THE DEVELOPMENT AND FEASIBILITY OF MASS PRODUCTION AS AN EDUCATIONAL EXPERIENCE IN INDUSTRIAL ARTS

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Lee H. Smalley

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THESIS

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ABSTRACT

THE DEVELOPMENT AND FEASIBILITY OF MASS PRODUCTION AS AN EDUCATION EXPERIENCE IN INDUSTRIAL ARTS

by Lee H. Smalley

Industrial arts, as does every subject matter area, needs to re-evaluate constantly its philosophy, content, and methods. In examining present practices of teaching industrial arts, one is struck by the similarity and singularity of the method used--the project. Sound educational practice warns of such heavy reliance upon one method of organizing instruction, so that teachers do not even recognize alternatives. The subject matter presented is generally that which can be "worked in" while the student is constructing his project. Industrial arts, drawing its content from industry, needs a broader framework to meet more adequately the challenge of a changing technology.

Industrial arts as general education implies acceptance on the part of educators of the contribution of industrial arts to the total school curriculum, as well as understanding on the part of industrial arts teachers of a philosophy and the objectives of general education. Neither proposition is supported by present practices.

The objectives of industrial arts, as accepted for this study, are the ones proposed for general education by the Educational Policies Commission;[1] Self Realization,

Human Relations, Economic Efficiency, and Civic Responsibility. By analyzing these objectives and translating them into student behavior, a direction may be found that will include industrial arts as a significant subject in the public school curriculum.

If industrial arts draws its content from the industrial demands of the society, then industries or segment of them will have to be surveyed and analyzed in order to derive the scope of the content. One of the dominant features of the present day industrial scene is the mass production of goods. This development has been taking shape for many years, though almost totally ignored by industrial arts teachers.

Understandings, skills, and information about mass production cannot be "worked in" as each student makes his individual project. The unit method of organization is appropriate for this kind of instruction. A definite time is set aside to teach about mass production; objectives are identified, content selected, teaching methods proposed, and evaluation procedures worked out.

To test for feasibility, several industrial arts teachers were asked to teach a unit on mass production in one of their classes. The writer observed and evaluated their endeavors. A written test over knowledge of mass production was given to students who had participated in a mass production unit. This test was also given to control

groups, or if no control groups were available, a pre-test and a post-test were given to the experimental group. Generally the experimental groups scored significantly higher than the control groups, who had no organized contact with mass production.

Based upon the response the author received from teachers who were willing to teach a unit on mass production, it would seem that industrial arts teachers are willing to improve their teaching, especially if a little assistance is offered. Using average teachers, facilities, and students, a product may be mass produced in an industrial arts laboratory and significant behavior changes can take place because of it. Generally, the only important change that needs to take place in order for a mass production experience to be included in the industrial arts curriculum is in the values of the industrial arts teacher.

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[1]Educational Policies Commission, The Purpose of Education in American Democracy (Washington, D.C.: National Education Association, 1938).

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By

Lee H. Smalley

A THESIS

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PREFACE

The constant need to re-evaluate goals and practices of education in light of new conditions and forces in our society has always been a motivating force for change in educational institutions. This is all the more true in these times of rapid technological and social change. New generations, viewing their society with new eyes, need to blend their views with the ideas and skills that have been previously developed. With this aim in mind, the writer embarks upon the present undertaking.

Encouragement and a challenge has come from faculty advisors: Dr. Walter Ditzler, formerly of State College of Iowa; Dr. R. Lee Hornbake of the University of Maryland; and Dr. John Fuzak of Michigan State University. To the remainder of my doctoral committee, Dr. Charles Blackman, Dr. George Brandon, and Dr. Orden Smucker, plus Dr. Lawrence Borosage and Mr. C. Blair MacLean of the Industrial Education Service, there is an acknowledgment of their influence.

Wives always seem to have an important part in a person's professional life, and Helen is no exception. This is an opportunity to formally say "Thank you!"

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CHAPTER I

INTRODUCTION

Need For the Study

Industrial arts, because of its relatively recent emergence as a subject area for inclusion in the curriculum of the public schools, is under pressure to remain dynamic in relation to our changing society. The re-evaluation that followed Sputnik, the increased demand for more tax monies by all departments of the government, and the higher cost of education have all had their impact on newer areas of the curriculum. The very fact that industrial arts relates to the industrial aspect of our democracy is enough to demand a constant look at its curriculum.

> Continuing study of the curriculum in American schools is highly important. Not only is it essential that prospective teachers have a good understanding of curriculum principles and practices before undertaking the responsibility of teaching; it is important also that teachers in service constantly review and refine their conceptions of what the curriculum should be. This is especially true in American schools because of a great pioneering undertaking in which we are engaged in attempting to provide appropriate education for all the children of all the people extending through the elementary and secondary periods in a common program. Great progress has been made toward this goal, but many problems remain to be solved.[1]

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[1]Galen J. Saylor and Wm. M. Alexander, Curriculum Planning (New York: Rinehart and Co., 1954), p. v.

Although the writer had taught and observed units on mass production previous to this study, there was a need to provide more examples of what industrial arts teachers would do if they were to teach a unit on mass production. There was also a need for a model unit to be proposed so that others could be judged against it. The examples of a unit on mass production that have appeared in the literature are mostly personal experiences the teachers wish to relate. In only one instance in approximately 30 articles that have appeared in magazines during the last ten years has any mention been made of <u>why</u> such a unit was taught. In no cases were specific objectives defined nor were there any illustrations of evaluation procedures or instruments. What has been written then are personal, fragmented experiences that are of little use to a teacher starting to plan, organize, teach, and evaluate a unit on mass production.

The content of industrial arts in the public school has tended to reflect the patterns of industry that have been prevalent in the past. Wood, metal, and drawing have formed the core of the offerings, even though these may not be appropriate for every situation. Slowly other content areas are beginning to take their place: electricity, plastics, mechanics, and graphic arts. The latter are still in the minority as far as number of offerings are concerned.

The method of organizing instruction in industrial arts has been limited generally to the individual take-home

project. Although teachers generally feel this method is adequate, a closer examination will usually reveal that important aspects of a comprehensive curriculum are missing, or not being emphasized. If a variety of educational experiences are to be included, then the organization of instruction will have to be flexible enough to accommodate this variety. There is a definite need in industrial arts for a continuing re-evaluation of the content and organization to keep pace with our changing technology.

Many industrial arts teachers have gotten into a habit sometimes ascribed to a physical education teacher who will "throw out a ball" and that is the end of his teaching. The individual interest take-home project has provided a ready device to capture the enthusiasm of many students, regardless of what may or may not be learned. When the industrial arts teacher says, "O.K. let's go to work!" it becomes a familiar and welcome cry. A look at the planning books of industrial arts teachers would reveal many of them composed of "work on projects" for weeks at a time, or else not filled in at all. The majority of industrial arts teachers still do not use a textbook. To say the least, the industrial arts teacher has generally become careless in planning and organizing his teaching, relying rather on a day-to-day off-the-cuff kind of a preparation. The mission, responsibility, and content of industrial arts demands more than that from an industrial arts teacher. This study will attempt to show

that if something is valued, i.e., mass production, it takes work, planning, and organization to accomplish something significant. Good teaching just does not happen.

Industrial arts must constantly build upon one of its traditional and inherent strengths; the possibility of providing students with concrete experiences rather than with merely verbal ones. The concept of mass production can best be learned by the maximum involvement of the learner in planning, organizing, designing, producing, assemblying, and distributing a product by assembly line techniques. This study will attempt to show why this is important and how this may be accomplished.

Methods of Research

"While there may be countless ways of uncovering evidence and of analyzing and classifying it for purposes of research, they can all be described broadly under four headings: (1) documentary or historical research, (2) experimental, (3) descriptive research or the survey, and (4) the case study."[2] All four of these techniques were used in this study.

Documentary research techniques were used in developing a concept of general education, in orienting industrial arts as a part of general education, and in developing a curriculum that is appropriate for industrial arts. In these areas, and

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[2]Tyrus Hillway, Introduction to Research (Boston: Houghton Mifflin Co., 1956), p. 125.

others as well, the literature on the subject was examined and a summary of relevant ideas presented.

Experimental techniques were used to determine the significance of the differences in information about mass production between groups of students who had participated in a unit on mass production and those who had no formal exposure to mass production. The t-test was used to test the significance difference between the means of the two groups.

Descriptive research, or a survey, was made of the opinions of students and teachers who had participated in a unit on mass production. This was given at the conclusion of the unit and was concerned with their opinions on the appropriateness, strong and weak points in the unit.

A case study approach was used in describing the 11 units on mass production that were observed and evaluated by the writer.

The industrial arts teachers who participated in this study were selected in a number of ways. Names of public school industrial arts teachers who might be interested in teaching a unit on mass production were solicited from teacher educators at Michigan State University. Other names were added so that a form of a stratified sample was developed. Care was taken to see that teachers were represented from larger city systems to smaller rural schools, that they ranged in teaching experience from one year to those who had

been teaching for some time, that a variety of industrial arts courses were represented, and that there was a range from 7th to 12th grade. Twenty-four teachers were selected with the additional criterion of teaching within a radius of about 45 miles of East Lansing, Michigan. Letters[3] were sent to these 24 teachers on August 24, 1959. A reply form[4] was enclosed asking the teachers what they knew about mass production and if they would be willing to teach a unit on mass production. Sixteen replies were received and 11 of these expressed a desire to cooperate with the writer in teaching a unit on mass production. These 11 were sent follow-up letters requesting that a meeting be arranged where this could be discussed more fully. After meeting with the 11 teachers individually at his school, each agreed to include a unit on mass production in at least one of his classes during the school year 1959-60.

The writer made three requests of the 11 cooperating teachers; (1) that the mass production project be assembled by an assembly line process, (2) that the writer be allowed to evaluate the unit, and (3) that the writer observe the unit during its operation. All other decisions concerning the organization and teaching of the unit were left up to each individual teacher to decide. The writer acted as a consultant, helping the teachers when asked, and as an

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[3]See Appendix II.

[4]See Appendix III.

observer, recording impressions of what was taking place during the unit. The writer visited each school at least three times during the unit. These visits ranged from one hour to a full school day. When necessary, or possible, more than three visits were made.

These public school experiences were used in two ways: (1) to provide examples of teaching techniques and organizational patterns that could be incorporated into a model mass production unit the writer includes in Chapter V, and (2) to evaluate and compare what the selected public school teachers did with the model unit the writer recommends.

With some of the classes that participated in this mass production experience a pre-test and a post-test[5] were given to see if any changes in behavior could be measured. Where possible an experimental and a control group were set up and the measurements taken from both groups. Instruments[6] were developed to get opinions from the teachers and students participating in this study.

Organization of the Thesis

In Chapter II, "Some Factors Affecting Curriculum Development in Industrial Arts," a concept of general education is developed. Industrial arts as general education implies an understanding of a philosophy of general education

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[5]See Appendix IV A.

[6]See Appendix IV B and C.

that will necessitate a place for industrial arts to contribute. A curriculum in industrial arts must be developed from this rationale.

Since it would be impractical to attempt to develop in detail the whole range of educational experiences that could be included in a comprehensive industrial arts program, one segment of our industrial society was abstracted to emphasize and to illustrate curriculum planning in industrial arts. That segment is the concept and operation of mass production. Chapter III, "Educational Implications of Mass Production," is devoted to tracing the historical development of mass production, its relationship to general education and the applications that may be made in teaching industrial arts.

Chapter IV, "Some Educational Experiences in Mass Production," is a description and an evaluation of the 11 mass production units that were organized and taught by public school industrial arts teachers. The author's recommendations for a teaching unit on mass production are presented in Chapter V, followed with the summary, conclusions and implications.

The appendices contain forms used in the study, data collected from participating students and teachers, and supplementary information on the 11 situations reported on earlier in the study.

CHAPTER II

SOME FACTORS AFFECTING CURRICULUM DEVELOPMENT IN INDUSTRIAL ARTS

A Concept of General Education

As a culture changes, so must the social institutions that support it. Within the last 80 years there has been a tremendous change in American life. In 1870 more than one-half of the people were employed in agriculture while today the farmers represent less than 10 per cent of our labor force. The number of persons engaged in the mining industries declined 28 per cent during the last 40 years, yet there has been an increase in production by 38 per cent. In the present labor force of 70 million people, less than 5 per cent are employed as laborers. The craftsman has given way to the mass producer, which is now being characterized by the automated dial watcher. Iron has given way to steel. The transition from steam to gas to atomic power has occurred during this period. The rise of Big Labor, the shorter work week, increased mobility, and a higher standard of living than any people on earth, has been accomplished within the life span of our older generation.

These changes could be added to, but certainly there is no disagreement that important changes have come about in fairly recent years. The importance of these changes is in the effect they have had on education, particularly at the secondary level. The two most dramatic changes in secondary education have been the enormous numerical growth of the high schools, and the enlargement of the school's functions. The increased industrialization of America has raised the age of entry into the labor market and has demanded a higher level of skills from the workers.

"In 1880, there were approximately 110,000 youths enrolled in American high schools. In 1950, the corresponding secondary school grades enrolled approximately 5,700,000 students. The fiftyfold increase in secondary school attendance during the past 70 years compares with a threefold increase in total population during the same period."[1]

With this influx into the schools, or rather with a larger percentage of students staying in schools longer, teachers were faced with a wider range of abilities, interests, and ambitions. This was partially compensated for by the increase in the number and variety of course offerings on the secondary level. Proportionally there were as many additions to the curriculum as there were increases in the number of students enrolled in school.

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[1]Educational Policies Commission, Education for All American Youth (Washington, D.C.: National Education Association, 1952), p. 3.

> At the rate of six courses each academic year it would take a student almost 46 years to complete all of the 274 courses offered by the high schools in 15 or more states in 1948-49! At the same rate a student could have finished all the courses offered in 1889-90 in a maximum of six years.[2]

Courses were dropped, sub-divided, and added, but the general trend was away from the strictly college preparatory curriculum to one that would more adequately meet the needs of all children.

As it became increasingly clear that the schools would have to provide for the great masses of children, rather than for just a few, the organization of the curriculum became more important. As the elective system became more popular in the high schools, there needed to be some compromise between a completely required and a free elective system. As the high schools also became the "common" schools, there was the obligation to transmit some common body of knowledge and skills to all of the students enrolled. Some students were physically separated, mainly into vocational schools, while others were in the same building but following different "tracks" or curricula. These different tracks usually were composed of different courses leading to different goals, as their names implied: College Preparatory, General, Commercial, Industrial, or Vocational.

The comprehensive high school attempted to work this out by requiring a number of courses that everyone would

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[2]John F. Latimer, What's Happened to Our High Schools? (Washington, D.C.: Public Affairs Press, 1958), pp. 47-48.

take, and then leaving time for a student to choose some electives. This position is expressed by James B. Conant:

> "Recommendation 3 - Required Programs for All
>
> A. GENERAL EDUCATION: The requirements for graduation for all students should be as follows:
>
> Four years of English, three or four years of Social Studies - including two years of History (one of which should be American History) and a senior course in American problems or American Government - one year of Mathematics in the ninth grade (Algebra or General Mathematics), and at least one year of Science in the ninth or tenth grade, which might well be Biology or General Physical Science. By a year I mean that a course is given five periods a week throughout the academic year or an equivalent amount of time. This academic program of general education involves nine or ten courses with homework to be taken in four years and occupies more than half the time of most students, whatever their elective programs.
>
> B. THE ELECTIVE PROGRAM:
>
> The other requirement for graduation should be successful completion of at least seven more courses, not including physical education. All students should be urged to include art and music in their elective programs. All students should be advised to have as their central core of their elective programs significant sequences of courses, either those leading to the development of a marketable skill or those of an academic nature."[3]

Conant makes the common assumption that the general education of students is met through the required courses. If it is required it is general education, if it is elective it is something else. This does not seem to be a realistic position for determining what is general education. Is

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[3]James B. Conant, The American High School Today (New York: McGraw-Hill, 1959), pp. 47-48

learning to type a part of general education? Typing may be a marketable skill, or only used for personal use.

> The general - whether it be a course to take, an atmosphere to be striven for, a heritage to be glimpsed, an outcome to be achieved, a need to be fulfilled, a problem to be solved, a vision to be shared, a heart to be stirred - must be so conceived by a faculty that all pupils have a chance to participate in it. No other meaning of general education is sufficient for the task facing the American high school.[4]

General education is something more than a list of required courses, of sacred subject matter that can be put into neat bundles and labeled "general" or "specialized." Much of the separation has to come from the learner; how is he going to use this information, this skill, this idea? But the learner does not classify his life into general and specific, it is all one life. So the difference has to be an organizational, and sometimes an administrative, one.

General education is not an attempt to make everyone into the same mold. As people get more and better education, they move together as well as apart. The moving apart, or the being different, is not only related to the person's occupational choice, but also rightly belongs in general education. For instance, everyone should have a chance to participate in the expressive arts, but this does not mean that everyone has to attain the same proficiency in playing the violin, that everyone has to play the violin, or that everyone has to play a musical instrument, but that everyone should have the

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[4]Association for Supervision and Curriculum Development, What Shall the High Schools Teach? (Washington, D.C.: National Education Association, 1956), p. 172.

chance to participate in the expressive arts. Such experiences would tend to make people different although they are shared experiences, represent a common body of knowledge, and are products of our cultural heritage.

The philosophical foundations of general education determine to a great extend the content and method to be included under the heading of general education. The rationalists and neo-humanists rely on "the great tradition" of Western Culture for their body of knowledge. The general education program in the secondary school is merely a downward extension of the traditional college program of the liberal arts; however, the instrumentalists in education believe that the data from psychology and the social sciences provide the clues for making up a school program.

> The intention of the new program is not simply to sharpen the reasoning powers of the student or to increase the powers by which he can serve his own particular ends, but to make him an active element in the creative change of the society around him. It seeks to mesh the individual and social aspects of education in such a way that the sensibilities of the private person and the commitments of the responsible citizen are developed together.[5]

The position taken by the instrumentalists seems to be more defensible in the 20th century. It takes into account not only where our society has been, but where it is going. The subject matter would not be limited, but rather unlimited, for it would allow for any material to be presented

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[5]National Society for the Study of Education, General Education, Fifty-first Yearbook, Part I (Chicago: University of Chicago Press, 1952), p. 43.

that would produce a better citizen in our society. General education must look constantly both to the individual and to the society for its direction.

General education is based upon the recognition that schools are obligated to provide instruction planned to meet the life needs of students, not just academic scholarship or preparation for the professions. It is intended for everyone, and concerned with the total personality of the student. Generally it is concerned with the non-specialized activities of the student, but still recognizing that each person has to contribute to society and, usually, earn his own living.

The objectives of general education which seem to the author to have had the most impact upon the school program are those published by the Educational Policies Commission in 1938. They seemed to have the same impact the "seven cardinal principles" had when they were first published in the 1918 Report of the Commission on Reorganization of Secondary Education. The 1938 report, The Purposes of Education in American Democracy, proposed the following four objectives for general education.

> The first role, or phase of total behavior, is that of the educated person. Conduct in this field is centered on the personal development, growth, and learning of the individual. It includes his use of the fundamental tools of learning, his health, his recreation, his personal philosophy. The placing of these objectives first in the list is not accidental. They deal with the development of the individual himself. In a democracy this field is of supreme importance. Success in this role conditions one's success in every other phase of life's activities. The purposes of

education which fall under this section of total behavior will be referred to as The Objectives of Self-Realization.

A second area is that of home and family relationships with their immediate and natural extensions to neighbors and community. Educationally the home is the most powerful as it is perhaps the oldest, of all social institutions. Good homes and good communities are the basic units of democracy. The activities of the educated individual which relate to these immediate, person-to-person contacts are, therefore, grouped together in a section on The Objectives of Human Relationship.

The next aspect of the activities of the member of a democratic society includes the economic sphere - the creation and satisfaction of material wants. Here we consider the education of the individual as a producer, a consumer, an investor. The importance of such education in providing the indispensable material basis for comfort, safety, and even life itself is clear. The objectives within this general area will be classified under the heading of The Objectives of Economic Efficiency.

Finally, there are the activities of the educated citizen. They involve his dealings with his government - local, state, and national - his relationships with the peoples of other nations, and his other "long distance" contacts in large scale collective enterprises. This field of activity is served by education through The Objectives of Civic Responsibility.[6]

What is general education? It is impossible to sum up in a neat phrase all of the implications involved in this concept. It is a way to organize and administer a curriculum so that students are improved, so as to improve society. It is a way to select content so that students will be able to apply this to the solution of their problems. It is a way to have students share experiences, yet still become different.

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[6]Educational Policies Commission, The Purpose of Education in American Democracy (Washington, D.C.: National Education Association, 1938), pp. 45-47.

Industrial Arts as General Education

In the previous section an overview of general education was developed. Consistent with this view would be the twofold responsibility of subject matter areas in general education: (1) to provide a common core of learnings for all students, and (2) to provide for students who would be interested in, and profit by, increased specialization in an area. The role industrial arts can play will be developed later in this section, but first some definitions of industrial arts will be examined to more clearly identify the area.

One of the original definitions, and one that seems to have had the most lasting impact, was that of Frederick Bonser in 1924:

> The industrial arts are those occupations by which changes are made in the forms of materials to increase their values for human usage. As a subject for educative purposes, industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes.[7]

In 1937, in a bulletin from the U. S. Office of Education, came this definition:

> Industrial arts is a phase of general education that concerns itself with the materials, processes, and with the contribution of those engaged in industry. The learnings come through his study of resultant conditions of life.[8]

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[7]Frederick Bonser and Lois Mossman, Industrial Arts for Elementary Schools (New York: Macmillan Co., 1924), p. 5.

[8]U. S. Department of the Interior, Industrial Arts - Its Interpretation in American Schools (Washington, D.C.: U. S. Government Printing Office, Bulletin 1937; No. 34), p. 1.

The American Industrial Arts Association in 1947 attempted to create a new definition that would more clearly express the changing concept of industrial arts. Dr. William Warner's contribution in this regard was as follows:

> Functionally, industrial arts as a general and fundamental school subject in a free society is concerned with providing experiences that will help persons of all ages and both sexes to profit by the technology because all are involved as consumers, many as producers, and there are countless recreational opportunities for all.[9]

He then elaborates on the scope, content, method, and physical setting of an industrial arts program that would implement his definition.

Dr. Gordon Wilber states that ". . . industrial arts will be defined as those phases of general education which deal with industry--its organization, materials, occupations, processes, and products--and with the problems resulting from the industrial and technological nature of society."[10]

In a class discussion in which the writer participated, Dr. R. Lee Hornbake, at the University of Maryland, defined the purpose of industrial arts as that of "helping boys and girls meet their problems that confront them, particularly as their lives are affected by the industrial aspects of our culture. This industrial arts can do through work centering

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[9]William Warner, "A New Type of Definition," unpublished paper adopted from The Industrial Arts Teacher (March, 1947).

[10]Gordon Wilber, Industrial Arts in General Education (Scranton, Pa.: International Text Book Co., 1954), p. 2.

on tangible or concrete media, calling into play an optimum of learning participation by the student in all phases of the learning process.

If these definitions are representative of those that have been formulated, certainly some patterns emerge that should be of importance. First of all, industrial arts is concerned with the productive enterprise of man. The scope of the content covers all of our industrial technology, not just the mechanical trades. It is concerned with such areas of our industrial technology as products, processes, occupations, tools, materials, and organization. This is accomplished by working in one or more of these areas: wood, metal, ceramics, textiles, graphic arts, mechanical drawing, transportation or power mechanics, and electricity. The ends to which industrial arts works are the same as any other area in education, to provide the student with experiences that will make him a better contributing member of the democratic society of which he is a part by educating him to his optimum development.

The functions of industrial arts may be more clearly expressed by using the four objectives of general education as adopted by the Educational Policies Commission and outlined in the previous chapter.

The Objectives of Self-Realization

Some of the current literature reveals objectives, aims, methods, and content that seem appropriate under this objective.

"It seems quite obvious that improvement in the critical thinking ability of every individual as applied to the problems of democracy, must be a paramount purpose of industrial arts teaching."[11]

"I can foresee a date which will be upon us far sooner than we dare believe, a date when: Our students will be primarily concerned with problem solving. As our society and our technology become even more complex, our students cannot be provided with a package of skills adequate for future problem solving needs."[12]

"Emphasis upon the development of the potentialities of the individual will be of the same order in industrial arts as in all other aspects of education in the school in a democracy."[13]

"To begin with, we look upon the shop room as a laboratory where students can explore the medium of the tool and the material. This includes the origination of an idea through the entire processes that result in the product: emphasis on creativity, problem solving, and aesthetic taste."[14]

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[11]John Fuzak, "Analysis of Developments to Determine Implications for Industrial Arts," The Industrial Arts Teacher, XVII (November-December, 1957), p. 12.

[12]Aarre K. Lahti, "Design for Industrial Arts," The Industrial Arts Teacher, XIX (March-April, 1960), p. 6.

