- Allied Industries

ORGANIZATION

- Enterprise
- Administration
- Management
- Labor
- Associations
- Production Departments
- Plant Organization

RESEARCH AND DEVELOPMENT

- Original Concept
- Market Evaluation

RESEARCH AND DEVELOPMENT *(Continued)*

- Product Research and Development
- Process Research and Development
- Materials Research and Development
- Market Research

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

- Idea Visualization
- Design and Preparation of Visual Information
- Production Drawings
- Material Specifications
- Design of Tools, Jigs and Fixtures, and Special Machinery
- Plant Layout
- Plant Organization
- Estimating and Cost Accounting
- Procurement and Inventory
- Automation and Numerical Control
- Quality and Production Control Procedures and Scheduling
- Production Flow

PRODUCTION OR MANUFACTURING

- Custom
- Continuous or Mass
- Materials
- Processes
- Energy and Power

DISTRIBUTION

- Advertising (Promotion)
- Packaging and Shipping (Materials Handling)
- Marketing

SERVICING INDUSTRIAL PRODUCTS

- Diagnosing
- Correcting
- Testing

It is essential that a total program of industrial arts in- [c]lude opportunities for meaningful educational experiences [i]nvolving all of the areas outlined. Emphasis on each major [a]rea will enable the learner to understand more effectively [i]ndustrialism with all its implications so essential for everyone.

Obviously, there already exists curricula in the school pro- [g]ram which deal with certain aspects or functions outlined above. [N]evertheless, some emphasis should be given to each area as [s]tudents study and attempt to understand our industrial society.

## *ORGANIZATION FOR LEARNING*

If programs in industrial arts are to provide students with meaningful and lasting experiences, learning must be based on the study and application of knowledge related to understandings or concepts. In this manner the learner can more effectively deal with the transfer of knowledge to new and different situations, adjust to the rapidly changing times, and cope with forces which influence the learner's well-being. Likewise, programs of this nature increase the possibilities of retention and the assurance of providing more meaningful learning to the student.

While major concepts or areas of study have been identified along with content applicable for achieving comprehension of these concepts, it should be emphasized that the material which follows is not a course of study dealing with specifics. It is rather a broad framework from which the teacher can develop individual industrial arts offerings which lead to study for understandings and provide meaningful educational experiences.

A detailed program can and should be developed by the teacher from this structure even though it is broad. For example, if a selected unit of study were taken from the outline concerning the process of *cutting* or removal of material, and for our purpose, by abrasion (one of several methods listed) was considered, the breakdown would continue to smaller units dealing specifically with abrasion until ultimate goals were reached.

In this manner, specific goals are achieved, flexibility in program development is possible, and stated knowledges and skills are related to understandings. Each fact is related to the total experience. This relationship in turn leads to integrated learning. The material which follows is organized in this related pattern.

**INDUSTRY AND CIVILIZATION**

The terms *industry* and *civilization* are more congruent than one may expect. In fact, an analysis of any social order reveals the basic characteristics of specialization and organization. Because of this close relationship, it is easy to understand how social, political, and economic patterns have regulated activity, while specialization or industry has determined the type and degree of civilization.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| HISTORICAL VIEW OF MAN AND INDUSTRIAL TECHNOLOGY | A systematically arranged account of events in the practical application of scientific principles affecting nations, social groups, institutions, sciences, or arts with an attempt to explain events and their relationship. | Cave man society<br>Man, tools, and skills<br>Development of alphabet and number systems<br>Science<br>Energy and power |

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| HISTORICAL VIEW OF MAN AND INDUSTRIAL TECHNOLOGY *(Continued)* | | Man and his environment<br>Social institutions<br>Economics |
| EVOLUTION OF MODERN INDUSTRIAL TECHNOLOGY | The progressive increase and refinement of industry from man power to machine power to machine control. | Craft age<br>Industrial revolution<br>Machine age<br>Scientific management<br>Development of movable type and other printing processes<br>Man, machine, and organizations<br>Mass production<br>Automation |
| HISTORY OF MATERIALS | A systematic account of the discovery and development of materials and their effect on man, industry, and society. | Forest products<br>Origin of paper and ink<br>Nonmetallic minerals<br>Ferrous metals<br>Nonferrous metals<br>Synthetic materials<br>Future supply |
| TECHNICAL HERITAGE | The aggregate or complex of processes, tools, materials, and all factors having to do with technology that serves as a basis for technological development which is passed on with modification from generation to generation. | Man and contributions<br>Libraries<br>Museums<br>Industrial displays |
| GENERAL EDUCATION | The ability to store and pass to future generations the accumulated knowledge of man. | Man's need to communicate<br>Need for knowledge<br>Storage and retrieval of knowledge |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| GENERAL EDUCATION *(Continued)* | | Inquiring mind<br>Theoretical<br>Practical<br>History |

**'HE INDUSTRY**

Industry is a reflection of the development of civilization and human progress. It is directly related to social, economic, and educational programs and movements dating from the early beginning of history to the modern era of automation. As a result, it is more than a study of the factory system, for the term industry refers to man's adjustments to his environment, his use of resources, and the opportunities made possible by such advancements.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| RELATIVE IMPORTANCE | Manufacturing and servicing products which man requires to satisfy his material needs. | Resources<br>Man power<br>Facilities<br>Market |
| HISTORICAL BACKGROUND | Man's adjusting to and changing his environment by the use of tools, materials, and their social institution. | Tools<br>Machines<br>Factory<br>Management<br>Labor |
| OPPORTUNITIES | Unlimited for people with a variety of interests and skills. | Occupations<br>Advancements<br>Experimentation<br>Expansion<br>Invention |
| ALLIED INDUSTRIES | Dependent on the coordinated help of many other industries for one or many parts of their completed products. | Parts<br>Components<br>Sub assembly<br>Suppliers |

**ORGANIZATION**

Organization is the key to the meaning of the term *civilization* and to the functioning of nearly every aspect within any society. As such, its role and importance has steadily increased as man has developed from tribal communities, via the city-states, to the vast metropolitan areas of today; in the same respect, enterprise systems have evolved and industry itself has developed its own organizational hierarchy.