[13]M. Ray Karnes, "Improving Industrial Arts Education," The Industrial Arts Teacher, XIX (May-June, 1960), p. 6.

[14]Vincent Napoleone, "Time for Awakening," Industrial Arts and Vocational Education, XLVIII (June, 1959), p. 177.

In addition to the above statements, industrial arts can make a contribution in the area of the individual's self-realization by providing experiences to improve his work habits and aesthetic appreciation and to teach him to practice safe procedures and to recognize good standards of accomplishments. By providing the amount of individual help that is usually found in an industrial arts program, this may be one of the strongest areas of emphasis for industrial arts as general education. The processes by which a student solves problems is an important element in his education, and problem solving is receiving much more consideration and thought by industrial arts teachers than had previously been the case. By utilizing the individual project approach, individual needs and capabilities can be accommodated, and the student's potential contribution can more adequately be reached.

The Objectives of Human Relationships

This is an area of general education that does not seem to lend itself to specific techniques and evaluation. In an area such as industrial arts, where students are working together in one room, some immediate concern has to be recognized in order for some work to get done. This, of course, is in itself not enough. The immediate situation must be compared and associated with other situations that may occur out of school, or after the students leave school. This has been generally recognized in the literature, as

indicated by the following:

> The third group includes a reasonable willingness to cooperate with others and to have consideration for their convenience and welfare, a reasonable reliance on one's own ability. When properly organized and properly presented these industrial arts experiences provide excellent opportunities for exploration and guidance.[15]

> In the living, moving situation of the industrial arts laboratory, the student has an opportunity to be honest with himself and with others in the care and return of equipment, checking out and use of materials, tabulation of costs, and sharing of locker space with other students.[16]

> Sociologically, each pupil should develop as one of the group. The somewhat informal organization of the industrial arts class makes possible many opportunities for working with others. . . . Both leadership and followership can be developed. By participating in a well organized personnel plan, the pupil comes to feel that he is a part of the group, that his efforts and contributions are accepted, and that his worth is recognized. Working with others on a common project also helps to develop a sense of belonging.[17]

As educators try to structure experiences so that students learn how to live and work together, certainly the industrial arts laboratories provide a natural setting for them to engage in activities that will attempt to fulfill this objective. Small group projects will help to focus attention upon this area, for when several people have to work together, sharing facilities and making decisions, the

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[15]U. S. Department of the Interior, Industrial Arts - Its Interpretation in American Schools, p. 57.

[16]Department of Public Instruction, Industrial Arts for Secondary Schools (Des Moines: State of Iowa, 1948), p. 18.

[17]Wilber, Industrial Arts in General Education, p. 40.

problems of relating to others will be enlarged, and, it is hoped, then diminished by good teaching.

The Objectives of Economic Efficiency

When general education is looked upon as assuming some of the responsibilities of preparing people to enter the world of work, then the objectives of economic efficiency take on a new and added importance. Industrial arts is many times confused with vocational education, and unfortunately the literature, and leaders in the field, sometimes do not clarify the difference between the two aspects of education. Because industrial arts students work with industrial materials and procedures, it is assumed by some that this is done in order for the person to learn the skills of the occupation associated with the materials and processes. This assumption is true to the extent that students should become acquainted with occupations in the area in which they are working, but this is also true of students in science, English, social studies, etc. But, as is pointed out in the present chapter, this is not the only function of industrial arts.

Some authors have indicated the responsibility of industrial arts as follows:

> The value of basic mechanical resourcefulness has been increasingly apparent during the rapid expansion of technological work and scientific progress of recent years. The ability to do has become equal in importance with the ability to think; and often discovery, research, and planning can be carried out

> only piece by piece to the degree that mechanical and manipulative work accompany theoretical developments.[18]
>
> In the developmental phases of the basic and applied sciences, a relatively few top-level people carry the responsibility. But the effective production, application, use, and maintenance of the instruments, machines, and goods which results require technical competence on the part of the masses of the people. A primary personal and social contribution of industrial arts is precisely this dual task; namely the development of technical competence among the millions and the discovery of a variety of technical talents. These goals can be achieved only if children and youth are provided with representative experiences . . .[19]

"If we will construct our program for the technology, then we must conceive of a subject matter representative of the new industry, as well as appropriate to the new leisure."[20]

Preparing to make an intelligent choice of life-work, becoming a more literate consumer, recognizing problems related to organized business and labor, etc., are certainly important aspects of students' education. The traditional relationship with federally subsidized vocational education has been that of exploration, and basic preparation, for a vocation. Industrial arts was generally for junior-high school students so that they might try out and select an

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[18]Emanuel Erickson, Teaching the Industrial Arts (Peoria, Ill.: Manual Arts Press, 1946), p. 254.

[19]R. Lee Hornbake, "Professional Growth in Industrial Arts Education," The Industrial Arts Teacher, XIX (November-December, 1959), p. 50.

[20]Delmar Olson, "A Call to Industrial Arts," School Shop, XIX (June, 1960), p. 10.

occupation in which they thought they could be successful. Industrial arts was a screen and a feeder for the high school vocational curriculum. This relationship is becoming less important as more people see the broader implications of industrial arts as general education, its direction, and goals.

The Objectives of Civic Responsibility

Civic responsibility may be characterized by the term--participation. A democracy is founded upon the principle of citizen participation in the affairs of state. The nature of the problems that may be identified in industrial arts, the concreteness of the material and the laboratory or shop environment demands an involvement of the learner--citizen in the tangible solution of the problem. If this is done consciously by the teacher and the students are aware of this facet of industrial arts, a great contribution to the civic responsibility of future citizens may be made.

Other industrial arts responsibilities in this area includes: seeing present-day industrial events in some historical perspective, becoming oriented to the physical world, and appreciating what scientific advancements mean to a society. What does a person need to know to be an American citizen? Certainly knowledge of our industrial technology and the productive enterprise of man is an area that needs to be considered in the education of our future citizens. Following are some concerns that other people have had about

this responsibility of industrial arts.

"The cultural, social and economic implications of the use of tools and materials will receive much more attention in the preparation of teachers of industrial education."[21]

> A course, Modern Industry, is available to the upper-undergraduate industrial arts students. The course provides an overview of manufacturing industry in the American social, economic, and cultural pattern. Representative basic industries are visited and studied from the viewpoints of personnel and management organization and control, industrial relations, communications, production practices, distribution of products, and other essentials of importance in teaching Industrial Arts as an indispensable phase of general education.[22]

> When production--the quantitative--becomes the means to the qualitative we shall be entering the third phase of industrial relationship, the phase in which man can proclaim that the machine serves man, not man the machine. I have thus tried to show how the problem of industrial arts education is the same problem in the schools as in the shop. It is the problem of putting knowledge to work in order that the arts which the few have enjoyed in the past may now be available to all. To bring this about would amount to affecting a major revolution in American life, a revolution in the democratization of the Arts.[23]

> We may approach social purpose or social function in two ways. In one sense we may work toward having the pupil come to understand and accept the responsibilities inherent in his culture. Or we may view social purpose as the optimal development of the learner so that he may make his own unique

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[21]William Micheels and Wesley Sommers, The Minnesota Plan for Industrial Arts Teacher Education (Bloomington: McKnight and McKnight, 1958), p. 23.

[22]American Council on Industrial Art Teacher Education, Superior Practices (Bloomington: McKnight and McKnight, 1955), p. 53.

[23]Henry Herrmann, Art and Industry (Washington, D.C.: American Industrial Arts Association, 1956), p. 14.

> contribution to his culture. We, in industrial arts, can use both avenues.[24]

Some of the objectives of civic responsibility may be realized by involving students in the problems, products, and processes of modern technology. The materials that are used should reflect as closely as possible those used in commercial products. In ceramics the students cannot "pinch a pot," thinking that this is the way much of the commercial models are produced. They cannot set type by hand in graphic arts, thinking that this is the way newspapers and magazines are published.

The potential of any subject field to fulfill its mission will depend upon the imagination and competence of the teachers and leaders in the field plus the support and recognition they receive from other areas of education and the lay public. Industrial arts has not been recognized by the people in general education as providing a significant experience for all students in the public school. The role of industrial arts has been conceived as assuming some responsibility for the education of the non-college bound boy. As illustrated in previous quotations, there have been many people in industrial arts who have sounded a warning, issued a call, or shown a way that would make industrial arts a more meaningful part of general education. It would seem unnecessary and redundant at this point in the history

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[24]Hornbake, "Professional Growth in Industrial Arts Education," p. 14.

of industrial arts to keep insisting that "Industrial arts is a part of general education." What we need now is to get other people to say this.

Industrial arts, through the contemporary content of technology, has the opportunity to provide all students in the public schools information, knowledge, and concepts about our industrial democracy which is necessary to be a functioning citizen in our future society.

Industrial arts, through the process of experiences working with concrete materials and solving problems in a laboratory situation, has the opportunity to provide all students in the public schools with attitudes, skills, and insights into the nature of learning and how problems are solved in an industrial situation.

This is the challenge to industrial arts--to become general education and to have some demonstratable results so that others are convinced. The increased cost of education, the shortened time for social changes to take effect, the increased demands of modern society upon education--all of these are pressures on subject areas in the public school to search out and find better ways of doing the job that is necessary. Industrial arts must meet this challenge if it is to be a dynamic force in education.

How this challenge may be met, in the organization of content, will be explored in the following section.

Development of an Industrial Arts Curriculum

In the preceding parts of Chapter II a foundation has been laid, in terms of objectives and the selection of content, for the teaching of industrial arts in the secondary school. The need now is to transform these ideas into a workable framework that will increase the effectiveness of the industrial arts teacher.

Traditionally, industrial arts instruction has been organized around an individual project. The reliance upon only one method of organization has led to a restriction of activities and objectives that are taught. The selection of the project is either done by the student in terms of something he needs, wants or could use, or else is selected and required by the teacher. This, then, forms the basis for the content presented until the project is completed. The problem, and the objective, for the student is to complete the project in a satisfactory manner. If objectives for the course had been developed earlier, they soon become clouded over for both the student and the teacher, with the immediate, individual problems connected with the project. The content of the course is then drawn from what the teacher knows, and what the student needs to know in order to complete his project.

In building a curriculum four main areas are important: determining the objectives, selecting the content, organizing the instruction, and evaluating the results. If the

objectives have been determined, then the next step is to determine what is to be taught. If industrial arts is concerned with the productive enterprise of man, from this, then, the content is derived--the present day industrial technology. Industrial arts courses are generally named after materials or areas of industry: woodworking, metalworking, ceramics, graphic arts, power mechanics, etc. The teachers in these areas need to survey the field in which they are teaching in order to determine its essential features, and to organize this material into some logical and convenient form.

Selection of Content

Surveys may be organized in a number of different ways. The following are some examples of outlines that have been used to organize materials gathered for a survey.

<u>Survey of the Wood Industry</u>

I. Organization and Operation of Wood Industries
II. Trees to Consumer Products
III. Processes in the Wood Industry
IV. Tools of the Industry
V. Materials of the Industry
VI. Occupations in the Industry
VII. Research and Problems

Graphic Arts Industries

I. Organization
II. Occupations
III. Tools
IV. Materials
V. Processes
VI. Products
VII. Problems

A Survey of Magnetism and Electricity

I. Milestones in Electricity and Magnetism
II. Forces Met with in Electricity and Magnetism
III. How Electricity is Made
IV. Electrical Measurements
V. Control and Transportation of Electricity
VI. How Electricity is Used
VII. Electrical Safety
VIII. Employment Possibilities

A Survey of the Metals Industry

I. History of Metals
II. The Kinds of Metals
III. Sources of Raw Materials
IV. Mining of Raw Materials
V. Smelting (ferrous)
VI. Smelting (non-ferrous)
VII. Alloying of Metals

VIII. From Smelter to Semi-finished Product

IX. Manufacturing Methods and Tools

X. Metal Industries

XI. Occupations Involved

XII. Occupational Opportunities

XIII. Industrial Associations

XIV. Technical Publications

Survey of Power Mechanics

I. Air

- A. Design
- B. Control
- C. Propulsion
- D. Socio-Economic

II. Marine

- A. Design
- B. Control
- C. Propulsion
- D. Socio-Economic

III. Land

- A. Design
- B. Control
- C. Propulsion
- D. Socio-Economic

IV. Space

- A. Design
- B. Control
- C. Propulsion
- D. Socio-Economic[25]

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[25]These examples are taken from papers submitted by students in a graduate curriculum class the author taught, and from the files of Dr. Kenneth Brown, director of the Industrial Arts Education Division, State University College at Buffalo, New York.

As teachers begin to look more closely at industrial activities a whole new set of resources will have to be used in order to survey an industry. Some selected sources of information for an industrial survey are included in Appendix I. As being a part of curriculum development, the survey needs to be a continuous process of gathering information and materials. Once the basic outline is set up, then new additions may be made and incorporated into the basic structure. One of the main contributions the survey may make is to confront the teacher squarely with the question, "Where do you draw your content?" The survey will actively engage the teacher in answering this question.

More than books and magazines will have to be examined to even partially complete a survey. Field trips will have to be made by the teacher to industrial plants so that he may talk to people working there. Some of the information can be gathered by direct contact with people in industry, and many valuable leads can be gained as to where to find more information, or to learn about other aspects of the industry.

Just to have a conglomerate of information and materials included in a survey is only one part of developing a curriculum. The instructional content should be selected from the survey in terms of:

1. Objectives of the course, or of industrial arts
2. Time available for teaching
3. Maturity and ability of the learner
4. Facilities for teaching

Tyler identifies five principles in selecting learning experiences:

1. The student must have experiences that give him an opportunity to practice the kind of behavior implied by the objective.
2. The learning experiences must be such that the student obtains satisfactions from carrying on the kind of behavior implied by the objectives.
3. The reactions desired in the experience are within the range of possibility for the students involved.
4. There are many particular experiences that can be used to attain the same educational objective.
5. The same learning experience will usually bring about several outcomes.[26]

To select the content calls for some creative and imaginative thinking. Patterns and trends must be recognized, more important information must be separated from the trivia, concepts, and generalizations must be identified, always with the learner and the society in mind. If gathering the

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[26]Ralph Tyler, Basic Principles of Curriculum and Instruction (Chicago: University of Chicago Press, 1950), pp. 42-44.

information and materials is the job of a clerk and a technician, then the selecting of the instructional content is the job of a professional person. Choices that are made here will determine the importance of the subject matter and the impact it will have upon the students. No amount of showmanship can cover up archaic or trivial subject matter. The selection of subject matter cannot be left solely to the textbook writers or to professors in colleges and universities, but each teacher will have to do some of this himself. It is hoped that in the future the literature in the industrial arts field will be of more help to the teacher than it has been in the past.

While instructional content is being selected, the organization of this into a teachable pattern should be considered. As industrial arts is conceived there are two ways in which this subject matter may be organized, around a project, or around a unit. The project approach has been briefly explained and since this is historically, and presently, the predominate pattern for organizing instruction, no further details will be presented here.

Organization of Content

An approach that is not new, except that it has not found widespread use by industrial arts teachers, is the unit approach to teaching.

> Though not the most widely followed, the most generally approved organization of instruction today is the unit plan. It is still in need of much refinement and further development, but its worth as an instructional instrument is well founded in practice.[27]

A problem of particular importance in teaching is the organization of instruction. Traditionally, instruction has been organized by 'lessons' or perhaps by textbook divisions such as chapters, units, or parts. Teaching that is organized in better conformance to principles of learning includes related experiences in a basic division usually called a 'unit of work,' or 'unit of experience,' or 'instructional unit.'[28]

It may be necessary here to distinguish between some different kinds of units. There are many different classifications that are proposed, but the two that run fairly constant through most of the literature is the type used as a source for many different kinds of situations and experiences and the kind that is for a specific time, place, and objective.

> The <u>resource unit</u>, or as it is sometimes called, the source unit, is an organized plan of suggestions centered around some problem, which serves as a source of ideas for objectives, planning, learning experiences, evaluation, activities, and materials to assist the teacher in planning the teaching of a unit. The

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[27]Othanel B. Smith, William Stanley, and J. Harlan Shores, <u>Fundamentals of Curriculum Development</u> (Yonkers-on-Hudson: World Book Co., 1950), p. 554.

[28]Saylor and Alexander, <u>Curriculum Planning</u>, p. 9.

> resource unit contains far more suggestions than can actually be used.
>
> On the other hand, the teaching unit is the unit as actually carried out with the children.[29]

The resource unit is derived from: (1) the objectives or desired outcomes, (2) maturity of the pupils, (3) an area of relevance to the learner, and (4) its relation to other experiences of the learner. It must also be flexible in its organization and development. The teaching unit is then derived from the resource unit, many times with the interchange of ideas between the teacher and the students through teacher-pupil planning. The teaching unit may be as rigid and dogmatic as any other type of teaching, but the organization easily allows for other kinds of student-teacher relationships.

The resource unit may be planned in different ways. Most of the outlines are similar except for slight variations. The steps indicated below are not rigid operations to perform, but each step must be developed with all of the other parts in mind.

The following general plan is taken from Anderson and seems to be best adapted to the kinds of resource units that would be developed in industrial arts.

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[29]Anderson, Principles and Procedures of Curriculum Improvement, pp. 364-365.

General Plan for a Resource Unit

I. The Overview

This is a brief statement of the purpose and scope of the unit. It should indicate the social significance of the theme and its relation to pupil needs.

II. The Objectives

These should be put in behavioral terms of what is expected of the student. Objectives should be capable of being evaluated and more should be listed than are possible to be achieved in any one teaching unit. These behavioral objectives may fall into the following categories:

A. Attitudes

This is a mind set or a readiness to react to situations in a certain way.

B. Appreciations

This represents a feeling or awareness about the value or significance of something.

C. Skills

This is something a person has learned to do with ease and precision, either mentally or physically.

D. Understandings

Generalizations of experiences which are used as guides to further experiences.

III. The Development Sequence

A sequence is necessary to provide a rich fund of resources to which the teacher can refer in planning with the group.

A. Approaches

This part of the resource unit needs to be as carefully planned as any of the others. This is a means of stimulating the interest of students in order to expand the scope and breadth of their interests, or of using their immediate environment as an opportunity for beginning and introducing the theme.

B. Planning with the Class

The most helpful part here would be in how the planning will be done, how the teacher will handle and direct the pupil-teacher planning phase, if there is to be one.

C. Probable Learning Experiences

There should be more learning experiences than the teacher can possibly use. There should be some endeavor to anticipate some of the problems that might come up if these learning experiences are used. These experiences should be directed toward the accomplishment of the objectives.[30]

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[30]Anderson, Principles and Procedures of Curriculum Improvement, pp. 368-79.

IV. Evaluation

Because this process comes toward the end of the unit outline does not imply that procedures for measuring and evaluating student progress comes at the end of the unit. If objectives have been stated in terms of student behaviors, then it is much easier to incorporate the measuring techniques and instruments as an integral part of teaching the unit.

V. Bibliography

This should contain an extensive but well selected list of references that may be useful to the students. There may be a different bibliography for the teacher's use.

If the unit method of organizing instruction is used to teach industrial arts, how will it differ from the present practice of organizing instruction around a project? It would seem that the biggest difference would be that with a unit there is a unity of experiences, or a theme, that can be organized around an objective. Rather than have the students design and construct a project where the teacher would try to work in related information, an amount of time would be set aside to concentrate on one or two particular behavior changes desired.

To achieve an outcome such as 'the student will increasingly develop original, creative designs' a unit could be structured with this as the main theme or objective.

Each would know what was to be accomplished, and why it was important to do so. Specific teaching methods could be used, with all activities directed toward the outcome desired. Nothing should be between the behaviors desired and the suggested activities. Varied kinds of experiences are appropriate within the unit, as opposed to the usual restriction that the individual project must be something useful to take home. Some experimentation may be done where the apparatus is later destroyed. Perhaps a scale model may be made, or a group project may be appropriate. The objective is specifically 'to develop original creative designs,' not 'to make a project.'

These units are also flexible, changing from one grade level or course to another by selecting different subject matter and changing the techniques of teaching.

> Each course will be examined with respect to objectives. The teaching guides will be developed around major teaching units. This will provide for flexibility as it becomes necessary in subsequent years to shift units from one course to another or in some way alter existing patterns in terms of future plans . . .[31]

Teachers may be as autocratic in using units as in using projects, but the unit method of organizing instruction can provide a framework for student-teacher planning.

> . . . they can encourage cooperative student-teacher planning in identifying pertinent central cores, ideas, or themes, in formulating objectives

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[31]Micheels and Sommers, The Minnesota Plan for Industrial Arts Teacher Education, p. 30.

> and in organizing and implementing suitable curricular experiences. Another important value lies in the fact that units of work and unit teaching may give the learner an increasingly active and responsible role in curriculum building and in the total learning process.[32]

The unit method seems to be appropriate for industrial arts for the following reasons:

1. Industrial arts teachers generally restrict their activities to those that fit in with an individual take-home project.
2. In so doing, several important objectives are lost sight of, and are not taught.
3. By focusing attention on a few behavioral outcomes at one time, the objectives of industrial arts should become more meaningful in selecting content and method.

Industrial arts, if it is oriented toward the objectives of general education, selects its content from our dynamic industrial society and organizes this content around a format that makes it effective for teaching and learning and has the potential of fulfilling an important aspect of a person's general education.

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[32]Stephen Romine, Building the High School Curriculum (New York: Ronald Press Co., 1954), p. 231.

CHAPTER III

EDUCATIONAL IMPLICATIONS OF MASS PRODUCTION

History of Mass Production

If industrial arts is to select its content from the productive enterprise of man, then a glance at this aspect of our society reveals some elements that stand out in bold relief. The specialization of occupations, the bigness of corporations, the reliance upon volume consumption, the impact of governmental policies and spending, the standardization of products, the rise of credit buying, and the volume production of products are but a few industrial themes that dominate the scene today.

In selecting content for industrial arts, rather than for one particular course in industrial arts, a survey of our society, rather than a survey of an industry will be needed. In looking at the methods of producing consumer goods one is struck with the necessity for producing products on a volume basis, and the techniques used in its accomplishment. This chapter will attempt to explain the background of mass production, how it relates to general education and then more specifically how it may be utilized and taught in industrial arts.

Mass production as a means of economically producing similar items has an origin that undoubtedly dates far back before recorded history. Such a highly complex social organization as a modern mass production industry does not suddenly spring into existence. The techniques, understandings, skills, and values that contribute to a successful operation have been built up for thousands of years. Analyzing some of the ingredients that go into designing, producing, and distributing a present day mass produced item points up the sensitivity of the system. Each part is related and dependent upon the other parts, so that the whole may function effectively. Tracing such concepts as precision, standardization, interchangeability, specialization, mass communication, and distribution to their early recorded beginnings is a rewarding task, for it lays a foundation for a better understanding of the present day workings of modern industry.

Before 1,000 A.D.

During this time, great strides were taken in establishing civilizations in many parts of the world. Our concern here is for those inventions, developments, and concepts that affected the lives of the people through the mechanic arts. Some of the developments seem quite simple, in retrospect, but yet a complex series of developments had to take place before others could be completed. The Clepsydia, or water clock, is one example. This is a device over which a heavenly body had no direct control. It offered man an independence

he had not had before. This was a change from the natural measurement of time to the arbitrary division of the day into hours. "The instrument, in its primitive form, consisted of two vessels. From one to the other water fell, drop by drop, as the lower vessel filled, the water level met hour marks on the inside."[1] It had reached Rome in 159 B.C. and spread throughout the Roman Empire. The later developments included weight-driven models which showed an understanding of gearing. People's lives became involved with the measured time, and so a very direct relationship between the technics and the behaviors and values of a society is established.

Lewis Mumford summarizes a list of inventions that existed before the Tenth Century.

> Fire: its application in furnaces, ovens, kilns. The simple machines: inclined plane, screw, etc. Thread cord rope. Spinning and weaving. Advanced agriculture, including irrigation, terrace-cultivation, and soil regeneration (lapsed in Northern Europe). Cattle breeding and the use of the horse for transport. Glass-making, pottery-making, basket-making. Mining, metallurgy and smithing, including the working of iron. Power machines: water mills, boats with sails, probably windmills. Machine-tools: bow drills and lathes. Handicraft tools with tempered metal cutting edges. Paper. Water-clocks. Astronomy, mathematics, physics, and the tradition of science. In Northern Europe a scattered and somewhat decayed technological tradition based on Rome; but South and East, from Spain to China, an advanced and still active technology whose ideas were filtering into the West and North through traders, scholars, and soldiers.[2]

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[1]Roger Burlingame, Backgrounds of Power (New York: Charles Scribners' Sons, 1949), p. 19.

[2]Lewis Mumford, Technics and Civilization (New York: Harcourt, Brace and Co., 1934), p. 438.

In 500 B.C., money had been produced by coining dies, molten metal had been poured into hollowed-out stones, and arrows were standardized to fit the same bow. Some of the basic requirements for mass production were developed during this time, in fact, much of what went on afterwards was only a refinement of previous methods or putting together a different relationship of ideas or techniques. Inventions, and new discoveries are the combined work of much that has gone on before, plus a small step forward.