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| ENTERPRISE | Ownership of business by funds of either private individuals or groups for financial speculation. | Free enterprise<br>Comparative systems<br>Types of ownership<br>Types of finance |
| ADMINISTRATION | The chain of command which delegates authority and defines responsibility in industry. | Organizational patterns<br>Job descriptions<br>Personnel<br>Line and staff |
| MANAGEMENT | The operational controllers of any enterprise. | Function<br>Duties<br>Responsibilities<br>Qualifications |
| LABOR | A person or group of people working as a productive body other than management. | Professional<br>Skilled<br>Technical<br>Semiskilled<br>Unskilled |
| ASSOCIATIONS | Labor, management, or enterprises joined for a common purpose. | Labor groups (unions)<br>Management<br>Businesses<br>Co-ops |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| PRODUCTION DEPARTMENTS | A part of management that analyzes steps of operations and assures that work is performed. | Production planning<br>Materials handling<br>Work flow |
| PLANT ORGANIZATION | The administration, managerial, and labor relationship based on the attempt to secure intelligent co-operation among the members of these groups. | Mass production<br>Assembly line<br>Custom production<br>Time and motion<br>Safety<br>Labor representation |

RESEARCH AND DEVELOPMENT

Growth by means of research and technological development holds the key to success for most types of industry. As such, the research and development area is responsible for not only generation and refinement of ideas dealing with the products, materials, and processes of industry, but also for continual investigation into the various areas of market research.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| ORIGINAL CONCEPT | A growth of an idea from within the industry through research and technological development. | Pure research<br>Applied research<br>Brainstorming<br>Experimentation<br>Creativity<br>Science |
| MARKET EVALUATION | An analysis to determine the possible or actual sales potential of a product. | Competitive conditions<br>Choices of customer<br>Consumption patterns<br>Consumer attitudes<br>Government policy<br>Business conditions |

| Industrial Concept and Description | | Content |
|---|---|---|
| PRODUCT RESEARCH AND DEVELOPMENT | The creation of new products and the improvement of existing products. | Functional requirements<br>Material requirements<br>Visual requirements |
| *Functional Requirement* | The need or purpose for which the product is intended. | Use—where, why, how, when, and by whom<br>Relationship to form and material<br>Time dimension—length of performance<br>Efficiency of performance |
| *Material Requirement* | The simple, practical, and direct use of the substances from which the product is made. | Maximum efficiency<br>Honesty and integrity<br>Propriety<br>Relationship of form and function<br>Strength and structure cost<br>Experimentation<br>New uses<br>Unity and variety<br>Process considerations |
| *Visual Requirement* | A pleasing appearance to the user and beholder. | Authenticity of form<br>Form and function<br>Form and materials<br>Beauty—esthetics<br>Elements—lines, planes, solids, and surface treatment<br>Principles—unity, variety, proportion, and balance<br>Integrity<br>Sensitivity<br>Form and process |

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| PROCESS RESEARCH AND DEVELOPMENT | Experimentation aimed at improving existing printing, cutting, forming, fastening, and finishing methods, developing new ones, and automating production systems. | Process improvement research<br>New process research<br>Process automation research |
| *Process Improvement Research* | The correction of deficiencies in existing processes and the adaption of them to new uses and materials. | High speed cutting<br>Ceramic cutters<br>Adhesive fastening<br>Improved finishes and finishing methods |
| *New Process Research* | The development of new processes for working new and old materials to meet the changing demands of industry. | Ultrasonic machining<br>Chemical milling<br>Electric discharge machining<br>Optical soldering<br>Electrostatic finishing<br>Electroforming |
| *Process Automation Research* | The process of improving efficiency and cost reduction by developing automatic, semi-automatic, or self-regulating production devices. | Electronic controls<br>Hydraulic controls<br>Tape and numerical controls<br>Computer-production<br>Machinery linkage |
| MATERIALS RESEARCH AND DEVELOPMENT | The experimentation aimed at improving the existing materials of industry, developing new ones, and finding new uses for the old. | New materials research<br>Materials improvement research |
| *New Materials Research* | The development of materials displaying unique physical properties and qualities in response to the demands of modern technology. | Synthetics<br>Laminates<br>Ceramics<br>Exotic metals |

| *Industrial Concept and Description* | | **Content** |
|---|---|---|
| *Material Improvement Research* | The correction of deficiencies in existing materials to improve products. | Tougher steel<br>Aluminum and other metals<br>Weather resistant finishes and plastics<br>Lubricants<br>New uses for materials |
| MARKET RESEARCH | The continuing search for new uses for existing products and the determination of the receptivity of new ones. | Consumer testing<br>Area samples<br>Market surveys<br>Consumer panels<br>Interviews<br>Advertising effects<br>Consumer suggestions<br>Competition<br>Pricing effects |

**PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS**

This phase of industry involves more than developing an effective plant organization and making efficient use of the physical buildings and facilities, for it also requires systematic use of research data. Therefore, by transforming such information into drawings and specifications, other functions such as estimating, procurement of materials, inventory, and the development of routings are made possible.