1000 to 1865 A.D.

Our modern technology, as well as our social system, was established during the period from 1000 to 1865 A.D. Knowledge and information from scattered points around the world were brought together, which made possible most of the key inventions necessary to universalize the machine. "This complex reached its climax, technologically speaking, in the 17th century, with the foundation of experimental science, laid on the basis of mathematics, accurate timing and exact measurement."[3]

By the 16th century, Florence and Venice had long established a money economy, bookkeeping, bills of exchange, and letters of credit. This gave rise to the basis of capitalism. Precision and standardization appeared in military drill, in the formations and tactics of the army.

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[3]Ibid., p. 111.

Gutenberg's use of standardized movable type in printing in 1450 was one of the great developments of this era for not only did it provide for mass communication but the principle involved influenced the production of other items. In Venice in the 15th century the division of labor was perfected so that as a new galley was launched, it went down the waterways to be outfitted. Out of windows on both sides, men would hand out supplies and small equipment so that by the time it reached the end of the street, it was completely equipped.

Before 1700, gunpowder and the magnetic compass were used by the Chinese, mechanical clocks were invented, cast iron was developed, glass making was improved, iron drills were used for boring cannons, and Leonardo da Vinci made his great contributions in such areas as centrifugal pumps, rifled firearms, anti-friction roller bearings, universal joints, spiral gears, and a standardized mass-produced house.

In the 18th century the rate of inventions and improvements increased rapidly. The use of the scientific method created a snowballing effect so that one invention begot many more. Watt's steam engine would not have developed as rapidly as it did without the assistance of James Black, a physicist in the Royal Society of Edinburgh, who wedded science to invention. A French watchmaker devised a lathe in about 1740 for cutting threads on small metal screws used in watches, and early in the 18th century, Thomas Newcomen developed an atmospheric steam pumping engine. The first large scale

demand ever made for absolutely standardized goods came in this period when Louis XIV commissioned the textile industry in France to outfit his army of 100,000 men in identical uniforms. The big change in the 1700's was the Industrial Revolution in England. Here was the start of our modern industrialism, not technologically as much as economically and socially. It is difficult to separate cause from effect in the industrial revolution, for it is an interdependent scheme. Some of the conditions of the times in England, whether cause or effect, were: the sea trade bringing in cotton and other raw materials, the change of peasants into laborers by grouping small tracts of land into large holdings, colonization which aided England to turn from agriculture to industry, the laissez-faire philosophy of government which made possible the exploitation of labor, increase in the birth rate, great abundance of available labor, the increased standardization in their society, capital being invested from long distances, entrepreneur divorced from management, and the setting up of codes that standardized industrial performance. Hargreaves' "jenny" in 1770 made possible the spinning of hundreds of threads at one time. These were moved into the home and formed the "cottage" industry. Work was done by the whole family at home. Richard Arkwright first successfully applied power to the textile industry, providing the link between artisan and engineer, between cottage and factory, between haphazard handicraft and timed machine fabrication.

> The general unrest resulting from these factors furnished a ready-made supply of cheap labor for the mushrooming textile mills which followed the giant growth of Watt's prodigy. From all over England, low paid farm workers, vagabonds, paupers impelled by the Poor Laws to rapid breeding, swarmed into the already crowded towns. . . . It developed, however, that by the time parents had discovered what the factories did to their children, the rise of living costs had made it necessary for the whole family to work to support itself. By 1815, when Waterloo ended the wars, the vicious circle was complete: all but the very youngest children working thirteen hours a day and the parents breeding more to increase the family subsistence.[4]

In 1785, Le Blanc, in France, used techniques of interchangeability in constructing muskets. Still, in the 18th century, Henry Maudslay of Woolrich, England, converted the lathe from being part tool to all machine by perfecting the slide rest and incorporating the lead screw principle for cutting threads. Apprenticeships were decreasing because of the rise in unskilled labor, through the factory system. And so, in the 1700's, there were uses and abuses of some of the refinements and techniques learned in the attempt to produce goods efficiently.

The scene shifts in the early 19th century to America. Sam Slater, a migrant English apprentice who had worked in an Arkwright factory, transplanted the textile industry to the United States. Eli Whitney was given a contract in 1798 to produce 10,000 muskets in two years for the United States government. He did not fulfill the contract until four years

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[4]Roger Burlingame, Backgrounds of Power (New York: Charles Scribners' Sons, 1949), p. 52.

later for he had to build special machines, develop jigs, standardize and make each part accurately, and use unskilled workers doing simplified operations. This was the most complicated, and most successful endeavor in mass producing a manufactured article up to this time. This opened the flood gates to the tremendous production that is still rising in America, and the rest of the world.

The flow westward of skilled workers made necessary their replacement by machines, the bigness of America demanded quantity: wagons, firearms, plows, reapers, clothes, saws, nails, hinges, everything that the people needed to conquer the frontier. There also seemed to be unlimited wealth, freedom of thought, a growing and diversified market, and a demand for social democracy, that could only be met by using manufacturing methods pioneered by Eli Whitney. Standardizing parts, making each part accurately by using special tools, machinery, and jigs guaranteed the interchangeability which American growth needed.

For example, Eli Terry and Chauncey Jerome installed Whitney's system in their clock factory in Connecticut. In 1803, they had sold four wooden clocks at $25.00 each, but in the years 1807 to 1810 they produced 5,000 clocks at $5.00 each. One of the catalysts of all mass production is mass communication. By 1830 the penny press, with its speed and distribution, became necessary to standardize thought through advertising in order to get a mass market. Many

things were gained from foreign inventors and suppliers during this period; there was almost no steel produced in America even up to 1850, Joseph Clement of England built a machine to plane metal surfaces, the Glonet brothers of France used this to plane the teeth of gears, and Palmer of France produced a more accurate micrometer. What Americans did learn they put to good use. Samuel Colt first had the Whitney factory produce his famous pistol, then when the job was finished the machinery became Colt's property. He hired Elisha Root, who formerly had made axes, to set up a new factory for the production of these guns, and by 1856 was producing 24,053 pistols a year. In 1832, a Massachusetts shoe manufacturer took another step toward making the worker a human cog in a mass production sequence. He divided the shoemaking operations into such simple operations that one man could hardly know what went on before or after his own operation. In the 1850's, the yard and inch were standardized. The first successful process leading to the inexpensive, large-scale production of steel was invented in Kentucky in 1847 by William Kelly, but it was not until 1870 that the Bessemer process, imported from England, was utilized to any extent.

Cyrus McCormick, in 1850, knew how to produce his reaper by the new system which automatically conveyed parts through successive operations, and to distribute it in a manner which was to become standard procedure for the 20th century industrial system. He gave the reaper to farmers for

a token payment before the harvest, and waited for the rest of his money until the farmer had sold his grain. He used agents to get the sales and collect the money.

> We have seen that, as techniques advanced, industry demanded more and more consolidation. With the grouping of machines into sequences about a single power source, the application of the interchanbeable parts system, the division and subdivision of labor and the wider acceptance of standards we have noted the changing pattern of production . . . we observed the disappearance of small, scattered local units in favor of large concentrated ones.[5]

In 1860, the production of the sewing machine embodied all the elements of mass production up to that time. It went into quantity production by means of the interchangeable parts system, it was distributed by agents and sold on the installment plan. It was sold as a luxury item to the mass of the people. And so by 1865, all of the elements needed for modern mass production were there. More refinements would take place, but there was a solid base of skills, knowledge, and values upon which to build.

1865 to the Present Time

The basic pattern that was set with the reaper and the sewing machine is still evidenced today. Many refinements and details have been filled in to make the system more efficient than before 1865.

In 1887, Oliver Evans designed a flour milling sequence that was wholly automatic from grain sack to flour sack, which

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[5] Ibid., p. 191.

out labor time in half and started the first "untouched by human hands" production. The Blanchard profile lathe which turned out irregular shapes, the development of the turret lathe and the expansion of railroads to distribute the goods all helped to move this concept forward. The organization of the American Federation of Labor in 1886 to preserve craft status and provide some social compensation for workers in mass production industries, Carl Johansson, the Swedish engineer, who produced gauge blocks in 1895 that were accurate within four millionths of an inch, Frederick Taylor and Frank Gilbreth who worked with stopwatch and motion picture camera to make effective the human tools they had to work with and so pioneer the "scientific management" movement, all contributed to the flowering of mass production in the automobile industry during the early part of the 20th century.

R. E. Olds established the Olds Motor Vehicle Company in Lansing, Michigan, in 1896. In 1899, it was moved to Detroit where the first factory to be built in the United States for the sole purpose of manufacturing automobiles was built. The Olds curved-dash-one-cylinder runabout sold for $650.00 in 1901, and 4,000 of them were produced that year. The dramatic focal point of modern mass production falls, however, on another automobile manufacturer, Henry Ford. Here was a man, and his company, who profited from the past, added a bit to the techniques and came up with a revolution. The Ford car had been purchased and assembled for several

years using more conventional methods. It was not until 1913 that they started putting the whole car together, using new and more efficient principles.

> In the fall of 1913, they pulled a chassis along the street beside the factory. Along the 250 foot route, they had piles of parts stationed at intervals. Six men walking beside the moving chassis picking up parts at the stations and bolting them to the chassis. Formerly, this process had taken fourteen hours but this first experiment reduced the time to less than six hours. Their next experiment was to mount the wheels on the chassis and roll it down a channeled track from one assembly station to the next. The next logical step quickly followed--a mechanically driven conveyor chain was installed to eliminate the hand pushing, and the assembly time was reduced again from 6 hours to one hour and thirty minutes. From then on the conveyors and overhead carriers multiplied, feeding in the right material at the right time to each station. The carrying and pushing were minimized and "Model T's" came off the lines by the hundreds of thousands.[6]

Many other things have to be taken into account to see this operation as a revolution. Examples of these are the production and cost figures of the Model T Ford.

Year	Price	Production
1909 - 10	$950	18,664 cars
1910 - 11	780	34,528 cars
1911 - 12	690	78,440 cars
1912 - 13	600	168,220 cars
1913 - 14	550	248,307 cars
1914 - 15	490	308,213 cars
1915 - 16	440	533,921 cars
1916 - 17	360	785,432 cars
1917 - 18	450	706,584 cars
1918 - 19	525	533,706 cars

(The above two years were war years and the factory was in war work)

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[6]Charles F. Kettering and Allen Orth, American Battle for Abundance (Detroit: General Motors, 1955), p. 67.

Year	Price	Production
1919 - 20	$575 - $440	996,660 cars
1920 - 21	440 - 355	1,250,000 cars[7]

By 1924, the price had dropped to $290.00.

> The great revolution of modern times, the only one that has essentially changed the forms of society, was carried out, not by Russia, but by America, without fanfare, quietly, patiently, and laboriously, as a field is plowed furrow by furrow. I consider 1914 a momentous year in history, but not because it evokes the tocsin and the war. For me, 1914 will always be the year in which Henry Ford, by establishing the eight-hour day and more than doubling wages at one stroke, finally freed the worker from "proletarian" servitude and lifted him above the "minimum subsistence wage" in which Capitalism had thought to imprison him.[8]

And so Henry Ford had used his workers as customers, had raised their wages, and reduced the price of his car so that everyone could buy. The more he reduced the price, the more people could afford to buy one and so, the more he would sell. All of the time he was attempting to cut corners, reduce inefficiency, buy up new plants for production, and plow profits back into the expansion of the company. He made his product, the automobile, not a toy for the rich but a workhorse of the masses. As such, he set a pattern that people have tried to emulate ever since.

There are other people, other events in this era that have improved on Ford's processes. When the second World War demanded supplies and equipment not only to feed, clothe, and

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[7]Henry Ford, My Life and Work (Garden City: Doubleday, Page and Co., 1923), p. 145.

[8]R. L. Bruckberger, Image of America (New York: Viking Press, 1959); pp. 196-7.

arm our Armies but the rest of the free world, America had the "know how" of engineers, designers, production men, managers, and workers to accomplish the job. Men like William Knudsen, Donald Nelson, Henry Krueger, and Charles Sorenson, were examples of men who could get things done. The reason was that America was "tooled up" for production; it was geared to go. It had the mass communications, the mass distribution and transportation, the skills of millions of people, the production techniques, and the trained managers to do the job.

> But World War II caused a dramatic change. The ending of wartime restrictions on raw materials, the redirection of an expanded industrial complex, the yearning of a product-starved public, fat with enforced savings, unleashed a tremendous buying spree which exhausted inventories faster than they could be amassed. The process of beating swords into plowshares produced an economic explosion fanned by the burgeoning plastics industry, the maturity of electronics, the growth of rocketry and a host of other factors. Coupled with this and arising perhaps from somewhat different causes, the cost of labor roared up out of the 30-cents-an-hour bracket that seems fantastic by comparison.[9]

Looking at the production techniques since the end of World War II, one is always drawn to the word "automation." Because of conditions described by Hawley above, the next step for manufacturing industries was to become more automatic. In order to reduce direct labor costs, and meet the increased demands for goods, the simple repetitive operations, the material handling, and inspection were areas that seemed

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[9]George Hawley, Automating the Manufacturing Process (New York: Reinhold Publishing Co., 1959), p. 2.

to most easily convert from people to machines.

Automation has been described in several ways: ". . . the latest type of assembly-line techniques,"[10] ". . . both automatic operation and the process of making things automatic,"[11] and ". . . rather an executive function, an administrative attitude, than any particular characteristic or machines."[12]

The history of automation goes back to Oliver Evans' continuous process flour mill in 1784, Watts' invention of the flyball governor for a steam engine in 1788, Joseph Jacquartds' punch card automatic loom in 1801, and automatic biscuit making by the British Navy in 1833. So, automation is not something entirely new and different. Many people have been living with it for years; for instance, the thermostatic control of furnaces. However, industry has dramatized it and developed it to a more complex form than before. The use of computers and memory machines, programmed tapes for repetitive machine operations, the continuous, integrated automatic completion of a series of operations, the electronic relays and transistors, and the use of the concept of feedback, are some of the technological advances necessary for industries to automate.

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[10]Carl Dreher, Automation (New York: W. W. Norton Co., 1957), p. 18.

[11]George Hawley, Automating the Manufacturing Process, p. 3.

[12]Ibid., p. 3.

There will continue to be improvements in the efficient use of human beings, and so the efficient production of goods. These improvements, as in the past, will be slow and irregular, developing spurts and leveling off, but the general direction will be toward more efficiency and a higher standard of living. Because of the increased rate of change, the psychological, moral, and social problems created by increased technological advances are magnified.

Mass production, then, combines mechanical techniques: precision, standardization, interchangeability, synchronization, and continuity with a social organization of workers headed by professional managers. Through specialization and integration all contribute a share toward the finished product, that, through mass communications and mass distribution can be brought and sold, to the public that is convinced it needs it.

Relationships of Mass Production to General Education

General education may be described as an effort to substitute a new unity for the fragments of knowledge into which the curriculum has disintegrated. It is that part of education which prepares youth to deal with the personal and social problems with which all men are confronted in a democratic society. It also develops each individual to his maximum, consistent with the general good, and prepares the student for a full and satisfying life as a person, as a member of a family, as a worker, and as a citizen.

Certainly there are many relationships and points of contact here between this definition and the concept of mass production developed in the previous section. Three approaches will be used to show different ways of looking at this relationship. The first will be based upon the Educational Policies Commission's Education and Economic Well-Being in American Democracy.

The next will be taken from Will French's Behavioral Goals of General Education in High School and the last will be a breakdown of subjects and the implications for developing the concept of mass production.

Educational Policies Commission

The Educational Policies Commission, appointed by the National Education Association, brought out a book in 1940 that attempted to link more closely the educational endeavors with the society that supported it. Two forces were at work that influenced this study. One was that education in America was feeling the brunt of the mass of students that were to be educated through the high schools. If all the children of all the people were to be educated, then something other than the traditional college preparatory curriculum would have to be devised. The other force was that this book, coming during and immediately after the depression of the 1930's, reflected the feeling on the part of many people that the way to prevent further economic catastrophies was to

more closely link education with the economic and productive systems of the country. These concepts of economics and production could not only be for those people destined for influential postions, but it was the Commission's position that as many members as possible in a society should understand these principles. And so these two forces met and combined into a study that is still important today.

The following statements are chapter headings and subtitles the Commission used to outline its proposals.

I. Education and Productivity in American Economy

A. Intelligence and efficiency of labor vitally affect economic production.

B. Educational opportunity encourages the worker to rise through personal effort.

C. General and specialized training increase the efficiency of labor.

D. Education increases productivity by promoting occupational mobility.

E. Health education has significant economic effects.

F. Educated man-power is a perishable resource.

G. The conservation of natural resources is important to production.

H. Education increases the economic possibilities of conservation.

I. Science and education significantly contribute to development capital.

J. Management is a crucial factor in modern economy.

K. Education contributes to effectiveness of management.

L. Education significantly affects all factors of production.

M. Statistical evidence indicates relation of education and productivity.

N. The cumulative influence of education is most important.

II. Kind of General Education for Economic Well-Being

A. Education should develop broad social intelligence on economic problems.

B. Education should aim at better understanding of industrial relations.

C. Development of cooperative attitudes tends to increase economic well-being.

D. Education should further raise the level of general mechanical competency.

E. Education should further encourage scientific competency.

F. The schools should give greater attention to the education of the consumer.

G. The educated consumer possesses high standards of value and taste.

H. Specific training in major areas of expenditure is essential.

I. There is need for better understanding of the significance of public expenditures.

J. Education is needed for wiser savings.

K. The educated consumer is sensitive to his social responsibilities.

III. Kind of Occupational Education for Economic Well-Being

A. Occupational education should be based on economic and vocational trends.

B. Manufacturing requires more skilled and semi-skilled than unskilled workers.

C. Many industrial jobs now require little formal vocational training.

D. The proportion of all workers possessing skill and technical knowledge is increasing.

E. Occupational education should take account of important social trends.

F. Facilities should be provided for presenting occupational obsolescence.[13]

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[13]Educational Policies Commission, Education and Economic Well-Being in American Democracy (Washington, D.C.: National Education Association, 1940).

The preceding outline is an analysis of one segment of our lives, economic well-being, and its relationship to education. This is not another course, or a text book, but an attempt to coordinate the activities of the school with problems that are facing our society, and the individuals within it. This relationship can be achieved in almost all of the traditional courses that go to make up the curriculum of the contemporary school. Each subject needs to take steps to incorporate the appropriate content from the suggested list into their course offerings so that this area of concern does not get lost and neglected because there is not a course entitled, "Economics and Production."

Will French and Associates

The next method used to show some of the relationships between mass production and general education is within the framework proposed in the book, Behavioral Goals of General Education in High School, published in 1957. This book is the result of interest in an earlier work under similar sponsorship, Elementary School Objectives, and also a need for a comprehensive work on the high school level that could give some direction and help to educators and laymen. This study was undertaken under the joint sponsorship of the Russell Sage Foundation, the National Association of Secondary School Principals, and the Educational Testing Service. The executive editor, Dr. Will French, organized three main

committees to assist in the development of this study. The Committee of Consultants, made up of leading educators, developed lists of behavioral outcomes under three areas of living; growth toward self-realization, growth toward desirable interpersonal relations in small groups, and growth toward effective membership or leadership in large organizations. The Committee of Advisors, composed of interested citizens, advised the consultants in light of public needs. The Committee of Reviewers, made up of teachers, administrators, psychologists, and curriculum specialists, examined the behavioral outcomes as proposed by the consultants with the needs of the learner constantly in mind.

The following are some of the behavioral outcomes that these people proposed as being important for educators to consider in developing appropriate curriculum materials or in evaluating a school.[14]

I. Growing toward Self-Realization

1. Reads and interprets the graphs, charts, tables, road and other maps encountered in newspapers, magazines, and other printed matter.
2. Takes increasing pride in his workmanship.
3. Recognizes mathematics as a way of thinking and speaking about quantities, measures, amounts, sizes, and quantitative relationships.

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[14]These are taken from Will French, Behavioral Goals of General Education in High School. These are scattered through pp. 92-213.

4. Achieves a considerable degree of skill in one or in a few activities and seeks to become more adept in them.
5. Respects and uses with understanding the scientific method for discovering solutions to problems.
6. Shows at least a general understanding of contemporary American society, the heritage which it carries, the historical roots of this heritage, and the major unsolved social problems with which it is confronted.
7. Understands some of the principle differences between our economic system and the economic systems of other nations.
8. Has some understanding of the materials, processes, tools, and the principle classes of manufactured products in our industrial world.
9. Visits industries and laboratories to see science in action and to find answers to his questions.
10. Shows growing ability to select the things he buys for their beauty as well as their usefulness.
11. Appreciates good workmanship and design in commercial products.
12. Knows and understands the purposes of and obeys safety laws, rules, and regulations which apply to his everyday life at home, at work, and at play.

13. Utilizes many resources for gaining some first-hand information about the vocations in which he might be interested: observation of workers, visits to factories, conferences with counselors, teachers, reading, tests, films, etc.
14. Has formulated some criteria for a choice of an occupation, taking into account earnings, prestige, intrinsic interest, service, security, fringe benefits, promotional opportunities, safety, health factors, etc.
15. Is learning to estimate details of a job, to use the basic tools and equipment, to plan how the work should be done, and to be responsible for the quality of his own work if his choice of vocation requires these abilities.
16. Is growing in his appreciation of the importance of ethical principles in vocational relationships.
17. Accepts the idea that work is a central function of human life.
18. Develops a code of business ethics which includes a fair price, honest product, fair standards of working conditions, and fair hours of labor.
19. Understands the simple economic facts of consumer economics; e.g., the factor of supply and demand, markups and discounts, charge accounts,

consumers' cooperatives, stocks and bonds, effects on economy of installment buying.

20. Acquires increasing knowledge of how to purchase and use goods and services intelligently, understanding both the values received by consumers and the economic consequences of their acts.
21. Recognized what has happened to major economic areas (agriculture, industry, etc.) because of advances in technology and research.
22. Appreciate to some extent the relations between population, resources, technology, stable employment, trained manpower, national peace, free labor, and economic prosperity.
23. Appreciates the need for new markets abroad, new products, new local demands, more earnings widely distributed to increase production; and the necessity for allowing foreign products to be sold in this country.
24. Is familiar in general with the productive and distributive system for goods and services.
25. Studies current problems of production, consumption and distribution of natural resources as a way of becoming more intelligently participative in the work-life of the world.

II. Growing in Ability to Maintain Desirable Small (Face-To-Face) Group Relationships

1. Works cooperatively with other members of the groups which he belongs and strives for good human relations in the group.
2. Respects the rights and decisions of others in group work.
3. Uses properly and keeps in good order the tools and equipment shared by a class or other group to which he belongs.
4. Is prompt, cooperative, and generally compliant in carrying out reasonable instructions on a job.
5. Is reliable in doing a job even when unsupervised. Does not merely make a pretense of working.
6. Feels responsible for giving a good day's work for a day's pay.
7. Has an attitude of responsibility toward his work which others in the group can count on.
8. Has learned how to make a report of his work-results with clarity and simplicity.
9. Is learning how to give criticism directly to people pleasantly and in terms they understand and accept.
10. Knows why labor has the right to organize and bargain collectively and favors it.

III. Growing in Ability to Maintain the Relationships Imposed by Membership in Large Organizations

1. Appreciates the struggles, sacrifices, and achievements of the courageous and freedom-loving people who made our nation possible and built it into the great nation it is today.
2. Recognizes that differences in geographic environment and/or methods of production account for differences in levels of living in different times and places; e.g., in the United States today versus the United States circa 1850, in the United States today versus Egypt today.
3. Appreciates the achievements of science and technology in discovering new sources for the materials we are already using, in finding new and more efficient ways of extracting resources from known deposits, in finding uses for materials known but not usable, and in discovering and creating new resources.
4. Is able to discuss some of the principal issues of organization, management, and control of production, distribution, and consumption of goods and services in a technical age.
5. Studies the changes that the past fifty years have shown in the nature of consumer goods and in manufacturing, and in the nature of employment.

6. Appreciates something of the impact of unemployment and overproduction on economic conditions.
7. Recognizes the advantages to the public of big business, such as efficiency of mass production methods, technological progress through research, patent laws, control of raw material supplies, and advantages inherent in volume of purchase and sales.
8. Has visited, or read about, and so understands something of the operations of a large industrial organization, and of a large labor organization.

These, then, are some of the behavioral outcomes proposed for general education in the high school that would seem to overlap objectives for understanding the development, techniques, and implications of mass production. No one course or unit would hope to cover but a few of the behaviors listed, but if these are deemed important behaviors for citizens to manifest, then somewhere during their high school years students should be exposed to experiences that would help to bring about these behaviors.

Subject Areas

The third framework that will be explored will be to take a number of separate subjects and see how each one may contribute to an awareness on the part of the student of concepts involved in mass production. The relationships

indicated will usually be gross and obvious ones, but will serve to draw some lines between individual subjects that usually are associated with general education, and knowledge, skills and understanding that contribute to the area of mass production.