| *Industrial Concept and Description* | | **Content** |
|---|---|---|
| IDEA VISUALIZATION | Symbols by which ideas are translated into visual shapes. | Structural qualities of symbols<br>Relationship of symbols to objects<br>Cultural influences<br>Science of symbology<br>Psychological foundations<br>The stages in the creative process<br>Training for creativity |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| DESIGN AND PREPARATION OF VISUAL INFORMATION | The arrangement of symbols and design elements in creating an effective visual communication entity. | Fundamentals of visual informati design<br>Design principles<br>Color<br>Typography<br>Illustrations<br>Photographs<br>Copy preparation<br>Layout<br>Materials |
| PRODUCTION DRAWINGS | The transmitting to paper, or other media of the various forms an object may take relative to its form, function, size, shape, and written description. | Selection of drawing<br>Shape description<br>Size description<br>Written description<br>Drawing revision<br>Drawing reproduction<br>Drawing media<br>Graphic solutions<br>Symbolic drawing |
| *Selection of Drawing* | The factor which determines what type of drawing and how it will appear. | Delineation (free hand, mechanical, a machine)<br>Simplified drafting<br>Standards<br>Reprography<br>Types of drawings |
| *Shape Descriptions* | Numerous attempts of describing visual appearance of a product by means of exact graphic procedures. | Multiview<br>Sections<br>Revolutions<br>Intersections |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| *Shape Descriptions (Continued)* | | Developments<br>Auxiliaries<br>Descriptive geometry<br>Pictorial drawing<br>Conventional practices |
| *Size Description* | The exact process of indicating the size or relationships of an object or product. | Dimensioning principles<br>Systems<br>Placement<br>Size and location dimensions<br>Precision dimensioning<br>Tabular dimensioning<br>Techniques and fundamentals |
| *Written Description* | Supplementary material or information that cannot be shown graphically on a drawing. | Notes<br>Scaling<br>Specifications<br>Lists or bill of materials |
| *Drawing Revision* | The checking and revision of drawings to insure accurate and up-to-date drawings. | Engineering change orders<br>Revising original<br>Printing, redrawing, and checking |
| *Drawing Reproduction* | The process involved in the copying and printing of drawings. | Iron processes<br>Diazo process<br>Silver processes<br>Electrostatic<br>Photographic |
| *Drawing Media* | Types of materials utilized for the drawing itself. | Detail paper<br>Acetate<br>Tracing paper<br>Vellum<br>Polyester film<br>Fiberglas |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| *Graphic Solutions* | Utilization and adaption of drafting principles for the graphic presentation of information and data. | Rectangular, bar, semi-logarithmic, and polar graphs<br>Trilinear and alignment charts |
| *Symbolic Drawing* | The use of symbols and diagrams to illustrate relationships between or the location of equipment, parts, personnel, materials, and a product. | Schematic<br>Flow diagrams<br>Processes charts<br>Organizational charts |
| MATERIAL SPECIFICATIONS | An accurate statement of the technical requirements that determine the description of the material. | Hard materials<br>Soft materials<br>Physical properties<br>Corrosion resistance<br>Special properties |
| DESIGN OF TOOLS, JIGS AND FIXTURES, AND SPECIAL MACHINERY | Necessitated advances or changes in production before manufacturing operations. | Ideas<br>Pilot models<br>Tests<br>Designing and engineering<br>Types |
| PLANT LAYOUT | The location of the physical buildings as well as the tools, machinery, and other facilities in the building to make the product. | Geographic<br>Facilities<br>Function<br>Scale models<br>Floor plans<br>Safety requirements |
| PLANT ORGANIZATION | A combination of management and labor which provides the greatest degree of efficiency and profit for the least production cost. | Labor-management<br>Administration<br>Production |

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| ESTIMATING AND COST ACCOUNTING | Predetermining the cost of materials and production and record keeping of operational costs. | Investigation<br>Estimating<br>Accessibility<br>Office methods<br>Computers |
| PROCUREMENT AND INVENTORY | The procurement and maintenance of control of supplies on hand. | Supply<br>Cost<br>Availability<br>Storage<br>Demand<br>Change |
| AUTOMATION AND NUMERICAL CONTROL | A technology of production which is based upon communication and control, with both of these functions being performed by means of electronic and mechanical equipment rather than by human beings. | Types<br>Applications<br>Programing<br>Punch cards<br>Codes<br>Base 2 number |
| QUALITY AND PRODUCTION CONTROL PROCEDURES AND SCHEDULING | The maintenance of certain standards of products manufactured by inspection, tests, and measurements. | Time<br>Machines<br>Labor<br>Inspection<br>Analysis<br>Testing<br>Instruments<br>Measuring and gaging |
| PRODUCTION FLOW | The coordinated route through which a product passes in its change from stock material to finished product. | Transporting<br>Scheduling<br>Planning<br>Routing<br>Assembly line |

## PRODUCTION OR MANUFACTURING

Production or manufacturing is primarily concerned with the methods, materials, and processes utilized in the construction of an article or in the development of several parts or complete products. In addition, it is also closely related to the increasingly important sources of energy and power which are the basis for all mechanized and technical development.

| ***Industrial Concept and Description*** | | ***Content*** |
|---|---|---|
| CUSTOM | The production of objects made to order, often one of a kind made by an individual. | Craftsmanship<br>Trade skills<br>Separate operations<br>Individual handling<br>Work creativity and satisfaction |
| CONTINUOUS OR MASS | The manufacture of large quantities through the use of machines, or integrated groups of machines, which automatically perform required ink transferring, machining, forming, assembling, handling, and inspecting operations, and through sensing devices make necessary corrective adjustments. | Automation<br>Power-head production<br>Transfer mechanics<br>Automatic feedback control<br>Numerical and tape control |
| MATERIALS | The substances requiring decisions based upon their intended usage, their behavior in service, and their behavior while being processed. | Sources of materials<br>Properties of materials<br>Nature of materials<br>Production of materials<br>Uses of materials |
| *Sources of Materials* | Both natural, which must be refined, and synthetic, which must be developed. | Raw materials<br>Principal location<br>Synthetics |

| Industrial Concept and Description | | Content |
|---|---|---|
| *Properties of Materials* | The qualities which require appropriate selection for success in manufacturing. | Classification of materials<br>Physical and mechanical properties<br>Static properties<br>Changing or altering properties<br>Testing |
| *Nature of Materials* | The determiner of the basic structure and physical characteristics of materials. | Basic structure<br>Physical state<br>Atomic structure |
| *Production of Materials* | Dependent upon the abundance of the material and the development of machine tools. | Ferrous<br>Nonferrous<br>Nonmetallic |
| *Uses of Materials* | The proper handling of materials resulting in their economical use. | Items<br>Purchases<br>Products |
| PROCESSES | The procedures in the design and manufacturing of products. | Cutting<br>Curing<br>Fastening<br>Finishing<br>Forming<br>Laminating<br>Character generation<br>Photographic techniques<br>Negative assembly<br>Image carrier making<br>Ink transfer<br>Finishing and binding |
| *Cutting* | The removal of material. | Abrasion<br>Drilling |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| *Cutting (Continued)* | | Flame or heat<br>Rotary<br>Shearing<br>Planing<br>Turning<br>Ultrasonic<br>Electrochemical<br>Chem-milling<br>Electro-arc<br>Electrical discharge<br>Optical lasers |
| *Curing* | Addition or subtraction of liquid for preservation. | Drying<br>Firing<br>Annealing<br>Tempering |
| *Fastening* | The attaching or joining of materials. | Adhesion<br>Cohesion<br>Mechanical linkage |
| *Finishing* | Changing the surface effect for appearance and/or preservation to provide optimum properties for service life. | Coating<br>Removal of material<br>Addition of material |
| *Forming* | The shaping or changing of the structure of a material. | Bending<br>Blowing<br>Casting<br>Drawing<br>Extruding<br>Pressing<br>Forging |

| *Industrial Concept and Description* | | **Content** |
|---|---|---|
| *Forming (Continued)* | | Rolling<br>Stretching<br>Explosive<br>Electrohydraulic<br>Magnetic<br>Electroforming<br>High temperature forming<br>Electric discharge<br>Induced sound waves |
| *Laminating* | Construction by bonding together of superimposed layers of materials with application of pressure and possibly heat. | Bonding<br>Solvents and cements<br>Heat and pressure<br>Properties of materials<br>Fusible and nonfusible materials<br>Interlayer principles |
| *Character Generation* | The arrangement of type characters into meaningful thought for the communication of ideas. | Hand composition<br>Hot metal composition<br>Strike-on composition<br>Photographic composition<br>Cathode ray composition<br>Computer applications |
| *Photographic Techniques* | A recording of a latent image or an object, scene, or copy on to a light sensitive material. | Darkroom layout and techniques<br>Line and halftone<br>Continuous tone<br>Exposure<br>Optics<br>Reflection and transmission |

| *Industrial Concept and Description* | | **Content** |
|---|---|---|
| *Photographic Techniques (Continued)* | | Magnification and reduction<br>Chemistry<br>Sensitometry<br>Contacting<br>Color separation<br>Special effects<br>Optical scanning |
| *Negative Assembly* | The assembly and placement of various photographic film combinations into an acceptable arrangement for platemaking. | Layout and measurement<br>Imposition<br>Photocomposing<br>Pin register<br>Opaquing and correction<br>Reverser and overprints<br>Auto-positive materials<br>Proofing<br>Spreads and chokes<br>Line up |
| *Image Carrier Making* | The preparation of the medium that will produce multiple copies of the image as desired, regardless of the process doing the reproduction. | Plates from movable type<br>Hand carved or cut<br>Photomechanical<br>Moulded plates<br>Electronic plates<br>Direct image<br>Photo wash out |
| *Ink Transfer* | The distribution of substances (ink), viscous or nonviscous, by various methods from printing plates, or other means, to paper or other material. | Operation of equipment<br>Maintenance<br>Adjusting<br>Feeding |

| ***Industrial Concept and Description*** | | ***Content*** |
| --- | --- | --- |
| *Ink Transfer (Continued)* | | Inking<br>Delivery impression<br>Dampening<br>Attaching plates<br>Makeready<br>Printing from type<br>Register<br>Drying<br>Ink mixing and making |
| *Finishing and Binding* | The application of numerous preservatives or assembly techniques to complete a product. | Cutting stock<br>Folding<br>Measuring<br>Numbering<br>Fastening<br>Gathering<br>Drilling<br>Punching<br>Perforating<br>Binding<br>Ruling<br>Packaging and shipping |
| ENERGY AND POWER | The basic ingredient in all mechanization and technical development in that it makes progress possible in communications, construction, manufacturing, and transportation. | Power sources<br>Power generation<br>Power transmission<br>Power utilization |
| *Power Sources* | A supply of energy which, when controlled, is capable of doing useful work. | Natural<br>Electrical<br>Thermal |

| *Industrial Concept and Description* | | Content |
|---|---|---|
| *Power Generation* | The transformation of energy into a usable form. | Solar<br>Hydro<br>Biological<br>Combustion<br>Nuclear fission<br>Electrical |
| *Power Transmission* | The conduction of energy from its source to its end use. | Hydraulic<br>Pneumatic<br>Mechanical<br>Electrical |
| *Power Utilization* | The control of power for useful application. | Manufacture<br>Construction<br>Transportation<br>Communication |

**DISTRIBUTION**

The completion of a product or the end of a production line does not mark the end of the industrial cycle, for the massive problem of distribution still lies ahead. In fact in most instances, factors such as advertising, packaging and shipping, and marketing have already played an important role in determining the product's appearance and construction. However, the product is now ready to be made available to the customer.

| *Industrial Concept and Description* | | Content |
|---|---|---|
| ADVERTISING PROMOTION | The promotion of a marketable product through one or more media by some identified sponsor. | Types of media<br>Standards of media<br>Psychology<br>Economic considerations<br>Displays<br>Customer appeal |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| PACKAGING AND SHIPPING (MATERIALS HANDLING) | The processes of preparing a product for distribution and the methods by which it is distributed. | Methods<br>Transportation<br>Packaging<br>Storage<br>Handling |
| MARKETING | The flow of goods and services from producers to consumers. | Nature and scope<br>Retailing and wholesaling<br>Advertising<br>Trade regulations<br>Transportation |

**SERVICING INDUSTRIAL PRODUCTS**

Although our industrialized economy is highly dependent upon mechanical and electrical products, the servicing of such products is commonly overlooked. It is imperative however that diagnosing, correcting, and testing procedures be completed on a high level of competence. Relaxation of these functions would result in the failure of our industrial complex.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| DIAGNOSING | The recognition of symptoms which lead to the correction of the malfunction or disorder. | Analysis<br>Diagnosis<br>Troubleshooting<br>Test equipment<br>Preventive maintenance |
| CORRECTING | The process of repairing or restoring the article to the original state and regaining the proper function. | Remove and replace<br>Repair<br>Reading manuals<br>Special tools<br>Tools |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| TESTING | The trial for exactness of the repair procedures. | Instruments<br>Methods<br>Procedures<br>Checks<br>Tests |

The outline study above is a construct in structural form based on a new direction for industrial arts. It carefully avoids a "cookbook" format in seeking to be truly a *guide* from which teachers of industrial arts can develop their own courses of study and teaching units.

This structure reflects wholeness, unity, and continuity. It suggests the possibilities of an organized program of industrial arts structured to provide for teaching the concepts that more realistically lead to a fuller comprehension of present-day technology to better meet the challenges of our times and to better meet the needs of our youth. The structure is organized in such a manner as to provide built-in relatedness among knowledges, skills, understanding, and concepts. It further provides optimum opportunities to show the relationship of each individual learning experience to the total experience.

## *AN EXAMPLE*

Although this new structure or outline of content for industrial arts seems different from previous publications, instructors in each of the present areas of study (e.g.—wood, metal, graphic arts, etc.) can extract from the total structure the specific concepts for content in their area. The field of graphic arts has been chosen as an example and on the following pages appear suggestions of what this area would include as its content outline.

It is important to reemphasize that this is a *content* outline and not a course of study, and that the teacher can and should develop his own course of study and teaching units.

It is likewise essential that an appropriate balance between manipulative experiences and the related technical and general knowledge be maintained.