Agriculture

Here the students can recognize what has happened to a major employment area because of advances in technology and research. They also work with materials and tools and study an industry for its structure, economics, and techniques.

Art

The ability to select products for beauty as well as usefulness and to possess high standards of value and taste in consumer products is certainly one of the main objectives of the area of art. This also contributes toward the student's understanding and improvement of our modern technology. The combining of an esthetically useful product with one that can be successfully produced and marketed is certainly a challenge for art educators to meet, and one that involves essential elements of both mass production and general education.

Business Education

The business and economic facets of American life are certainly becoming more complex. Developing the simple economic facts of supply and demand, charge accounts, stocks

and bonds, and installment buying all are necessary to an understanding of our economy. Developing a code of business ethics is much more difficult, but one that business education cannot ignore.

English

The ability to effectively communicate, both in writing and speaking, is an important requisite for any job, but all the more so in a beaurocratically organized industrial system. The dependency of different parts of a mass production system to all the other parts is predicated upon the assumption that each part will know what, when, and how the other parts operate. This is done mostly by people writing and reading, talking and listening. How effective the people do this will to a great extent determine how effective the system operates.

Foreign Language

This is an area that has gained in importance and popularity in the last few years. The study of a foreign language can help students understand the varying economic and social conditions in different parts of the world, and so to see America in a perspective that would otherwise be impossible.

Homemaking

This area has always concerned itself with consumer values. The process by which a choice is made and information

and techniques to support this choice is an important area of living in a land where the people are continually being presented with conflicting claims, high pressure sales, and the ease of installment buying. Intelligent consumption is one of the most important brakes on our economy, for it weeds out unnecessary and incompetent products, to make room for a better designed and constructed product.

Mathematics

To be able to think about quantitive relationships and to read and interpret graphs and charts are skills that are important for the understanding and participation in our technological society. Because so much of our life revolves around mathematics, the understanding of these concepts are a vital part of an intelligent workman.

Physical Education

This area offers the possibility of producing experiences for students to develop cooperative attitudes. This is an attitude that is necessary for the successful integration and continuity in a work force. There is a need for cooperation on all levels, and this can never be just left to chance, it has to be taught somewhere, and in physical education, there are situations where this is possible.

Physical Sciences

The importance of the scientific method, broadly conceived, to the rise of our technology is of inestimable value,

so this relationship should be known and understood. This is true not only for the understanding of the causes of our present position, but also to develop the techniques to keep it moving forward.

Social Studies

If one is to understand and effectively live in an industrialized society then the knowledge of their contemporary society, its historical roots, unsolved problems created by industrialization, and a sensitivity to social responsibilities are essential areas of concern. These also happen to be important segments of content in the social studies curricula in most American high schools.

Trade and Industrial Education

There may be some difference of opinion as to the status of trade and industrial education as a part of general education, but as it contributes to raising the level of general mechanical competencies of students and allows them to achieve a degree of skill in an activity, then it is contributing to general education and so to the concept of mass production. The industrial materials, tools, and setting that the laboratories provide cannot be discounted as having an influence in this direction.

A complex industrialized society demands many talents, knowledge, and understandings from its citizens. The industrial aspect that produces products by what is called mass

production is an integral part of such a system. General education is society's attempt to inculcate all of its members with some common learnings as well as individual skills. Education has the responsibility of acknowledging such an important concept as mass production. There are many ways this can be accomplished and some of these have been explored in this section. How it is accomplished is not important, but whether it is or not becomes increasingly crucial. This is not something that can be left to chance, something that will rub off or that students can pick up somewhere. The implications of increased industrialization or automation are apparent to everyone who has looked at the present situation, so that an intelligent mass of citizens will be necessary if Big Government, Big Business, Big Labor, or Big Something suggests answers or alternative solutions that will need to be acted upon.

There is ample evidence to support a very dynamic and crucial relationship between mass production and general education. The next section will suggest how one subject matter area, industrial arts, can address itself and contribute to the solution of this problem: how to create a more informed and more intelligent citizen in one aspect of the industrial democracy within which he lives, the implications of mass production.

Mass Production in Industrial Arts

Previously a connection between mass production and general education was established. The question now is, "What contribution can industrial arts make to this endeavor?"

Dr. George Keane, after studying this question, says:

> Participation in mass production activities and the study of their influences on our arts and social institutions is suggested as content of general education, and it is also advocated as method for achieving goals in citizenship, vocational adjustment, learning tools, and ethical development. Production is suggested as a curriculum tool, helping to integrate through experience a variety of activities and knowledge, particularly in the secondary schools.[15]

It is difficult to separate content and method when talking about mass production for it is at the same time a method of teaching content. A teacher cannot teach mass production techniques and concepts most effectively by using individual projects as the method of instruction. The individual project method does not lend itself to the content of mass production. Then how is it to be organized? In a previous section the unit method of teaching was deemed appropriate to teaching industrial arts; a resource unit follows which provides some examples of how a unit on mass production might be taught.

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[15]George Keane, Understanding Industry Through Production - A Project in General Education (New York: Columbia University, 1956), p. 2.

Resource Unit on Mass Production in Industrial Arts

I. Overview

The purpose of this unit is to provide experiences for students to better understand the techniques, place, and purpose of mass production in our society. This is increasingly becoming important because of the highly complex nature of our technology, the isolation of young people from the world of work, and the necessity for intelligent citizens and workers to participate in the maintenance and development of our industrial democracy.

Industrial arts is uniquely equipped to handle and carry on this kind of learning experience. The media that are ordinarily dealt with are industrial materials, and most of the physical facilities are adequate for the job. The teachers generally have the basic skills and knowledge upon which to build an understanding of the importance and organization of this kind of a unit.

The scope of the unit is limited only by the implications of our technology. It generally includes the designing and engineering of a product, tooling up to produce it, the production of a number of items on an assembly line basis, and the distribution of the item. This sequence provides an enormous number of learning experiences and situations where significant learning can take place.

II. Objectives

The following list is merely illustrative, to give some ideas as to the direction this unit could go. Objectives should not be chosen because they are the easiest or most convenient, but should fit into the general objectives of industrial arts in the school system. These should be selected because of the needs of students and of society. The objectives that are selected will determine the direction of the unit, as decisions will have to be made in terms of the objectives in order to remain consistent and to continue in the general direction that has been decided. The intelligent choice of objectives cannot be too strongly recommended.

A. Attitudes

1. Works cooperatively with other members of the group to which he belongs.
2. Seeks out new information in order to better understand the interworkings of industry and its relationship to our society.
3. Develops a group spirit and loyalty.
4. Assumes and discharges leadership responsibilities.
5. Accepts assignments and responsibilities from leaders within the group.

B. Appreciations

1. Appreciates good workmanship and design in commercial products.

2. Appreciates the achievement of science and technology in discovering new sources of materials, and in finding new uses for materials.
3. Appreciates the skills involved, and the occupations necessary to successfully design, produce, and distribute a product.
4. Appreciates the importance of each person in an industrial organization, and the necessity for each to do a quality job.

C. Skills

1. Achieves a considerable degree of skill in one or more activities and seeks to become more adept in them.
2. Is able to use the methods of science in solving problems.
3. Is able to design a product that could be successfully mass produced.

D. Understandings

1. Shows at least a general understanding of contemporary American industrial society, the historical roots of this heritage, and some problems it creates.
2. Has some understanding of the materials, processes, and tools used in manufactured products in our industrial world.

3. Is able to discuss some of the principle issues of organization, management, and control of production, distribution, and consumption of goods and services in a technical age.
4. Understands the process by which a product has to be designed, engineered, tooled up, and produced in order to be mass produced and mass consumed.

III. Developmental Sequences

A. Introducing the Unit

Generally, the introductory phase is used to relate the theme of the unit into the lives of the students, so that it will have meaning for them. This cannot be accomplished by the teacher telling the students to "go ahead and do it, you will need this some day." It is a difficult assignment to integrate into the lives of junior-senior high school students information, ideas, and concepts that are meaningful to the student, yet something adults have decided is necessary to know or understand. Without rapport much of what both teachers and students do is wasted effort. The introduction should not be slighted or taken for granted, but must be preplanned and organized if any further results are to

be expected. The following might strive to stimulate interest initially:

1. Speaker from industry, labor and/or management
2. Film on productivity, technology, or mass production.
3. Field trips to an industry
4. Reference to books, magazine articles, and free materials
5. Lecture, discussion by teacher and students
6. Teacher outlines why this is important
7. Student reports on implications of science, economic system, how products are produced, etc.

B. Planning

By this time some general questions should be answered and the general direction of the unit outlined. The planning stage, as opposed to the production phase, will usually take somewhat longer than students normally expect, but the engineering and organization phase is part of what they should learn about mass production. This phase should be discussed so that they are constantly aware of what stage they are in and why it is necessary to perform these operations. Some of the questions might be:

1. About how long will this unit last?
2. What are the objectives for this unit?
3. What will be some of the activities involved?

4. How will the students get started?
5. What will be the role of the teacher?
6. How is the product to be distributed?
7. How are materials to be purchased?

C. Organizing for Production

No matter what kind of a product is made, or how it is produced, some sort of an organization will be necessary. The organization can take shape through one or a combination of these?

1. Teacher assign stations and responsibilities
2. Teacher chooses top management officials and works with them in making other assignments.
3. Students vote on top management, then each of those elected officials designates his choice of men to work with.
4. Students choose job and present their qualifications for the position to a committee, which then select an appropriate student for each job.

The organizational chart that results should evolve from the job that is to be done and the people who are available to do it. For instance, if the product is to be used in the school, then no sales force is needed. If the parts need close tolerances, then more inspectors will have to be provided. No one standard form can be devised to accommodate the many different situations that could develop. The degree of specialization that

is built into the personnel organization will depend upon the complexity of the product plus the age level and abilities of the students. Generally, the working force should be kept flexible because certain segments of the production procedure demand more workers for a short period of time. A student may be a foreman in the engineering phase and a worker during the finishing operations.

D. Creating the Idea

The idea or the product may come from a number of different sources in several different ways.

1. The teacher shows the class what they are to make.
2. Committees are formed to make recommendations as to possible projects for a specific segment of the population.
3. Each individual in the class submits a plan of a project and the group votes on one, or management officials may choose one.
4. The teacher may suggest several alternatives, students submit designs, prototypes are made, and one of them picked.
5. Ideas may come from a magazine, another person, or a commercial product.
6. The product may be something that the class can make for the school or give away at Christmas to an orphanage or children's home.

E. Designing and Proving Prototype

After a product is chosen a model is made, either full size or to scale, to look as much like the final version as possible. Also included would be an introduction to customer research and cost accounting. Feasibility of production should also be taken into consideration. Several prototypes of different ideas may be made and presented to the whole class for consideration. These may be different versions of the same idea with judges selecting the most appropriate. Small groups of students could work on different models so that the time can be shortened and more students get some experiences in model making. These groups may be working simultaneously and one model selected after all have been presented. The manpower usually available in a class would not justify tooling up for more than one product at a time. By this time, however, there should be enough jobs to keep almost everyone busy on the one product.

F. Tooling up for Production

A small group may be responsible for developing the jigs for production or one person may be in charge and then bring in other workers as they are needed. Whichever way it is done, the product must be broken down into its component pieces and each operation analyzed as to how it may best be done with the facilities and workers that are available. Those responsible for tooling must work with those responsible for materials, training programs,

and quality control. If changes have to be made, they will have to consult with the designers. Tooling is one of the most important phases, one that can contribute heavily to the realization of many of the objectives. Students will have to be reminded that each operation, although small and simple by itself, must be repeated many times, and that parts cannot be hand fitted, but must be accurate the first time. This is a difficult concept to understand for students will have been accustomed to the "one of a kind" techniques.

G. Materials and Timing

The students in this area must have the right material at the right place at the right time. They will have to work with those responsible for costs, jigs, and fixtures. The materials may be purchased by the class from money raised from the sale of stocks or the school may be used as a credit source. The teacher may provide some clues as to where material may be purchased or students could make recommendations. A layout of the shop should be made to show where tools, benches, and stations are, as well as the flow of material from start to finish.

H. Records, Publicity, and Sales

About this time a record system and sales must be considered. Record forms can be designed and kept by a business class in the school or by students within the industrial arts class. Records may be kept of hours put

in by various class members on various jobs, of number of pieces produced in an hour or a day, number of rejects, time of certain operations, number sold, amount of money received, amount of money paid out, probable profit, progress of individuals or groups toward their goal, as well as employee suggestions.

As soon as the prototype is approved for production, publicity should start. There may be two forms of publicity--that publicizing the mass production unit itself and that promoting the sale of the product. The school and local papers are usually a good outlet. Pictures may be taken to add to the effectiveness of the article. If the product is to be sold, local stores may cooperate by buying some wholesale, or by putting posters or models in their window. The administration, school board, other teachers, parents, or other classes may be invited to watch the dramatic final assembly. Complimentary gifts may be presented to appropriate people at a school function. If products are to be given away or are being made for the school, some simple ceremony should be used and perhaps recorded on film.

If there is to be a sales force, it should start early with its customer research to determine how many may be sold. The number produced should not solely be determined by sales potential since it must be remembered that this is an educational experience, profit being secondary. When the educational application has been

utilized, production should stop regardless of the amount of orders. A tentative production figure should be adopted early in the experience so that those responsible for ordering the materials will be able to judge needed quantities.

I. Training Program

Training personnel will have to work with everyone. These are the middlemen, getting from the people who are implementing the idea what needs to be done, and then training the skilled workers who can do the job correctly. Some of the jobs will be quite simple and almost self-explanatory, but most workers will need some orientation as to what they are to do, what has happened to the product, and where it goes after it leaves them. To the training people goes much of the responsibility for the morale of the group, for if sloppy work continues or if the workers fail to understand their importance, then there will only be an aggregation of people doing different jobs together and not a true working group. There may be a need for a training program to train foremen and supervisors. Drawings and directions may have to be made for individual jobs so that if people move from one job to another, the next person can fit in without extensive re-training.

J. Duplication of Parts

Parts may be made first and stockpiled for the final assembly or they may be made up in sub-assemblies as they

are produced. The facilities available and the design of the product will dictate which method is most feasible. Sometimes it may take weeks of work to get to this point, with everyone contributing something toward its success or failure. If the parts are being made separately, these will start to accumulate and provision must be made to keep a record of the number produced as well as a place of storage. Boxes or bags may be used so that they are all together for the next operation. Sometimes the operator of the machine or tool will check the quality of the piece after his operation to be sent either along the assembly line or put in a reject or reclaim pile. Sometimes every piece is checked and other times only a sample of the total. If the organization is large enough, special workers may be used to check on the quality of the product.

K. Final Assembly

As has been indicated before, the final assembly may be an extension of duplicating the parts or it may come as a separate operation. The problem of storage and handling of parts is reduced if it is all in one sequence, but sometimes this is not possible. The final assembly should be broken down into as many operations as possible. Every person should be busy during this time. If everyone works, the pieces go together faster and come off the line faster, which makes for a very dramatic event.

In one hour's time, weeks of working and planning may be culminated. As the workers get more adept at their operation, a real group spirit may be manifested that would be almost impossible to achieve in any other way. If everyone has done a good job, then the line will run smoothly, but preparations must be made for a few difficulties by having a few trouble shooters available. A problem sometimes arises as to how much or how many interruptions can be made during this time. Consideration must again be given to objectives so that if one of them is to have the students get the feel of a repetitive operation and develop a skill in it then there must be some uninterrupted time when this can take place. However, attention may be called to certain practices or procedures that, because of the immediacy of the action, should be commented on at this time.

L. Finishing, Packaging, and Distribution

Many times the finishing cannot be integrated into the final assembly. Care must be taken that this phase is not delayed, for by this time the enthusiasm of the students will usually be less than before. They may feel that the final assembly has finished the job, but there are always some loose ends that need to be secured. If the packaging and distribution can be so organized and integrated that they both can be accomplished at the time of the final assembly, it would be best. Packaging

and distribution may take as much planning and thought as the assembly operations.

IV. Evaluation

Nowhere is it more true than in this unit that the evaluation should be an integral part of the instructional program. There are many techniques which can be used, but they must be in terms of the objective.

It must be recognized that there will be some behavior, especially thought patterns, feelings, and attitudes, that will either be very difficult or else impossible to measure at the time of the mass production unit. Some of these may be measured after a period of time, but for some objectives it will be beyond the capabilities of the typical public school industrial arts teacher. However, the difficulty of measurement does not relieve the teacher of the responsibility of attempting to teach for a particular objective. A realistic attitude may be to separate the behavior changes into those that are to be measured and those that are not to be measured. The teacher should work toward a gradual reduction of the latter list, not by dropping ones from consideration, but by a more comprehensive evaluation program.

Since the resource unit is to give some ideas of possible alternatives, these will not be specifically directed toward any one objective.

1. The customers may rate the product as to design and craftsmanship.
2. The workers may evaluate the person to whom they were responsible as to his clarity, honesty, and helpfulness.
3. The students with management functions may rate their workers as to dependability, resourcefulness, and accuracy.
4. Workers may rate other workers as to cooperation, enthusiasm and dependability. These may go all the way up the line so that everyone, except the top person, is rated by people organizationally above, below, and across from him.
5. Tests may be constructed for the teacher to determine what concepts and generalizations the students have developed. A pre-test may be given or a control group may be used so as to check for improvement.
6. Oral or written reports may be given by individuals, setting down their reactions to the unit, what they learned, and how it could have been improved.
7. Other teachers and administrators may be alerted to listen for comments students in the class may make about this unit.
8. Parents may be asked whether they have any reaction to the product or the learning involved.
9. The teacher should have observational data on student behavior that he has recorded so that this can

contribute to the total evaluation.

10. Discussions may be held periodically, as well as at the conclusion of the unit, so that problems can be identified and people's evaluation made as to certain elements in the production.

Several of these techniques demand that data be collected and evaluations made as the unit progresses, since it is too late after the product is finished. Evaluation procedures must be provided for during the time of instruction, and many of them can be determined immediately after objectives have been selected. Only in this way can an effective program of evaluation be carried out so that the information received helps to improve the next learning situation.

Making a mass produced project in industrial arts should not be considered a fad, a frill, or a passing whim of some teachers, but rather it is the realization that objectives commit a teacher to certain courses of action. It is also apparent that the individual take-home project is not comprehensive enough to provide the experiences necessary to realize important objectives. If industrial arts is delegated the responsibility of acquainting students with the tools, materials, processes, and implications of modern industry, what better way is there than to have students experience a simplified sequence of what happens in an industrial situation from the conception of an idea to the closing of the books.

> Probably the most important curriculum implication for industrial arts is the possibility which methods of this kind have for raising its intellectual and aesthetic quality. Much of the emphasis in industrial arts is in the making, not in the whys. Children should enjoy expressing themselves with tools and materials; knowing about them is valid in itself. However, if the project method is closely adhered to, students experience only a progression of things to make with some related information thrown in. The technical, sociological, and economic concepts of industry cannot be taught or experienced through the individual project to any degree.[15]

Here is one area where industrial arts can exploit its uniqueness, for the students will not just talk about industrial operations, but will actually perform them; they will not only read about the monotony of the assembly line for they will experience it; they will not just look at materials, but will work with them; they will not make sketches and drawings to be handed to the teacher, for their drawings will be for the purpose of communicating with fellow workers.

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[15] Ibid., pp. 277-8.

CHAPTER IV

SOME EDUCATIONAL EXPERIENCES IN MASS PRODUCTION

Description of Selected Mass Production Experiences

As explained in the Introduction, 11 teachers volunteered to teach a unit on mass production. The writer acted as a resource person and observer, allowing the teachers to decide how to organize and teach each unit. The writer evaluated for some student behavior changes and also secured opinions from students and teachers who participated.

Following are descriptions of the 11 units on mass production that were organized and taught by selected public school teachers. This will be organized by describing each of the 11 situations separately under the following headings: teacher's objectives, both before and after the teaching of the unit, organizing for production, production, and related activities. There will then be a summary, or a review, of these 11 units. Information contained in the descriptive portion of this chapter was obtained from personal observations, conversations with teachers and students, and the teachers' responses to questions asked on the teacher reply form and teacher opinionnaire (Appendix III and Appendix VC).

The next part of Chapter IV will be devoted to an evaluation of each unit.

Situation 1

Teacher's Objectives

Before:

> It could have special value in giving students a better understanding of modern industry. Besides desiring the personal experience, I believe it would enrich our program, and add variety and interest for the student. We need more varied activities, especially those involving group cooperation. Many of our students will go into mass production types of work.

After:

> First of all it fitted nicely with our objective in advanced class, "to learn more about modern industry." Also, from my own experience and recent observation, I decided that it was one of the few shop projects that can accomplish several objectives at the same time. We concentrated on the historical and technical aspects of mass production. I wanted them to learn what it was, how it could be set up and carried out, and why it should be appreciated.

Organizing for Production

The teacher had indicated to the class earlier that several new and different things were going to be tried out during the course. As some of the other activities of the class were coming to a close, the teacher announced that the next few weeks would be devoted to exploring industry and a project using principles of mass production. The film, Productivity: Key to Plenty, was shown to the class and used as a basis for discussion the next day. Some reading assignments were given from the Ford Motor Company booklet,

The Evolution of Mass Production. The teacher outlined for the class the general objectives of the unit and some of the ways they could be accomplished. During the next few days the class suggested possible projects that could be produced. The three students who showed the most interest and aptitude were selected by the teacher for the positions of president, engineer, and production manager. The teacher acted as the stockholder, and worked with these three students most of the time. The other students were the workers and were responsible to one of the three officers. When the students were not actively engaged in mass production activities they were free to work on individual projects they had started previously. A field trip was then taken to a local manufacturing plant producing parts for automobiles. The next day the trip was discussed by the class and, in light of what had been learned, a decision was made as to the project to produce. So far, these activities had taken about eight periods to accomplish.

The item that was selected by the class was a wooden box, 15 inches long, 6 inches wide, and 8 inches high, which could be used for general storage or carrying small items. A model was made by the engineer and some of the workers. When this was about completed, there was a demonstration by the teacher as to the use of jigs and fixtures. The next day there was a class discussion on the historical background of mass production. After this many things had to be done and everyone was involved. Jigs and fixtures had to be made and

tested, flow charts were drawn of the assembly line and drawings of individual pieces were made. The students had reported the buying response they had received and a production goal of fifty boxes was set, the profits to go to a charity fund. By this time fourteen more class periods had elapsed.

Production

Some of the pieces were pre-cut and stockpiled. Three trial runs were made before enough of the difficulties were eliminated so that production could proceed smoothly. The production of 51 boxes took three periods with several more periods after that being used for touching up and finishing. Workers generally stayed with one job throughout the production run and there were few interruptions once they had started. The distribution of the items was as follows:

18 - wholesaled through local stores
20 - sold by class members to individuals
8 - kept in industrial arts laboratory
5 - used as complimentary gifts
51 - total production

There was a profit of about $3.00.

Related Activities

In the area of public relations, the president talked to a reporter from the local paper and the following article was printed in the paper about their activities:

> The industrial arts class of the _____ high school are promoting a mass production project to enable them to learn about modern industry and gain experience in solving production problems. They have formed a company with their teacher, Mr. _____, as stockholder. The name Handy Carrier Company has been chosen by the two seniors and nine sophomores forming the company. Officers elected are . . . The plan is to get first hand experience in assembly work. Tentative plans are to sell the project to the public.

A sample box and poster was placed in a local gas station and a hardware store for advertising purposes. One of the boxes was given to the Superintendent of Schools, the high school principal, the industrial arts teacher, the newspaper reporter, and the writer. The president of the company set up a record keeping system with the aid of the school's Business Education teacher. The materials were purchased through the school and that amount paid back through money collected from the sale of the item.

Situation 2

Teacher's Objectives

Before: 1. "Acquaint students with industrial processes."

2. "Make students consumer-wise."

3. "It would be a vocational guidance activity."

After: "There are lots of cogs in the mass production wheel--the line worker is a small one. He also has a boring job. I'm not too sure I had additional objectives in mind."

Organizing for Production

The teacher presented the assignment of a mass production project to the class during their six weeks of machine woodworking. The project selected by the teacher was a small drawing board and equipment. This was something the teacher thought was necessary for the students to have, but as yet could not get the school to purchase them. The teacher had a commercially made model and the students used this as a pattern. Three students volunteered to form an executive committee to plan the activities, with one of the three resigning at a later date. The remaining two students made most of the decisions and did most of the work prior to the assembly operations. The remainder of the class worked on individual projects they had started previously. The materials used were either available in the laboratory or else were purchased through the school. As the completed projects were to be left at the school, no sales or distribution was necessary. The two students had worked on the pre-production phase for about four weeks.