## *GRAPHIC ARTS*

**INDUSTRY AND CIVILIZATION**

*Understandings* (The students should) understand that the rise of man above other forms of life can, in a major sense, be attributed to the invention and employment of devices which permitted graphic communication and which preserved facts for later reference, refinement, and progress. These achievements should also be understood in relationship to the advancement of culture and its effect upon society.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| HISTORICAL VIEW OF MAN AND INDUSTRIAL TECHNOLOGY | A systematically arranged account of events in the practical application of scientific principles affecting nations, social groups, institutions, sciences, or arts with an attempt to explain events and their relationship. | Cave man society<br>Man, tools, and skills<br>Development of alphabet and number systems<br>Science<br>Energy and power<br>Man and his environment<br>Social institutions<br>Economics |
| EVOLUTION OF MODERN INDUSTRIAL TECHNOLOGY | The progressive increase and refinement of industry from man power to machine power to machine control. | Craft age<br>Industrial revolution<br>Machine age<br>Scientific management<br>Development of movable type and other printing processes<br>Man, machine, and organizations<br>Mass production<br>Automation |
| HISTORY OF MATERIALS | A systematic account of the discovery and development of materials and their effect on man, industry, and society. | Forest products<br>Origin of paper and ink<br>Nonmetallic minerals<br>Nonferrous metals<br>Synthetic materials<br>Future supply |

| ***Industrial Concept and Description*** | | ***Content*** |
|---|---|---|
| TECHNICAL HERITAGE | The aggregate or complex of processes, tools, materials, and all factors having to do with technology that serves as a basis for technological development which is passed on with modification from generation to generation. | Man and contributions<br>Libraries<br>Museums<br>Industrial displays |
| GENERAL EDUCATION | The ability to store and pass to future generations the accumulated knowledge of man common to all. | Man's need to communicate<br>Need for knowledge<br>Storage and retrieval of knowledge<br>Inquiring mind<br>Theoretical<br>Practical<br>History |

**THE GRAPHIC ARTS INDUSTRY** *Understandings* (The students should) understand the role and function of the graphic arts industry as part of visual communications in the context of the social order.

| ***Industrial Concept and Description*** | | ***Content*** |
|---|---|---|
| RELATIVE IMPORTANCE | Manufacturing and servicing products which man requires to satisfy his material needs. | Resources<br>Man power<br>Facilities |
| OPPORTUNITIES | Unlimited for people with a variety of interests and skills. | Occupations<br>Advancements |
| ALLIED INDUSTRIES | Dependent on the coordinated help of many other industries. | Supplies<br>Suppliers |

**ORGANIZATION OF GRAPHIC ARTS INDUSTRY**

*Understandings* (The students should) understand and be aware of the internal and external environment of the business enterprise.

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| ENTERPRISE | Ownership of business by funds of either private individuals or groups for financial speculation. | Free enterprise<br>Comparative systems<br>Types of ownership<br>Types of finance |
| ADMINISTRATION | The chain of command which delegates authority and defines responsibility in industry. | Organizational patterns<br>Job descriptions |
| MANAGEMENT | The operational controllers of any enterprise. | Function<br>Duties<br>Responsibilities<br>Qualifications |
| LABOR | A person or group of people working as a productive body other than management. | Professional<br>Skilled<br>Technical<br>Semiskilled<br>Unskilled |
| ASSOCIATIONS | Labor, management, or enterprises joined for a common purpose. | Labor groups<br>Management<br>Businesses |
| PRODUCTION DEPARTMENTS | A part of management that analyzes steps of operations and assures that work is performed. | Production planning<br>Materials handling<br>Work flow |
| PLANT ORGANIZATION | The administration, managerial, and labor relationship based on the attempt to secure intelligent cooperation among the members of these groups. | Mass production<br>Custom production<br>Time and motion<br>Safety<br>Labor representation |

**RESEARCH AND DEVELOPMENT IN THE GRAPHIC ARTS**

*Understandings* (The students should) understand that research and technological development holds the key to advancement and success. Organized research and development is responsible for generation and refinement of ideas dealing with materials, products, processes, and the marketing of the end product of the graphic arts industry.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| ORIGINAL CONCEPT | A growth of an idea from within the industry through research and technological development. | Applied research<br>Creativity |
| MARKET EVALUATION | An analysis to determine the possible or actual sales potential of a product. | Competitive conditions<br>Choices of customer<br>Consumption patterns<br>Consumer attitudes<br>Government policy<br>Business conditions |
| PRODUCT RESEARCH AND DEVELOPMENT | The creation of new products and the improvement of existing products. | Material requirements<br>Visual requirements |
| PROCESS RESEARCH AND DEVELOPMENT | Experimentation aimed at improving existing printing, cutting, forming, fastening, and finishing methods, developing new ones, and automating production systems. | Process improvement research<br>New process research<br>Process automation research |
| MATERIALS RESEARCH AND DEVELOPMENT | The experimentation aimed at improving the existing materials of industry, developing new ones, and finding new uses for the old. | New materials research<br>Materials improvement research |
| MARKET RESEARCH | The continuing search for new uses for existing products and the determination of the receptivity of new ones. | Consumer testing<br>Area samples<br>Market Surveys |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| MARKET RESEARCH *(Continued)* | | Consumer panels<br>Interviews<br>Advertising effects<br>Consumer suggestions<br>Competition<br>Pricing effects |

**PLANNING FOR THE PRODUCTION OF GRAPHIC COMMUNICATION MATERIALS**

*Understandings* (The students should) understand idea visualization and the arranging of symbols, design, and pictures into effective communication devices.

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| IDEA VISUALIZATION | Symbols by which ideas are translated into visual shapes. | Structural qualities of symbols<br>Relationship of symbols to objects<br>Cultural influences<br>Science of symbology<br>Psychological foundations<br>The stages in the creative process<br>Training for creativity |
| DESIGN AND PREPARATION OF VISUAL INFORMATION | The arrangement of symbols and design elements in creating an effective visual communication entity. | Fundamentals of visual information design<br>Design principles<br>Color<br>Typography<br>Illustrations<br>Photographs<br>Copy preparation<br>Layout<br>Materials |

| *Industrial Concept and Description* | | *Content* |
|---|---|---|
| PLANT LAYOUT | The location of the physical buildings as well as the tools, machinery, and other facilities in the buildings to produce graphic communication materials. | Geographic<br>Facilities<br>Functions<br>Scale models<br>Floor plans<br>Safety requirements |
| PLANT ORGANIZATION | A combination of management and labor which provides the greatest degree of efficiency and profit for the least production cost. | Labor-management<br>Administration<br>Production |
| ESTIMATING AND COST ACCOUNTING | Predetermining the cost of materials and production and record keeping of operational costs. | Investigation<br>Estimating<br>Accessibility<br>Office methods<br>Computers |
| OCUREMENT AND INVENTORY | The procurement and maintenance of control of supplies on hand. | Supply<br>Cost<br>Availability<br>Storage<br>Demand<br>Change |
| UTOMATION AND NUMERICAL CONTROL | A technology of production which is based upon communication and control, with both of these functions being performed by means of electronic and mechanical equipment rather than by human beings. | Types<br>Applications<br>Programing<br>Punch cards<br>Codes<br>Base 2 number |

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| QUALITY AND PRODUCTION CONTROL PROCEDURES AND SCHEDULING | The maintenance of certain standards of products manufactured by inspection, tests, and measurements. | Time<br>Machines<br>Inspection<br>Analysis<br>Testing<br>Instruments<br>Measuring and gaging |
| PRODUCTION FLOW | The coordinated route through which a product passes in its change from stock material to finished product. | Transporting<br>Scheduling<br>Planning<br>Routing<br>Assembly line |

**THE PRODUCTION OF GRAPHIC COMMUNICATION MATERIALS**

*Understandings* (The students should) understand the production of mass media, and other visual materials by having experiences with the materials, products, and processes of the graphic arts industry.

| *Industrial Concept* | *and Description* | *Content* |
|---|---|---|
| CUSTOM | The production of printed pieces to order, often in limited numbers. | Craftsmanship<br>Trade skills<br>Separate operations<br>Individual handling<br>Worker creativity and satisfaction |
| CONTINUOUS OR MASS | The manufacture of large quantities through the use of machines, or integrated groups of machines, which automatically perform required ink transferring, machining, forming, assembling, handling, and inspecting operations, and through sensing devices make necessary corrective adjustments. | Automation<br>Power-head production<br>Transfer mechanics<br>Automatic feedback control<br>Numerical and tape control |

| Industrial Concept and Description | | Content |
|---|---|---|
| MATERIALS | The substance requiring decisions based upon their intended usage, their behavior in service, and their behavior while being processed. | Ink<br>Paper<br>Sensitized materials<br>Image carriers<br>Sources of materials<br>Properties of materials<br>Nature of materials<br>Production of materials<br>Uses of materials |
| *Sources of Materials* | Both natural which must be refined and synthetic which must be developed. | Raw materials<br>Principal location<br>Synthetics |
| *Properties of Materials* | The qualities which require appropriate selection for success in manufacturing. | Classification of materials<br>Physical and mechanical properties<br>Static properties<br>Changing or altering properties<br>Testing |
| *Nature of Materials* | The determiner of the basic structure and physical characteristics of materials. | Basic structure<br>Physical state<br>Atomic structure |
| *Production of Materials* | Dependent upon the abundance of the material and the development of machine tools. | Nonferrous<br>Nonmetallic |
| *Uses of Materials* | The proper handling of materials resulting in their economical use. | Items<br>Purchases<br>Products |

| ***Industrial Concept and Description*** | | ***Content*** |
|---|---|---|
| PROCESSES | The procedures in the design and manufacturing of products. | Character generation<br>Photographic techniques<br>Negative assembly<br>Image carrier making<br>Ink transfer<br>Finishing and binding |
| *Character Generation* | The arrangement of type characters into meaningful thought for the communication of ideas. | Hand composition<br>Hot metal composition<br>Strike-on composition<br>Photographic composition<br>Cathode ray composition<br>Computer applications |
| *Photographic Techniques* | A record of a latent image or an object, scene, or copy on to a light-sensitive material. | Darkroom layout and techniques<br>Line and halftone<br>Continuous tone<br>Exposure<br>Optics<br>Reflection and transmission<br>Magnification and reduction<br>Chemistry<br>Sensitometry<br>Contacting<br>Color separation<br>Special effects<br>Optical scanning |
| *Negative Assembly* | The assembly and placement of various photographic film combinations into an acceptable arrangement for plate-making. | Layout and measurement<br>Imposition<br>Photocomposing<br>Pin register |

| ***Industrial Concept and Description*** | | ***Content*** |
| --- | --- | --- |
| *Negative Assembly* ***(Continued)*** | | Opaquing and correction<br>Reverser and overprints<br>Auto-positive materials<br>Proofing<br>Spreads and chokes<br>Line-up |
| *Image Carrier Making* | The preparation of the medium that will produce multiple copies of the image as desired, regardless of the process doing the reproduction. | Plates from movable type<br>Hand carved or cut<br>Photo mechanical<br>Moulded plates<br>Electronic plates<br>Direct image<br>Photo wash out |
| *Ink Transfer* | The distribution of substances (ink), viscous or nonviscous, by various methods from printing plates, or other means, to paper or other material. | Operation of equipment<br>Maintenance<br>Adjusting<br>Feeding<br>Inking<br>Delivery impression<br>Dampening<br>Attaching plates<br>Makeready<br>Printing from type<br>Register<br>Drying<br>Ink mixing and making |
| *Finishing and Binding* | The application of numerous preservative or assembly techniques to complete a product. | Cutting stock<br>Folding<br>Measuring |

| *Industrial Concept and Description* | | *Content* |
| --- | --- | --- |
| | *Finishing and Binding (Continued)* | Numbering<br>Fastening<br>Gathering<br>Drilling<br>Punching<br>Perforating<br>Binding<br>Ruling<br>Packaging and shipping |

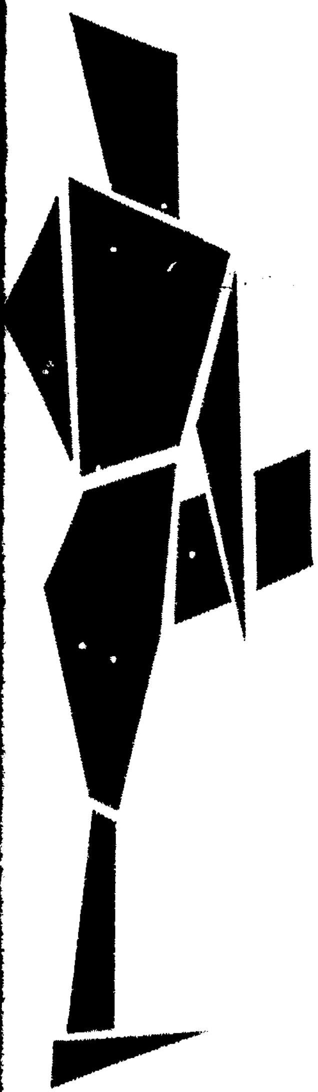
**DISTRIBUTION OF GRAPHIC COMMUNICATION MATERIALS**

*Understandings* (The students should) understand the distribution system of the products of the graphic arts industry and the role this industry plays for all other industries in the advertising, packaging, and marketing of their products.