Production

All of the parts for the drawing board were pre-cut by the two committee members. The assembly operation involved everyone in the class. The entire class was called together and the two committee members and the teacher demonstrated the assembly operations necessary for the completion of the drawing board. There was a short discussion here on the role

of the worker in industry. A combination of student choice and teacher appointments was used to assign students to the various jobs. Production was started the next day, and most of the class was involved for about six days, putting together and finishing the drawing boards. As the partially completed item came to each person, he decided whether he would complete his operation on it or put it in the reject pile to be reclaimed and sent through the line again. Production was stopped at one point for the teacher to point out some of the working conditions that were similar in their situation and in a manufacturing industry. Most of the 25 boards to be produced were completed. The pieces for the T-squares were cut out and an assembly jig was made, but they were not assembled. About half of the triangles were cut out but not finished. Interest in the mass production unit dropped off so all of the students continued on their individual projects they had started previously.

Related Activities

The two students on the executive committee gave a report to the class after production had been completed on some of the problems encountered in the pre-production stage of the unit. The teacher gave a short review of the unit in a faculty meeting. Finishing the T-squares and triangles will be the first assignment to next year's General Shop class.

Situation 3

Teacher's Objectives

Before: "As it regards our industrial society it should have a great deal to do with our objectives."

After: "Rudimentary economics and personnel structure of industry. A self association with individual manipulative requirements of line technique production."

Organizing for Production

The teacher had organized a previous class two years ago to make a number of toy tugboats for the Marine Corps Reserve Toys-For-Tots program. He thought this would again be a good project to undertake. About four weeks before Christmas vacation, the teacher drew up the plans and made a model of the toy tug. He explained to the class how they were to organize and produce the item. A steel strike was on at the time so this was discussed. Students brought in newspaper clippings about the strike and there was a discussion on the role of unions, management, and stockholders in an industrial organization.

The toy tug, which could be taken apart, was divided into four parts, one for each of the 7th grade classes. One class had the round parts, finishing, and packaging; another made the hull; another made the bow; and the third class made the cabin and pilot house. A foreman was appointed by the teacher for each class. The teacher acted as the general

superintendent and "hired" the students to produce this item, and then "paid" them on their report cards. Much of the responsibility for organization was left to the class foreman.

Production

The processes were broken down into small operations, since there were quite a few students available. The wooden stock started at one end of the laboratory, where the wood was kept, and worked its way to the other end. Few provisions were made for accurate duplication of parts. The teacher tried to work through the foreman in getting difficulties straightened out, and then have the foreman work with the workers. The pieces were inspected in the middle and at the end of the production line. The class responsible for packaging cut up cardboard boxes from a template and made an individual box for each toy. Forty-seven toys were finally completed and presented to a representative of the Marine Corps Reserve. Materials were generally already available at the school, but others that were needed were ordered through the school. No accurate accounting was kept as to the per cost unit. After about two weeks of intermittent production, the foremen took over, "fired" most of the workers and finished up the production themselves on an individual basis. The other students then went back to finishing up individual projects to be used for Christmas presents.

Related Activities

The school newspaper carried an article about the project, which included the following copy under a picture of several of the students working:

> Mass production methods are being taught in Mr. _____ wood shop. Each day is divided into four shifts, and there are four departments, each having a foreman as if it were a department in a regular factory. Each shift has a plant superintendent and the rest of the boys are responsible to him. Separate parts are manufactured on a line with each person doing a single operation. There is a superintendent for the tool and the stock rooms. There is a department for each part, for finishing, packaging, and for shipping. Delivery was made of an order recently to the Marine Corps Reserve Toys-For-Tots campaign.
>
> The boys are also learning about the business end of a factory or a corporation. They have sold shares of stock to imaginary buyers.

Just before production started, there was a Parent-Teacher Association open house. The industrial arts teacher talked to several of the parents explaining what was going to happen.

Situation 4

Teacher's Objectives

Before: Were not stated.

After: "To put more meaning into industrial arts. To add variety of activities. For students to learn 'advantages of mass production and appreciation of problems of industry.'"

Organizing for Production

The student teacher who was assigned to the teacher

was given the main responsibility for teaching this unit. The first day was devoted to a discussion on the importance of knowing about industry and production and some of the historical developments that have led up to modern processes and organizations. The class was then divided into four groups, each group to consider a project for different people: children, adults, students, and teachers. Each group then picked the best idea that was presented and made a model of it. These were explained to the whole class and voted on. The one that received the most votes was deemed too difficult by the teacher and student teacher so it was recommended that the second choice, a drawing board, be considered. A drawing board 24 inches by 15 inches with optional legs was then decided upon. Some of the material used in the item was surplus wood the teacher had collected from local sources. Other material was bought through the school and then refunded from money collected from the sale of the boards. A superintendent and three foremen were selected by the class, one each in charge of engineering, production, and sales. Jigs and templates, the flow of material, and the shop layout was decided upon and completed. The students worked on their own individual projects when they were not busy at their mass production responsibilities.

Production

A trial run pointed up the condition that the assembly was much faster than the parts production, so the assembly

was stopped until at least half of the parts were produced. The whole class participated in the assembly operation, but the lack of facilities reduced the smooth flow of production. One student was an inspector. He did not stay in one place, but floated around checking the accuracy of the parts at different places along the line. Most of the sales went to students and teachers in the school. Thirty completed drawing boards were produced.

Related Activities

A small advertisement was put in the school newspaper telling of the price and description of the article. The student teacher held a critique on the last day, discussing what had happened during the mass production unit.

Situation 5

Organizing for Production

One of the responsibilities of the industrial arts teacher in this school was to make the laboratory facilities available three times a week to a special education class for mentally retarded students. In talking with the industrial arts and special education teachers, they expressed the difficulty of finding suitable projects or things to do for this class of retarded children. It was evident that neither teacher had both the time and ability to organize and carry out a mass production unit, so the writer volunteered to organize something on an assembly line basis for the students to do.

The writer adapted a stool from an existing design to fit the requirements of the situation. Because of the distance from the school all of the preliminary work was done by the writer in the industrial arts laboratories at Michigan State University. Assembly jigs were made and templates used to reproduce parts. A trial run was made, using some of the members of a class the writer was teaching at the time. Arrangements were made as to when the writer would present this to the special education class.

At the start of the class period the writer introduced the coming activities, trying to tie this method of production to articles with which they were familiar. The work situation in an assembly plant, with simple repetitive operations being dominant, was explained and illustrated with the jigs and templates that had been developed to produce the stool. Adequate materials were available in the school for the number of projects to be produced. The writer then demonstrated each operation and completed a stool, using the methods the students were to use. As they were looking the tools and materials over, the special education teacher and the writer tried to assign students to jobs they would be best suited for. By this time the period was over and the announcement was made that they would start production tomorrow.

Production

The flow of materials through the different operations went quite quickly as the operations were broken down in small

enough units so that no student had to do very much with any one piece. Fifteen small pieces of paper were glued to each template that was used to cut out material so that a mark could be made on each one when a piece was completed. Even though some of the students could not count, there was still a check as to how many pieces were needed and how many completed. Since their manipulative skills were not highly developed, jigs and templates had to be used at almost every station so that the project would be assembled correctly. Nails and glue were used to hold the pieces together. It took about two periods to get the pieces cut out and assembled, and about five more periods to get the stools sanded and a coat of shellac on them. At first each student was to sand off all the rough edges of a stool and then take it to a girl who was applying the finish. It was found that their interest span was too short to go over the whole stool so another production line was organized so that each student only sanded one part; as a result the stools were sanded better and faster. Fifteen stools were produced, one each for the 12 members of the class and one to the school principal, the special education teacher, and the writer.

Related Activities

At the conclusion of production, the author talked to the class, briefly reviewing what they had done and thanking them for their cooperation. The special education teacher explained to the high school principal how the stool had been produced.

Situation 6

Teacher's Objectives

Before: "I feel a mass production unit fits in perfectly with the objectives of industrial arts."

After: "To introduce this phase of industry to my students in a practical manner."

Organizing for Production

The teacher presented the general outline of the unit to the class and they discussed some of the possibilities. It was decided that each class member was to present one idea as to a possible project that could be produced. The teacher presented a toy tractor, one that had been made in the unit he had participated in as a student teacher, as an illustration of what could be done. Some of the other class members also had ideas and a list was made of possibilities. The class voted on the one to produce and the highest number of votes was received by the toy tractor. This unit was introduced before Christmas, and many of the students indicated they could use or sell these as gifts. A plant manager was elected by the class. The teacher and plant manager then selected students to be responsible for engineering, production, and research. These, in turn, selected the remaining members of the class to work with them when they needed more help.

A prototype was constructed, the jigs made by the engineering group to duplicate parts and assemble it. Some

materials needed to be purchased, and these were secured through the school, being paid back by money received from their sales. Film strips were shown on A Car Is Born, from the Ford Motor Company, and there was a discussion on the contents of the booklets, American Battle for Abundance from General Motors and The Evolution of Mass Production from the Ford Motor Company.

Production

A continuous flow production line was organized, so that parts were cut out, assembled and finished on one continuous line. The facilities did not always lend themselves to this arrangement as some machines could not be moved so that the line sometimes became confused. There were also bottlenecks at various points because of the lack of available parts or a machine was not capable of more production. Finishing the tractor with enamel was a problem because of the lack of adequate facilities to paint or store the finished product.

Related Activities

There was a short article in the local newspaper telling of the activities of the class in carrying out this unit.

Situation 7

Teacher's Objectives

Before: "Teaches about industry and industrial processes - and group cooperation."

After: "Something about industry and how it operates, cooperation and distribution."

Organizing for Production

The teacher, two years before, had organized a limited form of an assembly line in producing a similar item and so the general framework was explained to the students on November 18th. Most of the students had read the booklets from Ford Motor Company and General Motors about mass production and these were discussed in class. The teacher had decided to duplicate the previous project: to have the classes make and sell Christmas wreaths. The students suggested possible alternatives for the design and production of the object. A production committee, selected by the teacher and the group, decided on the final design and arrangements. The production committee charted the work stations, made job assignments, and developed techniques to produce the wreaths. Materials needed were purchased from the Future Farmers of America treasury. Money from the sale of the wreaths was deposited to their account.

Production

Trees were cut down in the school wood lot and hauled

to the school by the students in the school's pick-up truck. Students took turns or volunteered to cut the trees down. The branches were cut off and the greens were wired to bent coat hangers. Decorations were applied and they were then taken to an outside shed for storage until students picked them up to sell them. This was all done in one continuous process, except for dipping the pine cones in paint. The two classes produced wreaths until December 11th and completed 170 of them. Both the industrial arts students and the Future Farmers of America members sold the wreaths. The money was to be used to buy needed tools and materials for the two departments. No accurate financial records were kept, but the industrial arts teacher spent $18.00 from the profits for materials that were needed in the industrial arts department.

Related Activities

An article in a local newspaper had a picture of the industrial arts teacher looking at completed wreaths, with the following text:

> Recently, the _____ industrial arts classes made a study of Mass Production. First, they looked at the History of the Industrial Revolution and saw movies about how things are made in mass production plants.
>
> The industrial arts classes decided to mass produce Christmas wreaths. The class formed a company and called themselves Christmas Wreaths, Ltd. Committees were formed to work on the many production problems and soon the company went into production. Many problems were encountered that lead to a good learning experience for all.

The greens were furnished from the Pine Forest, owned by the _____ chapter of the F.F.A. Wreaths are on sale from any of Mr. _____ shop students and from members of the F.F.A. The price is one dollar and the profits will be used by the F.F.A., and the industrial arts department to obtain materials and supplies that they otherwise wouldn't be able to purchase.

Situation 8

Teacher's Objectives

Before: "A mass production unit would fit in well with understanding industry better and attitudes of cooperation for my students."

After: "Some of the problems concerned with jigs and fixtures in a mass production job, and the feel of production terminology."

Organizing for Production

The teacher selected a project, a small steam engine, and presented it to the 12th grade mechanics class for their consideration. He had a commercial model to go by and had broken it down into its component parts. These parts he listed on the blackboard. Each student was to be responsible for making a number of these parts, with several students working on most of them. Each group was to develop its own jigs and produce them as best it could. Since these were 90-minute periods, students were to work on mass production about half of the period and their own projects the other half. Some of the groups produced some parts and there were

enough to assemble a prototype that ran on compressed air. However, interest lagged and so this unit was dropped by this class. The teacher then shifted it to a class of 11th grade metalworking and, using the same organization as before, called for volunteers to work on the production of the steam engine. Fifteen of the 27 students requested to help work on it. Materials were either available at the school or else purchased through the school and money credited to the industrial arts account from the sales.

Production

The original goal was 20 engines, but after the 11th grade class took it over only five students wanted one, so only five were completed. The individual parts were generally made on a mass production basis. Some of the groups working on the individual pieces became very interested in the production and developed efficient jigs and procedures for accurately duplicating parts. Others were made on an individual piece work basis. This went on for several weeks before all the groups had produced their allotted pieces. After all the individual parts were completed, they were put into separate boxes and an assembly line was organized to put them together. Most of the parts fitted accurately enough so that there were few rejects. The model steam engines were then tested and the new owners took them home.

Situation 9

Teacher's Objectives

Before: "One of my objectives is to give experiences that a student might use after he gets out of school. I believe a mass production project would do just that."

After: "I expected them to learn about some problems of industry and to get some idea of the tremendous amount of work and planning that goes into setting up a production line."

Organizing for Production

The teacher announced at the beginning of the eight-week period in metalworking that the next weeks would be taken up with a mass production experience. Ideas were gathered from the group as to how they could proceed and what some of the possibilities were of projects they could produce. Three students were elected to the Board of Directors, who had the responsibility of making policy decisions, picking a name for the company, and collecting ideas of possible projects. A metal box 12 inches long, 6 inches wide and 2 inches high was the choice of the group. Volunteers were called for to work on drawings, jigs, and design of the project. Orders for the boxes were taken by the students before production started and only enough boxes were produced to fill the existing orders. All of the students acted as salesmen. The booklets from Ford Motor Company and General

motors Corporation were also read by some. Much of the metal stock used was secured from government surplus materials, but the price was computed at the regular retail price for the material.

Production

Some of the pieces of material had to be cut out before the assembly started. All workers stayed at their original jobs except the spot welders. There seemed to be a necessity to change workers at this position because the production was slower there and pressure was being put on them to hurry. Two inspectors at different parts of the assembly line checked each part and rejects had to be done over again. Forty boxes were produced during this eight-week session. After they were produced, some of the customers wanted the boxes painted so this was done individually. As problems came up the teacher would stop the class and discuss the implications or possible solutions. In connection with the spot welders, they discussed that running a machine was not always glamorous, but got tiresome too. There was an attempt to impress upon them the need to save materials when quantities are involved.

Related Activities

The teacher discussed this unit with the principal and guidance counselor before starting it.

Situation 10

Teacher's Objectives

Before: None stated.

After: "I wanted the students to achieve an understanding of industry, its operation, and problems as well as learning how to work together and accept responsibility."

Organizing for Production

The teacher presented the project to the class. The ones who were interested in it could work on it, the others could remain with their individual projects. Seven of the 18 students in the class volunteered to work on the mass production project. They elected a foreman and he then appointed students to be in charge of machines, inspection, and assembly. The project was a religious cross of wood, with a metal overlay, 7 inches high and 4 inches wide. The students developed templates and jigs for production. It required five to eight days for the planning and a trial run. The teacher had a model of the cross so there was no engineering or designing to do. A small company in the town regularly donates scrap materials to the industrial arts department, so these materials were used to make the item.

Production

Individual pieces were cut out, then were sanded and assembled and, finally, they were finished and stored. The number of operations on this project were few and the

tolerances were not small, so it was not a complicated operation. Production continued for about eight days, getting about ten completed each day. Fifty-two were completed to be sold. They were sold for 35¢ each, with the money realized being donated to the Community Swimming Pool Fund. Two local stores had the project on display with a poster telling where the money was to be used.

Situation 11

Teacher's Objectives

Before: "I'm trying to have the students explore industry, etc."

After:

> The involvement of mass production; social relationships, importance of leadership, and followership, the organization of an industrial plant, value in working accurately, simplicity of the task when each person does just one part of the total process, and the value of standardization of parts and thorough planning.

Organizing for Production

The school had just changed to an I.B.M. card system for collecting and reporting data and each teacher had a card for each student in his class with which they took roll and marked absences. The cards were usually kept in envelopes, but the principal, in consultation with the industrial arts teacher, decided that something more permanent should be provided. The teacher presented the problem to this class and asked each one to present a design that

would hold the cards and also could be produced by the class. One was selected from the best three voted on by the class. There were class discussions as to the design of the container, methods of production, and appropriate materials to be used. During this time, the students had to write a report on some aspect of modern industry. The teacher also showed the film Body Beautiful from General Motors.

There was a three-man Board of Directors with other students being responsible for designing, making jigs, inspecting, layout, rough cutting, bending, notching, and assembly. Students, when not involved with their mass production activity, worked on individual projects. Two sizes of boxes were produced, one four-compartment box was 8 inches long, 3 inches wide, and 2 inches high; the other was slightly larger and had six compartments.

Production

This was a straight line production job with the sheet metal coming out of the storage area to be cut, notched, bent, partitions put in, spot welded, inspected, and stored. The students who made the jigs also acted as inspectors, but all others only had one job. It took about six weeks to fully complete the production. Since these were made for the school and all the material was available in the laboratory, no money or credit was needed. The final inspector took a completed box to each teacher in the building.

Related Activities

The teacher made up a bulletin board display in the hall of the school showing pictures, the personnel organization, and a description of the project. This unit was also explained at a Parent-Teachers Association meeting.

Review

To review the description of these 11 mass production units, it may be advantageous to draw them together into a statistical review.

The Setting

The size of the towns varied from 300 to about 100,000, with a median of 2,000. The total school population ranged from 550 to 24,000, with a median of 1,810 students per school system. The number of teachers in the school system with a low of 21 and a high of 916 had a median of 70. The years of teaching experience was spread from 1½ to 18 years with an average of 4½. Four of the teachers had no previous experience with teaching mass production, two had read about it, and the remaining five had been involved in such a unit, either in college or had taught it themselves. The grade level consisted of a special education class, one 7th grade, two 8th grades, four 9th grades, two 10th grades, and one 11th grade. The number in each class varied from 12 to 29 with an average of 18.8.

STATISTICAL SUMMARY OF SITUATIONS

	Size of Town	No. of Students in System	No. of Teachers in System	No. of Ind. Arts Teachers in System	No. of Years Teaching	Experience with Mass Production	Kind of Shop
Situation 1	700	500	21	1	2	some	General shop
Situation 2	2,000	1,810	70	1	4	little	General shop
Situation 3	100,000	24,156	916	22	5	did it before	General Shop
Situation 4	300	1,710	66	1	18	did it before	General Shop
Situation 5	2,000	1,285	47	1	6	did it before	General Shop
Situation 6	4,500	2,800	97	1½	2	did it before	General Shop
Situation 7	700	1,410	51	1	2	some	General Shop
Situation 8	3,500	2,450	90	3	2	none	General Metal
Situation 9	3,500	2,366	89	3	4	none	General Metal
Situation 10	1,500	1,090	42	1	1½	none	General Wood
Situation 11	22,000	3,360	150	2	4	none	General Shop

Organizing for Production

The project was selected by the teacher in seven of the schools and the remaining four were determined by the students. The designing of the project was done by the students in five of the units, taken from a commercial model in three, and previously designed by the teacher in the other three. In six of the cases the students worked on individual projects when not busy with their mass production responsibilities; in three all of the class worked full time on the production project; whereas, in the remaining two only part of the class worked on the mass production unit while the rest continued with their individual interest projects.

Production

The number of items produced ranged from five to 170, with an average of 46. In three of the situations, all of the parts were duplicated before assembly started, in one of them some of the parts were pre-cut, while in seven of the projects there was a continuous progression from cutting out the parts through assembly operations. In six of the cases, the item was sold to the public, two were used by the school system, two were produced only for individuals in the class, and one was donated to charity.

Related Activities

Only one of the 11 teachers took a field trip in connection with this unit, five showed a film and gave reading

assignments, while the other six did neither. There were articles in three local papers and one school paper concerning the mass production activities, while the remaining seven had no publicity of this sort.

Evaluation of Selected Mass Production Experiences

The measurement and evaluation of the mass production units, described in the previous part of the present chapter, was carried on at several different times with both students and teachers. The writer visited each class several times, observing the students working during the planning, tooling, and assembly stages. Information from these visits is recorded in the previous part of this chapter with the evaluation of what the writer observed in the following part.

The test given to students was divided into two parts: the informational test and the judgment test. The informational test[1] was composed of 22 questions, numbers 16 to 37. These were objective test items used to measure the extent of the knowledge and concepts the students had of mass production. These questions were mostly of the multiple choice type. The judgment portion of the test,[2] numbers 11 to 15, was composed of five questions. Each question described a situation where a decision had to be made in an

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[1]See Appendix IVB.

[2]See Appendix IVC.

industrial plant. The five choices were on a continum with the number one choice indicating a direct, "autocratic" handling of the problem; number three choice tending to show a "passing of the buck" or a rejection of an immediate solution; and the number five choice indicating that more of the people involved in the solution would be considered in a more "democratic" manner.

Pre-tests of both the information and judgment portion were given where there was not a comparable class in the school to be used as a control group.

At the conclusion of the unit the students who participated were given an opinionnaire[3] to get a reaction to their experiences. The teachers involved were given an opinionnaire[4] after the unit was completed, to get their reactions at this time and also to see how they would change the unit if they were to teach it again.

More complete data will be found in Appendix V concerning the data collected from the tests and opinionnaires.

Situation 1[5]

The students through the questionnaire generally indicated an acceptance of this unit as something they liked to

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[3]See Appendix IVB.

[4]See Appendix IVC.

[5]See page 96 for a description of this situation and Appendix VA for additional information.

do and learned something from. The teacher, in his opinionnaire, was able to see where improvements could be made and indicated a desire to include this as a regular part of the industrial arts curriculum. In the judgmental part of the student's test, the post-test scores indicated more middle responses than the students had checked on the pre-test. The means of the pre-test and post-test of the informational part of the test were not significantly different.

This teacher set the stage for this unit very well. He had included different kinds of learning experiences in their other assignments, so this was not something completely different. He had a very good rapport with this class, so they had a good working relationship to begin with. He showed the class a film, had a field trip, discussed common reading assignment, and allowed for a large amount of student participation. He took an active role in the production, for when they were shorthanded he worked on the assembly line with the others. They worked out and knew in advance what their objectives were and why these were important. The teacher showed evidence that quite a lot of pre-planning was done before the unit started. The teacher relied upon observation and informal devices plus an objective test for the evaluation; however, these were not always coordinated with the stated objectives.

There were many commendable features in this unit, by both teacher and students, notwithstanding the fact that

this was the first experience for either of them in producing an item in a school setting using mass production techniques.

Situation 2[6]

The students, in their opinionnaire, show a different attitude depending upon how the question is asked. Most of them expressed a liking for mass producing a project and for their particular job, but after that the negative votes begin to show; for example, the ten to one vote to work on their own individual projects. This was detected throughout the unit. The teacher, in his questionnaire, recognized this and would teach mass production as a separate unit next time. There was no difference in the judgmental portion of the test between the control group and the mass production group. The means of the informational tests were not significantly different between the two groups. This is not surprising as there was little time taken with student planning or related instruction.

This unit lacked unity and participation. The students worked on mass production as well as their regular work on their own individual projects. As a result two things happened: only two or three students were really involved in any part of the unit except the one-day assembly

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[6]See page 98 for a description of this situation and Appendix VB for additional information.

and the other students felt they were being pulled off their own projects to work on something they did not see the need for. As such it suffered from the lack of teacher attention and planning and student interest and participation.

The methods the class used for production followed some of the mass production techniques and the assembly line was organized with some thought and planning. The unit had to be terminated before its completion because students were reluctant to put their time and energy in this direction, so the T-squares and triangles remain unfinished to be completed by another class at the start of the next school year.

Was this unit successful? If what the teacher says in the opinionnaire is true then it has had a kind of long range success that is hard to evaluate. This is what he said, "It jogged my thinking towards putting my objectives squarely before me as to prerequisite to any given unit of instruction. I have talked about my objectives, but hadn't really planned my program to this." Maybe in the long run this is the most important kind of learning that can result from this kind of experimentation.

Situation 3[7]

Although 50 students expressed a desire in favor of mass producing another product, with 19 against it, 46 would

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[7]See page 101 for a description of this situation and Appendix VC for additional information.

rather work on individual projects rather than a mass production unit. The students indicated they would like to have better organization if they would participate in this again. The teacher seemed to have a realistic view as to the success of the unit, for his comments on the questionnaire did not claim any great changes in student behavior. He believed it had done some good, if nothing more than giving the teacher a chance to look at teaching mass production and improving on it the next time he teaches it.

There were very few differences in the judgmental test between the control and mass production groups. The difference between the means of the control groups and the mass production group was significant at the .10 level of confidence on the informational part of the student test. This was in favor of the control group which had a mean of 9.5 as compared to a mean of 9.1 for the mass production groups.

The teacher had made this project before, a take-apart toy tug, in his classes and so should have been aware of the difficulties. He either underestimated the tolerances necessary for the interchangeability of parts or overestimated the skills of the students. This resulted in a number of individual parts, hardly any of which would fit together. Part of this was brought about because of the lack of planning for any accurate duplication of parts. As the production started, each student was prepared to

measure and cut each piece as if there was only one piece to do. As they were going to produce about 100 of these that were to be taken apart and held together with dowels, with 7th grade students in their first semester of woodworking, this was quite an undertaking. Adhering to my "hands off" policy except when asked, the writer observed what happened. The teacher left many of the decisions and supervision up to the foreman. Most of these were willing enough, but could not keep up with all the problems that developed. As a result, after most of the pieces were produced the workers were "laid off" and the foremen and a few selected students completed them. Each tug had to be re-drilled or re-fitted so that the pieces fit together. This was done on an individual basis. Meanwhile, the other students, since this was just before Christmas, were working on their individual projects that were going to be used as Christmas presents. Here again the individual project had been assigned previously and work interrupted to do the mass production.

It seems to the writer that the students exhibited an amount of interest at the beginning that, had the unit been better organized, would have carried it through to a good conclusion. Lack of pre-planning by the teacher seemed to doom this unit to relative failure as far as student learning was concerned.

Situation 4[8]

The students, on the opinionnaire, generally expressed a dislike for the mass production experience. Most of them, 14 to 2, would have rather worked on their individual projects and felt that the unit was rather confused and not planned well. The students, in the post-test, indicated an autocratic leaning on the judgmental portion, as opposed to their reaction on the pre-test. This may have been a result of the dissatisfaction expressed in the opinionnaire about the lack of organization. There was little change in the pre-test and post-test scores on the information test. The teacher felt that some good had resulted and that the unit would be improved if he taught it again next year.

This unit was organized and taught mainly by the student teacher. The choice of the project was dictated by the kinds of materials available in the laboratory at the time as the teacher was reluctant to secure more material for this project. The changing of the project by the teacher probably lessened the interest by the students for they seemed to be disappointed when they were not able to follow through on their first choice. The physical facilities were not arranged so that material could be conveniently moved from one place to another, and the different operations had to be performed in a sequence that demanded a lot of moving.

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[8]See page 103 for a description of this situation and Appendix VD for additional information.

The students were not responsive to the student teacher and the teacher was reluctant to step in, so there never was real cooperation developed among the students. The project was constructed quite well, probably due to the teachers' insistence upon a high standard of craftsmanship.

Situation 5[9]

There was no teacher or student evaluation for this situation because of the nature of the group and the arrangements made for organizing the unit. The group was a special education class of mentally retarded students. The industrial arts teacher had tentatively agreed to cooperate with the writer on a mass production unit, but because of the demands of coaching athletics and his already heavy load of teaching, the teacher felt that he did not have the time to devote to developing a unit of this kind. He told about the difficulties the special education teacher and he had in finding projects for these special education students to do while in the industrial arts shop. The writer volunteered to help develop a project that could be mass produced by the students. Both of the teachers agreed to this arrangement. The writer then developed a project, templates, and jigs as described in a previous section.

The reaction of the students was good as long as they had a job that they could do. Even though each student was

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[9]See page 105 for a description of this situation.

to get one of the stools, the seven or eight class periods it took to complete the project was too long a period to sustain interest in the work. The facilities for applying a finish to the stools was not adequate and so this phase caused some confusion. Most of the students would lose interest in a job if it took too long for them. For example, one person was to sand off all the corners of one stool at a time, but this just did not work. When it was changed to two students on the legs, one on the top, and one for the sides, it went much faster and a better job resulted.

Both of the teachers, in discussion, seemed pleased with the results and hoped that they would have time in the future to do more of this kind of teaching.

This situation was developed in order to see the possibilities and difficulties of using this technique with mentally retarded students. No attempt was made, other than observation and talking with students, to measure what the students learned, as this would involve different instruments than had been developed for the other groups.

Situation 6[10]

The students were generally in agreement that they liked to mass produce an item, but yet 10 out of 15 said they would rather have worked on their own individual projects. The teacher seemed to be interested in trying the

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[10]See page 108 for a description of this situation and Appendix VE for additional information.

unit again and improving on it. The difference between the means on the informational test was significantly different at the .02 level of confidence, in favor of the mass production group. The amount of related information that was presented clearly shows up on the results of the test.

The planning and related information stages of this unit were handled quite well. Once production started, however, the limitation of physical facilities and teacher organization created some confusion that worked to a disadvantage as far as contributing to the success of the unit. The number of students who commented on the disagreeableness of the painting operation points out the importance of adequate facilities to mass produce an item. There was not a clear-cut pattern or flow of materials and job assignments were sometimes fuzzy. As with many of the others, the teacher did little to bring the unit to a conclusion, in trying to tie it all back up or evaluating for any results. The students drifted back to making individual projects.

Situation 7[11]

The students' response on their opinionnaire was generally favorable with not one "no" vote on whether a mass produced project was appropriate for industrial arts. In the judgmental test there was again the shift in the mass

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[11]See page 110 for a description of this situation and Appendix VF for additional information.

production groups away from the number five response, which is the one that involves the most people in decision making. The differences in the results of the informational test were the greatest of any situation. The difference between the means were highly signficant at the .01 level of confidence, in favor of the mass production group. The teacher was enthusiastic about the unit and indicated he would teach this again.

This teacher probably did as good a job of teaching the related material as any of the 11 who participated in this study. Using films, booklets, and personal experiences, the teacher related what they were doing in industrial arts to what is going on in industry. He gave assignments and then reviewed and discussed these in class. He required student participation, but yet kept control of the situation so that he could direct it when needed. The competition that developed between the two mass production groups was unique for the 11 situations, for there was a spirit of enthusiasm, of competing to see how many items they could produce in an hour, that was entirely lacking in any of the others. On one visitation, during the production of the Christmas wreaths, after a brief period taken up by the foreman, the students rushed out to the shop with the cry, "Let's break the record of 25 today." Several students, on the reaction sheets, said that the competition between the two groups was the best part of the mass production unit. The

students were always looking to see how their job could be done better and faster.

The money was not handled with the same sort of efficiency. Materials were purchased from the F.F.A. fund and money collected from the sales was credited to the F.F.A. account. No prior arrangements were made as to the disposition of the profits, except a general agreement between the agriculture teacher and the industrial arts teacher that some needed tools or supplies could be purchased from this money for use in industrial arts.

The evaluation by the teacher, as with most of the others, was still an informal, observational type of reaction. The teacher's rapport with the students helped a great deal in getting their cooperation and keeping their enthusiasm. Only in getting the trees from the woodlot was there much dissatisfaction expressed by the students on the way the unit was taught and organized.

The sales force was active enough so that almost all of the wreaths were sold and distributed before school let out for the Christmas vacation.

Situation 8[12]

The teacher started with a 12th grade class of advanced metalworking and when this did not work out, switched to an

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[12]See page 112 for a description of this situation and Appendix VG for additional information.

11th grade class. The teacher had proposed a mass production project several months before to the advanced class and wanted them to suggest ideas of projects to make. They never came up with anything practical enough so the teacher brought in a model steam engine. The basketball season, starting too late in the school year, the coming of spring, and the number of jobs the students wanted to do for themselves on motors, cars, lawnmowers, etc. all contributed to a lack of interest in the mass production project. This again demonstrates that it is very difficult to carry on a mass production unit while the students are also committed to completing individual, personal interest projects.

The writer feels that if this had been a recognized and independent unit, the student's skills and the teacher's ability could have resulted in a very fine learning experience. As it was, there were too many things working against it.

A pre-test was given the advanced class, but since many of them did not work on the project and not much was accomplished, a post-test was not considered appropriate. In the 11th grade class that finished the project up, this still was a part-time, hit-or-miss arrangement with students being involved to a different degree so that a test would have had little validity for the class.

The teacher still feels that this is an appropriate experience, and indicates that he will attempt it again with a simpler project.

Situation 9[13]

In the opinionnaire the students generally expressed a high regard for producing a project in the manner they did. However, there was one element that kept coming up in their comments, that of the monotony of their jobs. Typical is this comment by a student:

> I would not like to produce another project because there would be no chance to show individual talent. If we made individual projects, there would be a chance to do more things and work on more machines where in mass producing you do the same thing the whole time.

Evidently, for those who complained of monotony, it was not sufficiently impressed upon them that this was one of the things they would probably learn from mass producing an item. When a student comments that "It was all right, except I got stuck on one job," one might wonder about how well the students understands how people and machines are organized to produce items in quantity. The mass production group again moved away from the number five item in the judgmental portion of the test, compared with the control group. This again would indicate that those people who had experienced the mass production unit feel that decisions should be made without always involving the people who will be affected. The difference between the means of the two groups on the informational part of the test were not quite significant at the .05 level of confidence.

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[13]See page 114 for a description of this situation and Appendix VH for additional information.

The teacher indicated that this was a refreshing experience for him, as well as for the students and he was going to continue this as a regular feature of the eighth grade metalworking curriculum.

At the start of the eight-week metalworking course, the teacher told the group it was going to devote full time, for eight weeks, to this unit. There was nothing else competing for their interest. The pre-planning with the students was good as they were not hurried by a pressing time limit or the necessity to get back to something else. Many things were considered in this pre-planning period and the teacher allowed a heavy involvement of students in making decisions on many questions that would arise. No more boxes were made than they had advanced orders for, so this set their production goal and reduced the let-down at the end of the unit if it is then necessary for the students to get rid of all their production. The personnel organization was good in that someone was designated to make decisions or carry them out for most of the areas that were of concern. If something came up during the production, the class was stopped and some discussion followed as to the implications of this person's behavior, why this happened this way, or how could this be changed. It is important to call some of these situations to their attention, but yet it is also important that they get the feel of an uninterrupted, repetitive, continuous operation.

After the writer's test had been given to the group, a class period was spent going over the test, discussing it, and referring to their experiences for support of the correct answers.

Situation 10[14]

The seven students involved in the mass production, although they were volunteers, still voted seven to nothing that they would have rather made an individual project. The differences between the means of the mass production group and the control group were highly significant at the .001 level of confidence. In the judgmental portion the mass production group tended to select answers toward the middle of the scale which would indicate a passing-of-the-buck kind of attitude.

The teacher indicated that if he taught this unit again, "I would guide the students more in setting up the project." Since the teacher selected and designed the project there would be some doubt as to where he might guide it more.

Since the selection of the project and its design was already decided upon, both the teacher and the students seemed to want to go right into production. The organizational phase was not well thought out and some of the

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[14]See page 116 for a description of this situation and Appendix VI for additional information.

planning and changes that should have preceeded the start of production had to come after the assembly operations had started. The operations to complete the religious cross were quite simple as no fine tolerances had to be held to. The simplicity of the project may not have offered the challenge necessary to stimulate the students to a high interest level. The distribution of the project, although for a worthy cause, did not increase the personal involvement of the student into feeling that something tangible resulted from his efforts and time. This seemed to be a personal project of the teacher's and he really never involved the students in it other than to have them do the work.

Situation 11[15]

The students seemed to be fairly evenly divided, by their responses on the opinionnaire, as to whether they thought this was worthwhile. Several of them thought that once was enough and would not care to do it again. The differences between the two groups in the judgmental portion of the test did not seem to be significant. The informational test scores showed that the differences between the means were significant at the .02 level of confidence.

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[15]See page 117 for a description of this situation and Appendix VJ for additional information.

The teacher, in his response, diagnosed some of the difficulties, such as slowness of the process and simplicity of some of the tasks, and will try to remedy them in a similar unit next year. The informational test scores were significantly different at the .01 level of confidence. This would be suspected by the use of a film, student reports, and discussions to tie together the student experience and how it is done in manufacturing industries. The unit was organized and pre-planned by the teacher so that no serious difficulties arose, but yet students were able to make many of the decisions affecting their operations. Here again the importance of an appropriate selection of a project is re-affirmed. The metal box that was produced did not have the operations necessary to keep the whole class busy, plus the limited amount of some equipment so that there seemed to be too many people and not enough work at times, a condition that usually leads to more confusion. This was a class that had lots of interest and abilities and could have been challenged to really produce a high quality product. The simplicity of the project did not stimulate them to use their imagination and so to create an interest in this unit.

Summary Evaluation[16]

If these 11 teachers and the way they taught this unit in mass production is some indication of what industrial arts

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[16]See pages 118-122 for a summary description of the 11 mass production units.

teachers do, then what has been learned from describing and evaluating these 11 situations? The generalizations and patterns that emerge from these situations are only true for these 11 teaching situations, but as these may be representative of the larger group of industrial arts teachers and if there is evidence found that these patterns also hold for the larger group, then there will be some validity for predicting what other teachers in similar situations might do.

Weaknesses

The biggest difficulty that the writer observed was one of the most basic ones. The teachers generally did not define specific objectives for this experience, structure experiences that would lead to the desired behavior changes, and then evaluate to see to what extent the objectives were realized. Without this or a similar kind of organization, successful teaching and/or learning is difficult. The evaluation of the students was usually left up to an informal observational and discussion type of feedback, many times with no relationship to stated objectives.

Once the mass production unit was started several themes seemed to repeat themselves in a number of these situations. There was a tendency to rush through the planning stage, generally not realizing this is usually the most fruitful part of the experience. Some of the teachers still confuse teaching with telling and cannot seem to tell the

difference. For most of the teachers this was their first attempt to teach about mass production.

There seemed to be a lack of imagination and effort toward using a variety of learning experiences. Books, magazines, films, film strips, field trips, speakers, panels, reports, etc. were ignored with a regularity that would amaze someone who realizes the wealth of materials and resources available in this area. Several made the mistake of trying to carry this on with other assignments and projects not connected with it and finding that time and effort was being diverted from this unit until any hope of success was gone.

The students generally reflected the drive, the interest and ambition, and the skill and ability of the teacher. If the teacher was sincere, enthusiastic, and able to carry forth an intelligent teaching-learning experience, then the students usually reacted in kind. The students generally were not sold on the idea that learning about mass production was a significant activity. In their responses on the opinionnaire an overwhelming majority indicated they would rather have worked on an individual project. The results of the informational test usually corresponded quite closely to the writer's observation of the amount and quality of teaching involved. Where the teacher taught related material, the mass production group scored significantly higher than the control group and, of course, the converse

was true. It is difficult to generalize on the judgmental portion of the test. The number five response was consistently picked fewer times by the mass production group than by the control groups. Some of this loss was shifted to the other extreme, numbers one and two, and some of the middle, number three. The number five response was the one that involved the most people in the decision-making process. Evidently there was something in the mass production experience which tended to produce an attitude for an immediate decision, which would be number one, or else to "pass the buck," which would be number three. The attitude of the mass production group may be more realistic in an industrial situation where things need to get done.

Strengths

The main strength that I find in these 11 situations is in the fact that they did them. Most of the teachers were aware of such a thing as a mass produced project, usually due to articles in industrial arts magazines or from experience with it during their college work, but most had never taken the step to become directly involved. The little nudge the writer gave some of them was all that was needed for them to plunge in and try it. Most of their programs were flexible enough so that they could accommodate this unit on rather short notice. These teachers are to be commended for their willingness to try something they had not attempted previously.

Not overwhelmingly present, but enough to be hopeful, were the areas of student decisions and public relations. Most of the teachers, for not having taught such a unit before, allowed the students to make many of the decisions that might lead to important learning. As they become more secure, they will certainly allow an even more intensive involvement on the part of the students in the area of decision-making. There were also some good public relations. This unit may be a really dramatic one, one that lends itself to good publicity. This was taken advantage of in a number of cases and should be exploited even more in the future.

CHAPTER V

RECOMMENDATIONS

A teaching unit on mass production was deemed appropriate for this study for several reasons. There is almost a total lack of examples of such units in the literature of industrial arts. The magazine articles that have appeared on this topic have been incomplete with a rather simple declaration of what was done along with some personal opinions as to the results that were achieved. Because of the type of articles written about mass production, teachers who participated in this study had not had the opportunity, through the literature, to read about a variety of ways in which a unit on mass production could be planned, organized, taught, and evaluated. There also needs to be a rather complete teaching unit on mass production so that other attempts will have something to be measured against.

Not all of the objectives of a course can be taught at all times. There must be some varying emphasis during a course so that each area gets some individual attention, and yet all of those objectives that are deemed appropriate by both student and teacher receive some consideration.

With the use of the unit approach several objectives can be isolated and the instruction concentrated on these for a specific period of time. It should be noted that the objectives stated in the forthcoming teaching unit are ones that should be of some concern for every potential citizen of our society. This is a necessity if industrial arts is to be an integral part and contribute to the general education of the students. Some industrial arts course objectives may be touched upon in other courses, but the advantage that industrial arts has in having the students actively engaged in a mass production endeavor, rather than just reading and discussing it, is one that should be exploited in industrial arts.

This teaching unit will also contribute to the emerging, more modern concept of industrial arts where a wide variety of educational experiences are offered to the students with content that more nearly reflects our modern industrial society. If industrial arts is to attain a permanent and significant place in the education picture, then teaching units such as the one proposed here should help secure this position.

A Teaching Unit on Mass Production

This unit is designed for a class of 9th grade boys and girls. They have had some industrial arts experiences in the 7th and 8th grades where they explored different

materials in a variety of situations. This unit will take place the second six weeks of the school year. The first six weeks have been devoted to sketching and designing, providing experiences so that the class can effectively work together in small groups, as well as being able to function as a total group. In addition, the students will have developed some skills in problem solving, designing, and the use of tools and materials.

Overview

If there is one characteristic of modern America it is the abundance of material goods. Our productive capacities in some cases match the total for the rest of the world combined. Any comparison with other countries merely highlights the fact of our material superiority, if not always in quality certainly in quantity and accessibility to people. This ability to produce goods is not something magical nor did it spring forth overnight. There are reasons for this happening, and principles which make it work. This provides the substance for the unit on mass product and the fact that it is here, with all of its advantages and problems, provides the reason and importance for it being included into the industrial arts curriculum.

Objectives

1. Achieves a considerable degree of skill in one activity and seeks to become more adept at it.

2. Has some understanding of the materials, processes, and tools that are involved in the production of manufactured products in our industrial world.
3. Is familiar in general with the productive and distributive system for goods and services.
4. Works cooperatively with other members of the groups to which he belongs and strives for good human relations in the group.
5. Shows at least a general understanding of contemporary American society, the heritage which it carries, the historical roots of this heritage, and the major unsolved social problems with which it is confronted.

Introduction

As the unit starts, a lecture-discussion will be held setting forth the objectives of the unit and putting these into a context that is meaningful to the students. This can be done by being aware of student activities and their interests and drawing out from the students where the area of our industrial democracy touches their present and future lives. Each objective can be related to some significant aspect of an American citizen's life and to the present day obligations and interests of the students. Two booklets will be handed out to each student: The Evolution of Mass Production from the Ford Motor Company and American Battle for Abundance from General Motors Corporation. The students

will be requested to read these within the next few days. The teacher will point out special points and emphasize parts that will come up again in a discussion period in a few days.

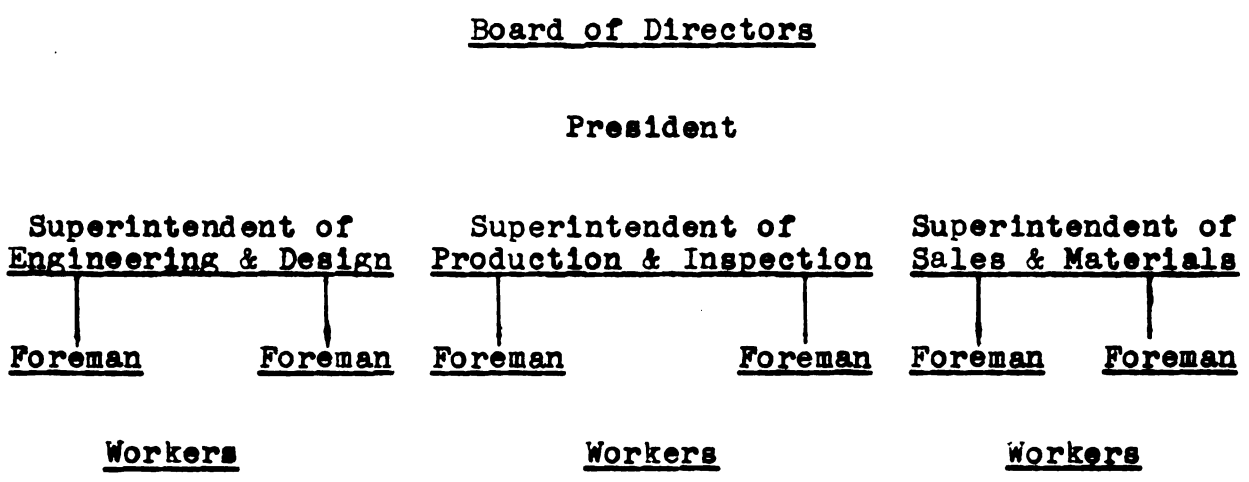
An assignment will be made for each student to investigate the production and distribution of one contemporary American made consumer product. The material gathered and information gained will be put into a written report form to be handed in following the field trip to be taken. At the time when they are handed in, some short oral reports and discussion will be held comparing the production and distribution of various products.

A bulletin board display with a theme of modern industry will be prepared by the teacher and a group of interested students. Advertisements, articles, bulletins, and examples of new industrial materials or techniques would be appropriate to focus attention upon some of the objectives of this unit. The film, Productivity, Key to Plenty, will be shown to make clearer some of the implications of mass production and how America has been able to achieve the material wealth that it has in relation to most other countries of the world. After the students have some idea of what mass production is, the teacher and students can begin to explore ideas and activities that they can do in order to fulfill the objectives proposed earlier. This will be a "brainstorming" session with more definite decisions coming later.

Organizing for Work

This phase will be a direct continuation of the previous part, only focused upon how people get organized to do a job. The two booklets handed out previously will help indicate to students some of the personnel problems that need to be solved if there is to be a successful mass production experience. This method of organizing people should be contrasted with the older handicraft method where each worker completed the object. The necessity for unions or the conditions which brought unionism about will be explored here. Later the role of unions in industry today will make a good topic for a report and a discussion. Some of the duties and responsibilities that will be necessary to produce a project should be suggested by the group and some form of organization built around this. Care must be taken by the teacher that the wide variety of responsibilities are taken into consideration when an organizational chart is evolved. There will need to be a governing body, one to make policy and long range plans, also a group to act as a final arbitrator in case a decision cannot be reached on a lower level. This group will be composed of the teacher, the president, the department heads, and two other students. This board of directors will be the management group plus two other members who may be viewed as representing the workers. The president and department heads will be elected by the entire class, with the rest of the responsibilities

appointed by the department heads. Three departments will accommodate the jobs that need to be done: engineering and design, production and inspection, and sales and materials. The formal operational chart will be as follows:



The engineering and design department will have the responsibilities of the design of the product, the jigs, fixtures and templates, the tolerance specifications, the materials to be used, the job procedures, and the layout. These decisions will all have to be coordinated with other departments, showing the need for communicating between different departments and the importance of going through channels. The production and inspection department will be responsible for the job training program, quality control, production and assembly, production schedule, records of number produced, time involved, and rejects of material and pieces. The sales and material department should secure the material and supplies, launch a sales campaign if the product is to be sold, keep records of money expended and received,

and be responsible for publicity and public relations.

The Board of Directors also has some decisions to make. They will be responsible for deciding the final design of the product, how it is to be distributed, and number to produce, the price to charge and what to do with the profits, if any. The need for cooperation is evident here as these decisions cannot be made by one person. The teacher will be keeping an anecdotal record of the students' behavior to use in evaluating them for objective number four: works cooperatively with other members of the groups to which he belongs and strives for good human relations in the group.

Selecting the Product

The whole class, led by the president, will discuss criteria for selecting a product to be produced. The heads of departments will have to keep their areas in mind when arriving at a selection. Some of the things to keep in mind will be the adequacy of the facilities, tools, space, and equipment, the ability of the students, the distribution of the product, the time available to complete the production, and the job breakdown in relation to the number of workers available. The class will be divided into several smaller groups with each group responsible for exploring the possibilities and selecting one product to recommend to the Board of Directors. Each group will take a different age group or class of people to select a suitable product for. These

groups will be: (1) children from ages two to six, (2) the students own age level, (3) parents, and (4) the local school district.

The film, Profit Through Industrial Design, will be shown here since this gives a good illustration of how to design a product for a specific market. Each group will go as far as it can in designing a product, getting customer reaction, computing cost of materials, predicting possible sales and production figures, building a scale model or prototype, making a job analysis, etc. As each small group is working, the Board of Directors will be observing and working with all of the groups. As the several suggested products take shape, the Board will make a decision as to which one to produce. The heads of the departments will select the foremen and workers needed to get started with the product and the others not needed at this time will continue to work on their selection of a product, getting skills that may be necessary later on to produce the one that was picked.