| *Industrial Concept and Description* | | *Content* |
| --- | --- | --- |
| ADVERTISING PROMOTION | The promotion of a marketable product through one or more media by some identified sponsor. | Types of media<br>Standards of media<br>Psychology<br>Economic considerations<br>Displays<br>Customer appeal |
| PACKAGING AND SHIPPING (MATERIALS HANDLING) | The processes of preparing a product for distribution and the methods by which it is distributed. | Methods<br>Transportation<br>Packaging<br>Storage<br>Handling |

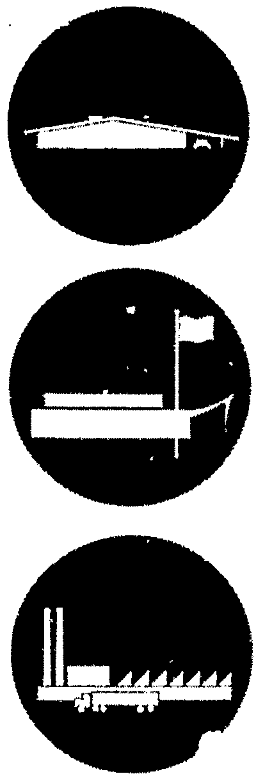
| *Industrial Concept and Description* | | *Content* |
| --- | --- | --- |
| MARKETING | The flow of goods and services from producers to consumers. | Retailing and wholesaling<br>Trade regulations<br>Transportation |

Again, it is important to reemphasize that this example serves only as a guide for teachers in the preparation of instructional materials. It is broad in its treatment of content and limited in detail. It has been presented to encourage and guide teachers in the development of their own programs. Detailed teaching units should be developed by the individual teachers suitable for their particular situations.



## SECTION IV

# EVALUATION FOR INDUSTRIAL ARTS EDUCATION



*Total Program Assessment*
*Evaluative Instruments*
*In Summary*

# EVALUATION FOR INDUSTRIAL ARTS EDUCATION

One might ask the question, "What is the role of evaluation in improving instruction in industrial arts?" A quick response to the question might be stated as, "The role of evaluation is to determine the relative success of the students in attaining the goals, objectives, and standards of the instructional program so that students may be graded accordingly." Granted that a prime purpose of evaluation is for determining student growth, nevertheless, evaluation should be projected to include total program assessment.

## *TOTAL PROGRAM ASSESSMENT*

The goals for contemporary industrial arts programs have been stated thus:

1. *Develop An Insight and Understanding of Industry and Its Place in Our Culture.*
2. *Discover and Develop Talents, Aptitudes, Interests, and Potentialities of Individuals for Technical Pursuits and Applied Sciences.*
3. *Develop an Understanding of Industrial Processes and the Practical Application of Scientific Principles.*
4. *Develop Basic Skills in the Proper Use of Common Industrial Tools, Machines, and Processes.*
5. *Develop Problem-solving and Creative Abilities Involving the Materials, Processes, and Products of Industry.*

In most cases, only the fourth goal has ever really been challenged by evaluation although most of these goals have been assigned to industrial arts education at one time or another. For the most part, this evaluation has been objective since it involves concrete projects and observable manipulative and technical testing. The other goals dealing with insights, understandings, talents, interests, potentialities, problem-solving, creative abilities, and the like have been more or less measured through the use of factual recall types of tests, student verbalization, student observation, and other means. Usually, employing these means has involved the biases, hopes, and aspirations of the assessor so they have not been really objective in determining the correct degree of goal attainment.

The major problem is in evaluating the degree of attainment of those goals which, in their abstract form, do not allude to any concrete evidence which can easily be measured by an objective instrument. In the case of these goals, the evaluator ust translate the general abstract goal into a concrete set of iteria befitting his particular area. These criteria then should stated in specific terms and should involve definite evidence hich can be observed and tested.

For example, problem-solving in the fifth stated goal could translated in the energy and power area to a specific and conete criterion such as: "The student should be able to convert D-C motor to a D-C generator and predict its output." Such criterion involves easily observed and tested evidence which ould lead to a valid and objective judgment of the possible tainment of the fifth goal by the student.

Of course, the evaluator in establishing criteria of a conete nature in order to determine abstract goal attainment ust strive to be as objective as possible by electing to use nly those criteria whose attainment can be readily measured. roup action in establishing criteria is a good method of mainining a relatively high degree of objectivity if the individual bides by the decision of the group and evaluates the student in ght of the group's established criteria.

The next step after student evaluation is program evaluaon centered around curriculum development and improvement, etermination of the quality of instructional methodology, and e assessment of a particular phase of the program in relation the total program.

In the presentation of "Industrial Arts Education," Secon I of this bulletin, it was pointed out that ". . . industrial rts education then by its very nature must be in a continual ate of transition." This mutability of industrial arts education ecessitates an ever-dynamic program of curriculum development nd improvement. In order to enter intelligently upon a conructive program in curriculum change, it is necessary to embark n a parallel program of realistic and objective evaluation so hat changes will be in harmony with the determining social and industrial environment. The purpose of such an evaluation program would be to determine the future goals and objectives of industrial arts instruction by means of well-directed and executed research studies of the roles which the industrial arts students will assume in society and industry. These studies would be directed toward evaluating the past program in light of future needs so that those elements which are evaluated to be in harmony can be retained and the others abandoned. Thus, evaluation through sound research becomes a necessary tool for curriculum development and improvement.

Another important role of evaluation in curriculum development and improvement centers around the effectiveness of the various means of implementation to bring about the desired changes. Although a given program of evaluation utilizing research may have determined and established certain goals and objectives and may have initiated a program to meet these goals and objectives, there must be a continual appraisal to determine whether the goals and objectives are constantly being met and whether or not the *most effective* means available are being utilized. Thus, evaluation is necessarily perpetuated in a changing program in order to determine the quality and effectiveness of instructional methodology.