Pre-Production

Other than choosing a product, this is the most crucial phase of the unit. Here many of the most important concepts may be learned for this phase demands more thinking, more creativity, and more skills than at any other part of the unit. Once a product is decided upon, then literally hundreds of decisions have to be made. The product has to be designed and engineered, then taken apart and each piece

analyzed as to the operations necessary, the tools, machines, and setups that will be required to accurately duplicate the parts. The amount of materials for each piece will be computed and then the total amount of material secured and made ready. Flow charts, work stations, training programs, sales campaigns, promotional and public relation affairs, quality control, record keeping forms, etc. will keep everyone busy. Because of the inexperience of the students, this phase may be confusing, for they are usually not prepared to spend this much time tooling up for production. When about all of the necessary work and planning for production has been accomplished, a field trip to a local manufacturing plant will be taken to break up the routine and provide some experiences that will help them with the rest of the production. By now the students should be aware of much of the organization and procedure of industry so a visit should provide some worthwhile experiences. After the field trip will be a good time to stop for an evaluation session, to sum up what has been done, and what needs to be accomplished yet.

The papers the students were to prepare on the distribution and production of a product will be due now and some of the discussion can center around what was learned in writing these. Through the paper the students wrote and their participation in the discussion, the teacher can arrive at an evaluation of two of the objectives: "Is familiar in general with the productive and distributive system for goods

and services," and "Shows at least a general understanding of contemporary American society, the heritage which it carries, the historical roots of this heritage, and the major unsolved social problems with which it is confronted." During this time the teacher will present to the class the evaluation instrument, illustrated below, that workers, foremen, department heads, and the president will use to evaluate the people they work for, with, and are responsible for. A worker will evaluate other workers he has worked with and the foreman he has been responsible to. The foremen will fill these cards out for the department head, other foremen, and workers he has been in charge of. The department heads will rate each other, the president, and their foremen, and the president will rate the department heads. In this way each person will have several different ratings from individuals in different types of positions.

Name	Position or job	Name	Position or job
	Your		Other Persons

Please give as accurate and honest a rating as you can to this person so that these may be used as an indication of how well he has done his job.

Put a check mark on the line where you think this person rates in comparison to what you could expect.

	Excellent	Good	Poor
1. His directions or reports were clear			
2. He was reasonable in requests or orders			

3. He was accurate and did a good quality job _____

4. He was dependable and did his job or assignment _____

5. In general, how did you like to work with him _____

The information gained from this instrument will help to evaluate each student in terms of these two objectives: (1) Achieves a considerable degree of skill in one activity and seeks to become more adept at it, and (2) works cooperatively with other members of the groups to which he belongs and strives for good human relations in the group.

During the pre-production period the small jobs and details necessary to get into production should be taken care of so that the production can run as smoothly as possible. It cannot be stressed too strongly that this phase is the real heart and core of the unit where most of the real learning experiences are. If this part goes badly, then there is not much hope for a successful product, but if this portion does go well, then not much can prevent a successful completion of the unit.

Production and Assembly

Without a specific product to analyze, it is difficult to predict procedures to follow or difficulties that might arise. Most products of any complexity will require some of the parts to be produced and stockpiled before the

final assembly starts. These can be handled on a sub-contracting basis. These should be stored in a place where they can be moved with ease when needed. They should be inspected and counted so that these parts are all in order for the full production run. By this time the students will be eager to see some of the fruits of their long labors so a trial run will be made to get the final processes polished up and to see that all of the activities are coordinated. The trial run will be stopped at several points along the way for the teacher to point out examples of situations they had talked or read about before, for others of the management group to suggest changes in routing or procedures, or for individual workers to comment on working conditions. The trial run should be an instructional session for everyone. Once the bugs are ironed out full production will start. Once this starts it will not be stopped unless something serious develops. The production should be continued long enough so that the workers get a real feeling for assembly and production jobs and the management group has had some problems to solve. This may last for two hours or for eight hours, depending upon the product, number to be produced, number in the class, etc.

The students responsible for public relations will have anticipated when the group will be in full production and will have written invitations to some appropriate people to visit during this time. The principal, superintendent,

supervisor, board members, other teachers, parents, etc. would be included. A little booklet has been prepared stating the reasons for the unit, some of the experiences involved, and some of the things that might be learned. The school and local newspaper should have a reporter and photographer there to record the event. This is the most dramatic portion of the unit, but it should be emphasized by the students the reasons for doing the unit and the tremendous amount of work and effort that was required to get to the final assembly operations. A sticker, prepared by the graphic arts class, will be affixed to each product explaining who produced it. The products should be finished immediately and distributed as soon as possible so that few loose ends are left when the assembly operations are finished.

Concluding Activities

After production has been completed there will still be some activities that will occupy the class until the next unit is started. The financial records will have to be completed, all money matters straightened out, equipment put back, the laboratory restored to its original condition, and reports to hand in. The evaluation cards the students received should be completed and given to the teacher. A written test will be given the students to test for objective number two, "Has some understanding of the materials, processes, and tools that are involved in the production of manufactured products in our industrial world." This will

be a combination essay, short answer and multiple choice test, measuring concepts and understandings, as well as factual information.

An assembly program, planned by the publicity committee, will be given at this time. Students will explain their part in the production sequence and complimentary products given to the distinguished guests invited for the occasion. A management or union official from a local manufacturing firm will be the speaker and should have the assignment of capping this experience for the class, as well as providing some insights for the other students in attendance that did not participate.

After the assembly program, the next class period will be used as an informal critique for students and teacher. The teacher should have his evaluation completed by this time so that he could report on some patterns that had occurred and some of his reactions to the unit. The students will be encouraged to give their views on the strong and week points of the unit and how it can be improved the next time. The objectives should be referred to to see how well they were achieved.

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SUMMARY

This study was concerned mainly with developing a rationale for the inclusion of a unit on mass production in the industrial arts curriculum in the public school. The feasibility of teaching it without special equipment or specially trained teachers was also considered. A more definitive study remains to explore what really happens when such units are taught.

General education not only has the responsibility of providing common experiences for everyone, but of allowing students to delve into special interest areas that will also create people who are different. There have been many national commissions, groups, and individuals that have made statements regarding general education. The Educational Policies Commission report, in 1938, published a book called The Purposes of Education in American Democracy in which are proposed four objectives of general education. These are: (1) The Objectives of Self-Realization, (2) The Objectives of Human Relationship, (3) The Objectives of Economic Efficiency, and (4) The Objectives of Civic Responsibility. These are inclusive enough to cover all the activities within a school curriculum, yet distinct enough so that subject

areas can identify parts or all of their courses with one or several of these objectives.

There seems to be ample evidence that industrial arts is general education. A contemporary, liberal view of industrial arts fits nicely into a theoretical framework of general education. As one becomes acquainted with the writings and thinking of people who represent general education and of those who represent industrial arts, it is amazing that in practice this relationship is not recognized more adequately.

The selection of content and the organization of the subject will have to be approached in a more intelligent manner than in the past if industrial arts is to play a dynamic role in modern education. The content will have to be upgraded chronologically and technologically so that some of the obsolete matter is discarded and some of the more significant technological advances are recognized. The "individual interest take-home project" to a great extent describes how industrial arts teachers organize instruction at the present time. Using the unit method the project can be put into a context that will increase its effectiveness. This will allow the teacher a greater flexibility of appropriate teaching techniques as well as granting the content a unity that has been generally lacking before. By identifying a specific segment of time with a unifying theme, unique objectives, teaching techniques, and evaluation, there is an

organizational pattern that will provide a structure upon which to build a successful curriculum and course of study.

In developing the concept of mass production, the history of modern industry and inventions should be considered. The student should be aware of some of the previous attempts to duplicate parts and to produce goods in quantity. To recognize some of the men, machines, tools, processes, and products that have made important contributions to our present industrial democracy is to put our present industrial democracy into a historical perspective that will be invaluable.

The relationship of mass production and general education is not a difficult one to see. If only one source is used, Will French's Behavioral Goals of General Education in High School, there are relationships that are seldom explored. These include such diverse areas as understanding the scientific method, achieving a considerable degree of skill in one or a few activities, showing a general understanding of contemporary American society, appreciating good workmanship, understanding the simple economic facts of consumer economics, and working cooperatively with other members of a group. Each of these areas has points of contact in general education and in understanding the concept of mass production. It is a challenge to the teacher to exploit this relationship.

With a resource unit on mass production in industrial

arts there are so many facets that can and should be learned that it should be quite unwieldy to try and include all of the possibilities for instruction. Some teachers may want to put more emphasis on industrial organizations or on industrial design. Still others will be more concerned with the manufacturing processes or materials. For some the historical or economic aspects will be more important, while others may teach primarily for consumer values. No matter what is emphasized, each of these areas and more will have to be given some consideration if an adequate coverage is to be done for developing the concept of mass production. As yet, there is not a large amount of resource material that is organized and available to a teacher attempting such a unit, so each teacher will generally have to gather and organize the materials without a great deal of additional help.

The mass production units as taught by 11 industrial arts teachers showed some commonality. The classes chosen by the teachers to participate were generally in the seventh through tenth grade, rather than in the eleventh or twelfth grades. The projects were generally made of wood with a few metal ones included. The project idea was usually chosen by the teacher with more freedom given to the students to design the final product. Generally, many of the parts were produced and stockpiled, then all assembled at one time. There was no clear pattern as to distribution for some were given away or made for the school, while others were sold

to class members or to the general public. Some teachers set aside a specific time for all of the class to participate, other used only part of the class for mass production while the others worked on individual projects when not committed to their mass production activity. None of them carried on an extensive evaluation program, but without exception all of them indicated they would try this unit again next year.

The evaluation of the selected mass production experiences took on several forms. The teachers expressed their personal opinion and generally thought they had learned quite a bit about teaching a unit on mass production. The students, via an opinionnaire, generally thought a mass production project was all right for industrial arts, but most of them would rather have made an individual interest take-home project. The test scores showed some interesting patterns. The first five items were designed to show who the person would involve in making a decision. These were set on a continuum with number one involving only one person and number five involving more people affected by the decision. In every case the mass production group or the post-test results showed fewer choices of number five. The informational test scores showed a higher mean for the mass production group in every case except one, and some of these were highly significant differences. The writer's evaluation of the teacher's organization and teaching of the unit showed one

obvious weakness in almost every situation. This was the failure of the teacher to define specific objectives, make these known to the students, pick appropriate techniques to accomplish these, and then evaluate in terms of their objectives. Without doing some of these, many other weaknesses followed.

A teaching unit on mass production was recommended as an attempt to incorporate many of the principles and procedures expressed previously. Such a unit incorporated the social and economic implications of mass production, the distribution and sales, the design and research phases of production, and the technical processes needed for an exact duplication of quantity parts and assembly procedures. There was also some attempt to put this into a historical and contemporary reference so as to interrelate other areas and make the learning more significant. Other units can be made that would have a different emphasis in terms of time and depth of penetration, but it is the writer's belief that the one presented provides a good balance of the many facets of mass production.

Changes in curriculum are as dependent upon changes in values as upon the addition of concepts and information. Changes proposed by the writer are no exception. If public school industrial arts teachers begin to value the behavior changes that may be brought about by participation in a unit on mass production, then this unit will be important, and be included in industrial arts.

Conclusions

1. The criteria for the selection of content in industrial arts courses should be the following:
   a. Contribute to the objectives of general education
   b. Be related to modern technology
   c. Be appropriate for students working with concrete materials in a laboratory setting.
2. Learning about mass production is appropriate content for the general education of all American youth. Social and technological elements of mass production go back as far as man has produced goods in quantity.
3. Industrial arts, being concerned with the productive enterprise of man, must include mass production as a dominant theme in its curriculum. Almost all of America's goods are mass produced and its economy is geared to mass production and mass consumption.
4. A unit on mass production is feasible, using the average teacher, students, and laboratory facilities available. No drastic or special changes will need to be made to accommodate this addition to the industrial arts curriculum.
5. By using the unit method of organizing instruction, industrial arts teachers can secure a unity in their teaching that has not been possible before. The unit provides a framework that demands pre-planning and an organization that may lead to better teaching and learning.

6. The industrial arts teachers who participated in teaching a unit on mass production generally conceived of mass production as the technical aspects of the production and assembly of a product in volume.
7. The industrial arts teachers who participated in teaching a unit on mass production generally failed to adequately pre-plan the unit. There generally was not a definite relationship between objectives of the unit, activities planned for the students, and the evaluation.
8. The image of industrial arts, as expressed by the majority of students participating in a mass production unit, is still one of "a place to go to make things to take home."
9. According to the results of the judgment portion of the mass production test, those students who participated in a mass production unit would, to a greater extent, involve fewer people in making decisions and also would "pass the buck" more for someone else to handle.
10. Students generally will score significantly better on an informational test over mass production after having participated in a mass production unit than those not having this experience. The differences in the scores of the mass production groups can usually be accounted for by the varied attention paid to the related instruction by the teacher.

Implications

1. What "success" the 11 participating teachers had in achieving the objectives of a unit on mass production was probably due to several factors: (a) they volunteered for the assignment and believed that mass production is an important area of industrial arts, (b) they were provided information and inspiration by the writer, and (c) they were a part of a research study. If similar "successes" would be expected in another situation, the above three factors should be examined to see whether they are present. If they are not then the writer doubts that similar results could be expected.
2. Industrial arts teachers are generally willing to improve their teaching and try new techniques if some additional help and stimulation is offered. This should provide a clue to colleges preparing teachers as to an expanding role they can play as a change agent.
3. In many cases it seems that the main concern of the teacher is to keep the students happy and that he might be able to do this by letting them make almost anything they want to make. This "neurotic addiction" to the individual interest project creates an image of industrial arts in the minds of the students and the public that is difficult to combat. They begin to think that industrial arts is a place to make things for themselves, rather than a place to learn. Unless both teacher and

student gives up this tenacious hold on the individual interest project, other things will continue to take a second place.

4. The professional literature of industrial arts needs to reflect more of the environment of today and tomorrow rather than dwelling upon the apparent "successes" of yesterday. Without an improvement in this area, the upgrading of industrial arts so that it realizes more of its potential will be difficult, if not impossible. For example, of all of the magazine articles listed in the bibliography for the unit on mass production, only one devoted any space to WHY this unit was being taught.
5. Industrial arts has the potential of being a dynamic force in general education. In order to do this the industrial arts teachers will have to exhibit leadership and professional activity that heretofore has been sadly lacking. Industrial arts teachers will have to play a greater role in education-wide organizations and activities, not only so as to be more understanding of other areas of education, but also so that other educators will better understand industrial arts.
6. There is a need for industrial arts teacher education to concern itself more with curriculum construction. Although graduate work is being increasingly sought by industrial arts teachers, the need for every industrial arts teacher to be competent in the area of curriculum

construction is so vital that it cannot be deferred and restricted to graduate work.

7. If industrial arts is to change the image which many students, educators, and lay people have of it, then some demonstrable results will have to be achieved. A good public relations program can only be built upon a good product. A unit on mass production may be one means of creating this new image.
8. The concept of mass production as narrowly conceived by the teachers who participated in teaching a unit on mass production is not so serious that it could not be remedied through the professional literature, in-service education, and observation of exemplary practices.

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APPENDICES

APPENDIX I

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APPENDIX II

Letter to Industrial Arts Teachers

August 24, 1959

Dear

I am trying to explore different techniques or ways of teaching industrial arts. One of the ways is through a mass production project in the school shop, where the students may design, engineer, produce, and distribute projects that they made by mass production methods.

Quite a few people have done this kind of thing, and some have written up their experiences in our magazines, but I know of none who have really tried to measure to see just what this experience did, or didn't do. I am working with Dr. Fuzak on a degree here at Michigan State University and I hope to do just that. What I would like to do is select about 10 teachers around East Lansing who would like to try a mass production project in one of their classes this year. If you would be willing and able to do this, I would help you get started. I would plan to consult with you during the operation and help you evaluate the results, in exchange for your ideas and the information we get. I anticipate that you will have a good deal of freedom in deciding just how this is to be taught. The organization, the project, how many, related information, etc., are all flexible enough to accommodate almost any situation. It can be 2 weeks or 2 months long, you can make 20 or 200, as there is really only 1 basic requirement and that is the mass production or assembly line basis for constructing the object. I realize that this is a very short summary of what I am proposing to do, so please feel free to ask any additional questions you may have.

If you will fill out the enclosed sheet and mail it back to me, I will then get in touch with you if you express an interest in this project.

I feel that this technique, the mass production project, along with some others, can add some real vitality to our programs, but only if we know more about them.

Sincerely,

Lee H. Smalley
LHS/ccl
Enclosure

APPENDIX III

Teacher Reply Form

NAME ADDRESS PHONE NO.

YEARS TAUGHT

7 8 9 10 11 12
CIRCLE GRADE LEVEL YOU TEACH

NAME OF SCHOOL ADDRESS OF SCHOOL GRADES INCL.

Check materials you usually work with:

Drawing __ Metals __ Plastics __ Electricity __

Wood __ Mechanics __ Graphic Arts __ Crafts __

Which would your shop generally be classified as:
General Shop __ Unit Shop __

What do you know about doing a mass production project in industrial arts?

What do you think this has to do with your objectives?

Have you ever done this before?

Would you try it this year if additional help was provided to get you started?

Would you like to state your reasons for your position on the previous question?

APPENDIX IV A

Test Over Mass Production

Do not write on this booklet - put all of your answers on the special answer sheet, with the special pencil supplied to you.

You are a foreman in the Jones Box Company. You have charge of 10 men in a department that makes 40 boxes a day on an assembly line.

11. Your supervisor tells you that your department must make 5 more boxes a day. Which one of the following would you do?

    1. Tell the men that either they produce 5 more boxes a day or else they will get fired.

    2. Put a notice on the bulletin board that 5 more boxes will have to be produced each day.

    3. Ask your supervisor how to get the extra boxes made each day.

    4. Call your men together and tell them you didn't have anything to do with the order for more boxes.

    5. Call a meeting and work out with the men some ways of doing the extra work.

12. One of your workers has been "goofing off" for the last few days. Which one of the following would you do?

    1. Recommend to your supervisor that either the man be fired or transferred out of your department.

    2. Tell him he had better "get on the ball"!

    3. Don't pay any attention to it, and hope that he quits soon.

    4. Ask some of the other men to see if they know what is wrong.

    5. Talk with the man to see if there is something you could help him with.

13. Within the next month you are to pick an assistant to help you on your job. One of the eligible men asks you to spend a week-end at his cabin to hunt and fish. Which one of the following would you do?

    1. Just tell him yes or no.

    2. Tell him you don't like to hunt or fish, even though you really do.

    3. Ask your supervisor and see what he would advise you to do.

4. Talk to the other workers who applied for the new job and tell them what you have decided to do for that week-end.

5. Tell him you can't go because this wouldn't be fair to the rest of the men who also want the job of assistant.

14. The inspector has been rejecting many of the pieces that are coming from one man's bench. Which one of the following would you do?

1. Take the pieces back to him and make him do them over.

2. Recommend to your supervisor that the man be transferred out of your department.

3. Change the work assignments around so that he has a different job.

4. Talk to him and ask him to be more careful.

5. Try to find out what is wrong and then work out a program with the training officer to correct it.

15. One of your men comes to you and tells you that because they have just had twins he will have to have a pay raise. Which of the following would you do?

1. Tell him no, that pay raises go to those people that work the hardest, not have the most children.

2. Mention it to your supervisor, but give him no definite answer.

3. Tell him you will take this into consideration when there is another pay raise.

4. Talk to him and see if there isn't some other way he can make more money.

5. Work out a program so that he learns a higher paying skill.

16. Which of these is always necessary for mass production:

1. highly skilled workers on the assembly line
2. standardization of parts
3. multiple purpose machines
4. all of these
5. none of these

17. Today, an accurately machined metal piece could be measured within:

    1. 1/64 of an inch
    2. as close as you wanted
    3. 1/1000 of an inch
    4. 1/10,000 of an inch
    5. 1/425 of an inch

18. Which statement is <u>not</u> true of mass production:

    1. the first completed object will be finished sooner than if they were made individually
    2. each part can be made by a separate machine
    3. it requires less overall skill by the workers
    4. they can be produced cheaper

19. Which one of the following is a device for holding work and guiding a tool so that duplicate pieces can be made:

    1. holder
    2. form
    3. vise
    4. clamp
    5. jig

20. A company produced 1,000 clamps last year and 10,000 this year. The price:

    1. may go down
    2. would probably go up
    3. may go either way
    4. would probably stay the same

. Following is a list of five operations that are necessary for mass production. Put these in proper order by placing a mark in the 1st column across from your choice of the 1st operation, place a mark in the 2nd column across from the operation that comes next, and so forth for all 5 operations.

    21. tooling up for production
    22. research creates an idea
    23. a model is designed
    24. the operations are timed and materials are ready
    25. the model is tested

26. Making identical objects by a form of mass production has been done:

1. since the Middle Ages
2. since recorded history
3. only in the last few years
4. since Henry Ford

27. To work on most assembly lines you would probably be:

1. skilled
2. semi-skilled
3. unskilled
4. any of these

28. To make the tools and dies you would probably be:

1. professionally trained
2. skilled
3. semi-skilled
4. any of these

29. To design the product you would probably be:

1. professionally trained
2. skilled
3. semi-skilled
4. any of these

30. To maintain the machines, you would probably be:

1. skilled
2. semi-skilled
3. unskilled
4. any of these

31. To be a foreman, you probably:

1. would be skilled
2. would be semi-skilled
3. would be professionally trained
4. could be any of these

You are going to buy a bicycle. You have your choice of one that has been mass produced or one that has been individually made.

32. Which one would probably be the cheapest?

1. mass produced
2. individually made

33. Which one would probably be the most decorative?

1. mass produced
2. individually made

34. Which one would probably be the best made and so last the longest?

1. mass produced
2. individually made

35. Which one would be the easiest to get spare parts for?

1. mass produced
2. individually made

36. Which one would probably go out of style first?

1. mass produced
2. individually made

37. Which one would probably be like someone else's?

1. mass produced
2. individually made

APPENDIX IV B

Student Opinionnaire

1. What do you think of mass producing a project in Industrial Arts?

2. What was your job or responsibility in the mass production project?

3. How did you like your particular job?

4. Would you like to mass produce another peoject?

   Yes _____ No _____ Don't care _____

5. Why?, or why not?

6. What would you have rather done than work on the mass production project?

7. What do you think you learned during the time you were mass producing the project?

8. What was the best part of the mass production experience?

9. What was the part you liked least about the mass production?

10. How would you suggest it be changed if this was to be done again next year?

11. Additional comments:

APPENDIX IV C

Teacher Opinionnaire

_____
Name

1. Why did you decide to do a mass production project this year?

2. Your Students:

   A. What was their reaction to this technique?

      1. At the beginning?

      2. At the conclusion?

   B. What did you expect the students to learn?

   C. What did the students learn?

   D. What evidence do you have of what they learned?

3. **Yourself:**

   A. Will you do this again next year? Why? or why not?

   B. What will you do differently?

   C. What did you like best about this technique this year?

   D. What did you like least about this technique this year?

4. **Additional comments:**

APPENDIX V A

Situation 1

Results of Student Opinionnaire: (9 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 9

2. How did you like your particular job?

   liked it 8[1]

3. Would you like to mass produce another project?

   yes 5 don't care 3

4. Why? Why not:

   it was fun 3 very tiresome, boring 2

   interesting doing it this way 2

   learned something 2

5. What would you have rather done than work on the mass production project?

   nothing else 5 work on individual project 4

6. What did you think you learned during the time you were mass producing the project?

   how things are produced 5

7. What was the best part of the mass production experience?

   the assembly operation 3

   working together 2

---

[1]Those items that had less than two responses were omitted.

8. What was the part you like least about the mass production?

a particular job 3 getting started 2

people not doing their job 3

9. How would you suggest it be changed if this was done again next year?

better jigs 2

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"First of all, it fit in nicely with our objective in advanced class 'to learn more about modern industry.' Also from my own experience and recent observation, I decided that it was one of the few shop projects that can accomplish several objectives at the same time."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"It was something entirely different than most of them had ever had experience with. There was a mild interest or curiosity at first. The interest climax came during the production run and after the publicity."

2. At the conclusion?

"Most of the class felt that they had experienced a valuable technique that possessed many complications. Their appreciation of what mass production has done for us was somewhat higher."

B. What did you expect the students to learn?

"We concentrated on the historical and technical aspects of mass production. I wanted them to learn what it was, how it could be set up and carried out, and why it should be appreciated."

C. What did the students learn?

"A mediocre understanding of the background, a

good appreciation for its value and complexity and a good understanding of jigs, fixtures, production, and business management. Weak as how to organize and set it up."

D. What evidence to you have of what they learned?

"Group discussion and evaluation (verbal)
Written opinion-type evaluation sheet
Objective test."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes, more extensively. It accomplishes so many objectives and it has the possibility of being a rather unique break in the routine type of activity. It has good student interest, student cost can be eliminated, and it can add value and general interest to our program."