A program is usually judged for its overall effectiveness even though in reality it is still the sum of its various parts. In some instances, programs which are evaluated to be very effective can be composed of weak elements which are carried along by stronger elements. Another role of evaluation in the improvement of industrial arts instruction is to ferret out the weaker elements of the program for possible elimination or improvement and also to recognize the stronger elements so that in the "hectic rush for change" they will not be extricated or made ineffective.

Only through a continuing program of evaluation which covers all aspects of industrial arts education—including the individual teacher and student on the classroom level—will any significant improvement in instruction be brought about.

## *EVALUATIVE INSTRUMENTS*

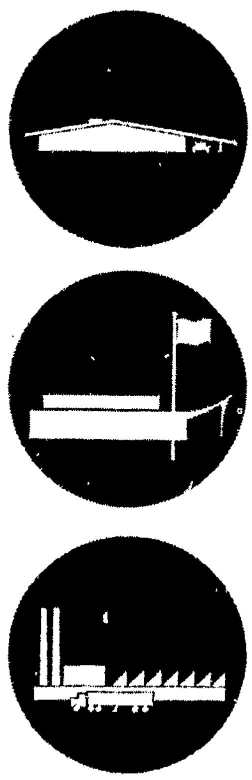
Evaluation instruments applicable to industrial arts instruction are available. Generally, they are composed of a comprehensive list of items which is educationally important in evaluating particular aspects of an industrial arts program. Many are "interaction" instruments which serve as guides for discussion between teachers, students, supervisors, and administrators. The effectiveness of these instruments in seeking improvement of instruction is governed by the sincere and active cooperation of all parties involved in their use.

## *IN SUMMARY*

The problem of evaluation in improving instruction in industrial arts presents many complex difficulties and is no easy task. While evaluative instruments are available, singularly they cannot really measure the effectiveness of all industrial arts programs in all places and at all levels. Most overlook student growth and measures of student change as valuable guides in program improvement. They can provide some direction to evaluation and promote "interaction" so necessary to any program appraisal.

The improvement of industrial arts programs will result only from a continuous program of evaluation covering all aspects of industrial arts education and from a continuous effort by teachers who understand how improvement is to be attained.

# APPENDIX



*Origin and Development of the AVA Industrial Arts Bulletin*

# APPENDIX

## *ORIGIN AND DEVELOPMENT OF THE AVA INDUSTRIAL ARTS BULLETIN*

An interest in the development by the American Vocational Association of a document which would help clarify, standardize, and improve instruction in industrial arts was first expressed at the Association's 1927 Annual Convention in Los Angeles. A concerned group petitioned the AVA Executive Committee to appoint a committee to study the problems of industrial arts and make a report at the next annual convention. The Committees on Standards of Attainment in Industrial Arts Teaching was appointed in 1928.

This committee concentrated its thinking and efforts upon the things which junior high school pupils should know and be able to do in the field of industrial arts. At the 1929 AVA Annual Convention in New Orleans, the committee made its first written report. Reports were submitted each year until 1934 when the sixth and final report, *Standards of Attainment in Industrial Arts Teaching*, was published. This ninety-two page booklet was widely used and accepted and its content influenced greatly the progress and scope of industrial arts in public education throughout America.

In 1939, the AVA Committee on Industrial Arts was reactivated, enlarged, and charged with the responsibilities of revising the 1934 document in order to bring content in line with current thinking in the field. The revision was published in 1946 under the title *Improving Instruction in Industrial Arts* and more than 20,000 copies were sold.

In 1951, when the supply of the 1946 edition was depleted, leaders of the Industrial Arts Division recommended the third revision of the bulletin. A new committee was formed and held its first meeting at the 1951 Annual Convention in Minneapolis. The committee decided that this revision should emphasize ways and means of attaining the objectives of industrial arts other than those involving shop and laboratory processes. In July 1953, *A Guide to Improving Instruction in Industrial Arts* was published as the third edition of the industrial arts bulletin of the AVA.

The Cabinet of the Industrial Arts Policy and Planning Committee of AVA approved revising *A Guide to Improving Instruction in Industrial Arts* at its February 1962 meeting and the same year appointed a Revision Committee to undertake the task. This committee had its initial meeting at the Annual

Convention of AVA in Milwaukee in 1962. At that time, detailed plans for producing the revised document were made. From 1962 through 1967, committee meetings were held each December at AVA Conventions. The committee also met in April 1963 and 1964. The fourth edition attempts to update the unique goals, basic content, and the philosophical approach of industrial arts, and is intended to be a guide for this field—as the title implies.

*Summary of Important Dates in the Development of*
A GUIDE TO IMPROVING INSTRUCTION IN INDUSTRIAL ARTS

1928 March. Committee appointed.

1929 December. First Report submitted at New Orleans Convention. Printed for general circulation by AVA, 16 pp. Emanuel E. Ericson, Chairman.

1930 December. Second Report, submitted at Milwaukee Convention. Mimeographed, 18 pp. Emanuel E. Ericson, Chairman.

1931 December. Third Report, submitted at New York Convention. Mimeographed, 31 pp. William T. Bawden, Chairman.

1932 December. Fourth Report, submitted at Kansas City Convention. Mimeographed, 12 pp. William T. Bawden, Chairman.

1933 December. Fifth Report, submitted at Detroit Convention. Mimeographed, 16 pp., accompanied by supplementary report on "The Objectives of the Industrial Arts Teacher," prepared by Robert W. Selvidge, mimeographed, 14 pp. William E. Roberts, Chairman.

1934 December. Sixth and Final Report, submitted at Pittsburgh Convention. Printed, 92 pp. William E. Roberts, Chairman.

1939 December. Committee on Standards of Attainment in Industrial Arts Teaching reactivated. Homer J. Smith, Chairman.

1946 February. Revised Bulletin, submitted at Buffalo Convention. Printed, 96 pp. Homer J. Smith, Chairman.

1951 August. New committee appointed by Roy G. Fales, Vice president, Industrial Arts Division, AVA, to revise the bulletin. Chris H. Groneman, Chairman.

1953 July. Revised Bulletin published, 120 pp.

1962 February. Revision committee appointed by G. Harold Silvius, Vice president, Industrial Arts Division, AVA, and Joseph J. Carrel, Chairman, Policy and Planning Committee, Industrial Arts Division. Ernest L. Minelli, Chairman.

*1968* *August*. Fourth Revision published.

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