B. What will you do differently?

"Involve more students in preliminary activities - plan a longer session for the unit - use this technique with other industrial arts classes, that is, besides the advanced class only. We would like to make a unit next year involving the general business class."

C. What did you like best about this technique this year?

"The fact that it added interest and challenge for me and the students while accomplishing a valuable part of one of our main objectives."

D. What did you like least about this technique this year?

"The initial work and planning was weak and the company executives were not too well coordinated. There were areas where I felt I was doing their problem-solving and other areas where it was difficult to interfere when I should have."

Results of Student Tests: (judgment items)

Answer	1	2	3	4	5
Pre-test (number of responses)	9[2]	6	3	4	23
Percentage	20%	13%	6%	9%	51%
Post-test (number of responses)	6	11	8	3	17
Percentage	13%	24%	18%	6%	38%
Difference	-07%	+11%	+12%	-03%	-13%

Results of Student Tests: (information items)

Student	Pre-Test number correct	Post-Test number correct	Difference
1	18	18	0
2	14	17	+3
3	13	10	-3
4	10	18	+8
5	9	13	+4
6	7	7	0
7	6	9	+3
8	4	7	+3
9	4	5	+1
	$N = 9$ $\bar{X}_1 = 9.4$	$N = 9$ $\bar{X}_2 = 11.6$	

Using the t test of differences between the means of two correlated samples,[3] $t = 2.04$ so that $.10 > P \geq .05$, which would not be significantly different at the 5 per cent level of confidence.

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[2]This should be interpreted as: out of 45 possible responses, the students chose answer number one as being appropriate nine times.

[3]Merle W. Tate, Statistics in Education (New York: Macmillan Co., 1955), p. 466.

APPENDIX V B

Situation 2

Results of Student Opinionnaire: (14 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 8 didn't like it 3

2. How did you like your particular job?

   liked it 10 didn't like it 3

3. Would you like to mass produce another project?

   yes 4 no 7 don't care 3

4. Why? Why not?

   just don't like it 2

   very tiresome, boring 2

   work on own project 4

5. What would you have rather done than work on the mass production project?

   work on individual project 10

6. What do you think you learned during the time you were mass producing the project?

   how things are produced 8

7. What was the best part of the mass production experience?

   the assembly operation 2 when we were finished 3

   individual jobs 4

8. What was the part you liked least about the mass production?

   a particular job 3

   people not doing their job 2

doing it 4

9. How would you suggest it be changed if this was done again next year?

don't do it 4

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"It's something I've always wanted to do and your request prompted me."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning:

"Lack of enthusiasm - just as well it's over - now I can devote full time to 'my' project."

B. What did you expect the students to learn?

"There are lots of cogs in the mass production wheel - the line worker is a small one. He also has a boring job. I'm not too sure I had additional objectives in mind."

C. What did the students learn?

"I believe they learned what I expected them to learn."

D. What evidence do you have of what they learned?

"Students indicated this feeling of unimportance and a small part the 'line man' plays during two discussion periods we had."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes - I feel this year's experience was a failure and I want to do better. I also see this as a unit of instruction that fills one of our major objectives. I have plans of incorporating this as a permanent part of my program."

B. What will you do differently?

1. "Teach this as a unit without anything else going."
2. "Planning will involve everyone."

C. What did you like best about this technique this year?

1. "It gave us an item we will use in the shop."
2. "It jogged my thinking towards putting my objectives squarely before me as a prerequisite to any given unit of instruction. I have talked about my objectives but hadn't really planned my program to this."

D. What did you like least about this technique this year?

"I had revised my units at instruction and wanted to see them develop. The mass production got in the way. I tried to teach MP along with my other units instead of treating it as a separate unit."

Result of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (15 responses)	1	12	10	6	46
Percentage	01%	16%	13%	08%	61%
Mass Production group (14 responses)	4	11	5	9	41
Percentage	5%	16%	7%	13%	58%
Difference	5%	--	-5%	5%	-3%

Result of Student Test: (information items)

Control group number correct	Mass production group number correct
15 -1[4]	13 -3
14	12 -2
13 -2	11 -3

[4]This should be interpreted as one student getting 15 answers correct on the informational portion of the mass production test.

Control group number correct	
12	
11	-2
10	
9	-3
8	-3
7	-2
6	-1

$N = 15$

$X_2 = 9.6$

Mass production group number correct	
10	-3
9	
8	
7	-2
6	
5	-1

$N = 14$

$X_1 = 10.4$

This test was given to the mass production group upon the closing of the unit. The control group that was used was another 9th grade section of industrial arts that had completed the same kind of work, except they had not mass produced an item. The mean for the mass production group was 10.4 answers correct and the control mean was 9.6. This produced a t score of 1.7, which was significant only at the .10 level of confidence.

APPENDIX V C

Situation 3

Results of Student Opinionnaire: (90 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 68 undecided 5 didn't like it 11

2. How do you like your particular job?

   liked it 66 undecided 3 didn't like it 15

3. Would you like to mass produce another project?

   yes 50 no 19 don't care 20

4. Why?

   it was fun 26

   interesting doing it this way 7

   learned something 14

   Why not?

   very tiresome, boring 4

   work on own project 7

   didn't learn anything 6

   too confusing 6

5. What would you have rather done than work on the mass production project?

   nothing else 33 work on individual project 46

6. What do you think you learned during the time you were mass producing the project?

   how things are produced 13

   individual job skills 34

   work with other people 12

   difficulties involved in M.P. 6

   nothing 7

7. What was the best part of the mass production experience?

   the assembly operation 16 when we were finished 17

working together 3 individual jobs 22

8. What was the part you liked least about the mass production?

a particular job 21 getting started 12

people not doing their job 15 wasted time 8

9. How would you suggest it be changed if this was done again next year?

no change 20 different project 7

better organized 21

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"Request by Mr. Smalley was the principle factor."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"Some apprehension - some anxiety and anticipation."

2. At the conclusion?

"Some disgust and antagonism - some elation."

B. What did you expect the students to learn?

"Rudamentary economics and personnel structure of industry. A self-association with individual manipulative requirement of live technique production."

C. What did the students learn?

"Some learned a great deal and wish to pursue the subject farther. Some may not have learned a great measurable number of facts, but certainly have had an additional experience."

D. What evidence do you have of what they learned?

"A few requests for reading material on the subject. General observation only - no additional testing as yet."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes, I believe it has a place in industrial arts programs. Our director has given it his tentative support."

B. What will you do differently?

"Different project - more stress on jigs and fixtures - machine set-ups."

C. What did you like best about this technique this year?

(no comment by teacher)

D. What did you like least about this technique this year?

"Misunderstandings with Principal and Director. Necessity to use machines in another shop."

Results of Student Test: (judgment items)

Answer	1	2	3	4
Control Groups (53 responses)	13	40	36	27
Percentage	5%	15%	13.6%	10%
Mass production groups (87 responses)	30	65	55	64
Percentage	6.8%	14.7%	12%	15%
Differences	1.8%	--	-1.6%	-5%

Results of Student Test (information items)

Control groups number correct	Mass production groups number correct
15 -3	15 -3
14 -2	14 -3
13 -8	13 -5

Control groups number correct		Mass production groups number correct	
12	-6	12	-8
11	-6	11	-7
10	-2	10	-13
9	-4	9	--11
8	-8	8	-10
7	-3	7	-12
6	-4	6	-7
5	-4	5	-5
4		4	-1
3	-1	3	-2
2	-2		
N	= 53	N	= 87
$\bar{X}_2$	= 9.5	$\bar{X}_1$	= 9.1

The teacher had four sections of 7th grade woodworking and there were two sections of 7th grade metalworking taught by another teacher. The two metalworking sections were used as the control groups. The individual class means for the mass production groups were 10.3, 8.5, 8, and 7.7 for a mean of 9.1 correct answers. The control groups had means of 9.9 and 9.3 for a mean of 9.5 for all the scores of the two control groups. This yielded a t score of 1.6, significant only at the .10 level of confidence.

APPENDIX V D

Situation 4

Results of Student Opinionnaire: (17 responding)

1. What did you think of mass producing a project in industrial arts?

   liked it 7 didn't like it 8

2. How did you like your particular job?

   liked it 8 didn't like it 8

4. Would you like to mass produce another project?

   yes 3 no 12 don't care 2

5. Why?

   learned something 2

   Why not?

   very tiresome, boring 3

   work on own project 2

   didn't learn anything 2

   too confusing 2

6. What would you have rather done than work on the mass production project?

   nothing else 2 work on individual project 14

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 3

   individual job skills 4

   work with other people 2

   difficulties involved in M.P. 4

   nothing 5

8. What was the best part of the mass production experience?

   the assembly operation 2

   when we were finished 6

planning and organizing it 3

learned things 2

individual jobs 2

9. What was the part you liked least about the mass production?

a particular job 7

getting started 3

people not doing their job 2

wasted time 4

10. How would you suggest it be changed if this was done again next year?

better organized 7

better project 3

don't do it 3

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"To put more meaning into industrial arts. To add variety of activities."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"Not very enthusiastic at beginning, but this improved as momentum was gained."

2. At the conclusion?

"I think they were fairly well impressed as to the value of knowing about this method of making a project."

B. What did you expect the students to learn?

"Advantages of mass production. Appreciation of problems of industry."

C. What did the students learn?

"Some of each, I hope."

D. What evidence to you have of what they learned?

"A 15-minute summary discussion was held followed by two questions asked and answered in writing."

III. Yourself

A. Will you do this again next year? Why? or why not?

"I believe so."

B. What will you do differently?

"Certainly will improve the flow of work."

C. What did you like best about this technique this year?

"The cooperation of the students in the planning."

D. What did you like least about this technique this year?

"The disruption caused by a couple of bottlenecks."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Pre-test (17 responses)	2	8	7	6	62
Percentage	2%	9%	8%	7%	73%
Post-test (17 responses)	11	8	9	5	51
Percentage	13%	9%	10%	6%	61%
Difference	11%	--	2%	-1%	-12%

Results of Student Test: (information items)

Student	Number correct Pre-test	Number correct Post-test
1	18	13
2	17	18
3	16	15

Student	Number correct Pre-test	Number correct Post-test
4	16	15
5	16	12
6	15	13
7	14	10
8	12	16
9	12	15
10	12	10
11	12	14
12	11	15
13	11	12
14	10	6
15	8	10
16	7	7
17	7	9
	$N = 17$ $\bar{X}_1 = 12.6$	$N = 17$ $\bar{X}_2 = 12.4$

Because of a mix-up in schedules, the pre-test was given to the group the day after there had been a discussion on mass production. The pre-test mean was 12.6 corrent and 12.4 for the post-test mean. The range was from 7 to 18 correct on the pre-test and from 6 to 18 on the post-test. With the means only .2 different, a t score of .34 was derived which would be $.80 > P > .70$ and so not significantly different.

APPENDIX V E

Situation 6

Results of Student Opinionnaire: (17 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 15 didn't like it 2

3. How did you like your particular job?

   liked it 11 didn't like it 6

4. Would you like to mass product another project?

   yes 9 no 2 don't care 6

5. Why? Why not?

   it was fun 3 very tiresome, boring 3

   interesting doing it this way 2

   learned something 4

6. What would you have rather done than work on the mass production project?

   nothing else 5 Work on individual project 10

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 8 work with other people 2

   individual job skills 6 difficulties involved in M.P. 1

8. What was the best part of the mass production experience?

   the assembly operation 4 when we were finished 2

   planning & organizing it 2 individual jobs 4

9. What was the part you liked least about the mass production?

a particular job	7	getting started	2
people not doing their job	2	wasted time	2

10. How would you suggest it be changed if this was done again next year?

more cooperation from the students	6	better organization (especially in painting)	7

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"To introduce this phase of industry to my students in a practical manner."

II. Your students:

A. What was their reaction to this technique?

1. At the beginning?

"Enthusiastic - most wanted to work in the mass production unit."

2. At the conclusion?

"Up to the very end when starting the finishing touches, the enthusiasm dropped off."

B. What did you expect the students to learn?

"How many of our products are made in industry."

C. What did the students learn?

"I feel they do understand the basics of mass production."

D. What evidence do you have of what they learned?

"A short quiz, other than the one given by Mr. Smalley. Also the pattern used in construction of projects since the mass production terminated."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"I hope to, but it has to wait until we finish setting up our new program."

B. What will you do differently?

"Better arrangements:
1. machines
2. finishing
3. broader background (before actual starting)."

C. What did you like best about this technique this year?

"It was new to the students and I wanted to find their actions and reactions in this type of learning situation. (I did.)"

D. What did you like least about this technique this year?

"At the very end when finishing was in progress, the group became restless. This may be remedied by starting another unit before the finish of the mass production unit."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (17 responses)	8	7	12	3	55
Percentage	9.4%	8%	14%	3%	65%
Mass Production group (17 responses)	7	8	12	8	51
Percentage	8%	9.4%	14%	8%	60%
Difference	-1.4%	-1.4%	--	5%	-5%

Results of Students Test: (information items)

Control group number correct		Mass production group number correct	
13	-2	17	-2
12	-2	16	-1
11	-3	15	-1
10	-6	14	
9	-2	13	
8	-1	12	-3
7		11	-3
6		10	-2
5		9	-3
4	-1	8	-1
$N = 17$		7	
$\overline{X}_2 = 10.2$		6	
		5	-1
		$N = 17$	
		$\overline{X}_1 = 11.4$	

The control group was another 9th grade section of industrial arts that had the same class requirements and organization except they did not participate in a mass production unit. The mean for the number of correct answers for the control group was 10.2 and for the mass production group was 11.4 correct answers. A t score of 2.5 resulted from these statistics which made the difference between the means significantly different, $.02 > P \geq .01$ at the .02 level of confidence.

APPENDIX V F

Situation 7

Results of Student Opinionnaire: (33 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 31

3. How did you like your particular job?

   liked it 26 didn't like it 6

4. Would you like to mass produce another project?

   yes 21 no 6 don't care 6

5. Why?

   it was fun 4
   interesting doing it 7
   learned something 9

   Why Not?

   work on own project 4
   didn't learn anything 2

6. What would you have rather done than work on the mass production project?

   nothing else 10
   work on individual project 17

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 18
   work with other people 6
   difficulties involved in M.P. 3

8. What was the best part of the mass production experience?

   the assembly operation 9
   planning & organizing it 3
   when we were finished 3
   individual jobs 4

the competition between classes 5

9. What was the part you liked least about the mass production?

a particular job	16	related instruction	5
people not doing their job	3	getting started	2

10. How would you suggest it be changed if this was done again next year?

technical change in production	7	better organization	5
		different project	3
was okay	5		

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"I felt that I could better meet some of the objectives of Industrial Arts in this experience."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning:

"They were willing to try and seemed to feel that they were doing something new and exciting."

2. At the conclusion:

"They were glad the experience was over but were generally happy they had had a chance to work in this type of a program."

B. What did you expect the students to learn?

1. "Something about industry and how it operates
2. Cooperation
3. Distribution"

C. What did the students learn?

"All I expected and lots about the problems involved in mass producing something."

D. What evidence do you have of what they learned?

1. "I have the completed project and I saw it improved from the first day to the last.

2. "Test results too prove they learned about the personal or line staff relationship."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes--because I have faith in this method and believe that if a purpose of Industrial Arts is to teach about industry, this is a very good method and one that kids like."

B. What will you do differently?

"This year I think I will select a project that requires more jigs and fixtures, and a project that will look the same as the next one."

C. What did you like best about this technique this year?

"I liked the enthusiasm of the students."

D. What did you like least about this technique this year?

"It takes lots of planning on the part of students that sometimes seems to be lost time. However, I'm sure that this is a very necessary part of this method."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (32 responses)	10	25	12	19	94
Percentage	6%	15.5%	7.5%	12%	59%
Mass Production group (33 responses)	10	23	29	20	84
Percentage	6%	14%	17%	12%	51%
Difference	--	-1.5%	+9.5%	--	-8%

Results of Student Test: (information items)

Control groups number correct		Mass Production groups number correct	
17	-3	17	-1
16		16	-2
15	-4	15	-3
14		14	-5
13	-5	13	-8
12	-5	12	-3
11	-5	11	-4
10	-1	10	-2
9	-3	9	
8	-1	8	-1
7	-1	7	-1
6	-1	6	
5	-2	5	-2
4	-1		
$N = 32$		$N = 33$	
$\bar{X}_2 = 11.3$		$\bar{X}_1 = 12.4$	

The closest control groups that were available were two 10th grade drawing classes. These had had the 9th grade industrial arts class the year before. The mean for the two control groups was 11.3 correct and for the mass production groups was 12.4. This yielded a t score of 2.9 which made the differences between the means highly significant being $.01 > P > .001$. This was the greatest difference between any of the groups in these 11 situations, being highly significant at the .01 level of confidence.

APPENDIX V G

Situation 8

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"I thought that there would be learning involved that otherwise could not be presented in the normal classroom activities of the shop."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"Skeptical."

2. At the conclusion?

"They seemed to realize that production in even a small way involved many interesting problems and that modern industry has many challenging jobs to offer the competent person."

B. What did you expect the students to learn?

"Some of the problems concerned with jigs and fixtures in a mass production job, and the feel of production terminology."

C. What did the students learn?

"Some procedures of the use of jigs and fixtures, availability of materials, and problems concerned with correct use of materials in the foundry."

D. What evidence do you have of what they learned?

"They developed a view of looking for the best available materials to do a given job, rather than picking the first material they came to."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes, in woodshop. I feel that even though we did not carry the project as far as I wanted to, they did absorb valuable information."

B. What will you do differently?

"Woodshop--simpler project--wood laminating."

C. What did you like best about this technique this year?

"Just the fact that the results were connected with Michigan State University gave the students added enthusiasm."

D. What did you like least about this technique this year?

"I could have done more research into a project that would have been more suitable for metals."

4. Additional comments:

"It seems as if the students tend to pick a production project that is too hard for them if they were working alone on it, so teacher supervision has to be a guiding factor."

APPENDIX V H

Situation 9

Results of Student Opinionnaire: (15 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 10 — didn't like it 4

3. How did you like your particular job?

   liked it 10 — didn't like it 5

4. Would you like to mass produce another project?

   yes 11 — no 4

5. Why? — Why not?

   it was fun 3 — very tiresome, boring 3

6. What would you have rather done than work on the mass production project?

   nothing else 7 — work on individual project 8

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 6 — difficulties involved in M.P. 4

   individual job skills 2

8. What was the best part of the mass production experience?

   planning & organizing it 5 — when we were finished 3

   working together 2 — individual jobs 3

9. What was the part you liked least about the mass production?

   a particular job 3 — getting started 2

   people not doing their job 2

10. How would you suggest it be changed if this was done again next year?

more time 3 different project 3

better organization 4

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"I have been planning on doing a mass production project in one of my classes for the past two years. When you contacted me and gave me some information on mass production, I made up my mind to try it."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"They seemed to be very interested and their interest increased as the project progressed."

2. At the conclusion?

"At the conclusion, they were more interested and enthusiastic than at the beginning."

B. What did you expect the students to learn?

"I expected them to learn about some problems of industry and to get some idea of the tremendous amount of work and planning that goes into setting up a production line."

C. What did the students learn?

"I think they learned to a certain extent what I stated in (B) but in addition they and I, as well, learned about some of the personnel problems that develop in a mass production project."

D. What evidence do you have of what they learned?

"By what they discussed in our class discussion."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes, because it is a new and refreshing experience to me and it teaches my students things that they are more likely to use after school."

B. What will you do differently?

"Spend more time on quality control and working on jigs and fixtures."

C. What did you like best about this technique this year?

"The students showed a genuine interest in this type of project."

D. What did you like least about this technique this year?

"The lags between different jobs for some of the students. I am sure that this can be corrected with better planning of work."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (13 responses)	3	4	7	5	46
Percentage	5%	6%	11%	8%	68%
Mass Production group (15 responses)	7	9	7	62	46
Percentage	9%	12%	9%	8%	61%
Difference	+4%	+6%	-2%	--	-7%

Results of Student Test: (information items)

Control group number correct		Mass production group number correct	
15	-1	15	-3
14		14	-2
13	-1	13	
12	-1	12	-1
11	-4	11	-4
10	-2	10	-2
9	-2	9	

Control group number correct		Mass production group number correct	
8		8	-1
7	-1	7	
6		6	-2
5		$N = 15$	
4		$\bar{X}_1 = 11.3$	
3			
2	-1		
$N = 13$			
$\bar{X}_2 = 10.1$			

The control group was a section of 8th grade boys that had just previously completed the eight weeks of metalwork. They had worked on individual projects and exercises. The mean of the control group was 10.1 correct and was 11.3 for the mass production group. This yielded a t score of 2.1, which makes the difference between the means $.10 > P > .05$, this being significant at the .05 level of confidence.

APPENDIX V I

Situation 10

Results of Student Opinionnaire: (7 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 7

3. How did you like your particular job?

   liked it 7

4. Would you like to mass produce another project?

   yes 3 don't care 3

5. Why? Why not?

   learned something 4 work on own project 2

6. What would you have rather done than work on the mass production project?

   work on individual project 7

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 2

   individual job skills 3

8. What was the best part of the mass production experience?

   the assembly operation 2 individual jobs 4

9. What was the part you liked least about the mass production?

   a particular job 4

10. How would you suggest it be changed if this was done again next year?

    different project 2 different organization 3

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"Because I felt that my students needed to be exposed to the operations and problems of industry today as they may have to make their living as a part of this industry."

II. Your Students:

A. What was their reaction to this technique?

1. At the beginning?

"They were enthusiastic about the project from the beginning and felt there was much to be learned."

2. At the conclusion?

"They were happy to have worked on the project but felt that at times industry could be boring and discouraging. They felt that in real industry, the problems could be handled better than they were capable of handling them."

B. What did you expect the students to learn?

"I wanted the students to achieve an understanding of industry, its operations and problems as well as learning how to work together and accept responsibility."

C. What did the students learn?

"It is my belief that the students learned exactly what I had hoped they would learn."

D. What evidence do you have of what they learned?

"The evidence I have of what my students learned is the evaluation of their project, written by each student and the test that they took concerning the mass production project."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"I'm not certain whether or not I would do the project next year because I feel that there was a

great deal more work done to accomplish what the students did accomplish."

B. What will you do differently?

"I would guide the students more in setting up the project."

C. What did you like best about this technique this year?

"I felt that it developed leadership among some students."

D. What did you like least about this technique this year?

"I felt that it centered too much around certain students and not enough around other students."

4. Additional comments:

"I feel that in a different school system, where I might have more school help, the project might be more worthwhile."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (10 responses)	2	6	5	4	33
Percentage	4%	12%	10%	8%	66%
Mass Production group (7 responses)	2	4	5	1	23
Percentage	5.7%	11%	14%	3%	66%
Difference	+1.7%	-1%	+4%	-5%	--

Result of Student Test: (information items)

Control group number correct	Mass production group number correct
14 -1	15 -2
13 -1	14 -1
12 -2	13 -1
11	12 -3

Control group number correct		Mass production group number correct
10	-2	11
9	-1	10 -1
8	-2	N = 7
7	-2	$\bar{X}_1$ = 13
N = 10		
$\bar{X}_2$ = 10.3		

The control group was another 9th grade group that was taking mechanical drawing during that semester. The mean for the control group was 10.3 and was 13 for the mass production group. This provided a t score of 5.1 which indicated a highly significant difference at the .001 level of confidence. The other 12 members of the class that did not participate in the mass production item were also given this test. Their mean was 10.7 which was very close to the control group's mean and so would be significantly different from the mass production group.

APPENDIX V J

Situation 11

Results of Student Opinionnaire: (15 responding)

1. What do you think of mass producing a project in industrial arts?

   liked it 12 didn't like it 3

3. How did you like your particular job?

   liked it 11 didn't like it 4

4. Would you like to mass produce another project?

   yes 6 no 8

5. Why? Why not?

   it was fun 2 very tiresome, boring 3

   learned something 3 work on own project 3

6. What would you have rather done than work on the mass production project?

   nothing else 5 work on individual project 9

7. What do you think you learned during the time you were mass producing the project?

   how things are produced 5 work with other people 4

   individual job skills 3 nothing 2

8. What was the best part of the mass production experience?

   the assembly operation 2 when we were finished 2

   working together 3 individual jobs 5

9. What was the part you liked least about the mass production?

   a particular job 4 getting started 2

people not doing their job 4 wasted time 2

10. How would you suggest it be changed if this was done again next year?

no change 5 different organization 4

too long and boring 3

Results of Teacher Opinionnaire:

I. Why did you decide to do a mass production project this year?

"I have been thinking about doing a mass production project for a couple of years and since the teaching staff had a need for boxes to hold their attendance cards, it was a natural for a class mass production project. By starting with a project that had a ready market, we were a little more assured of a successful experience for our first mass production project."

II. Your students:

A. What was their reaction to this technique?

1. At the beginning?

"At the beginning, they were interested but during the planning stages some lost their interest due to the slowness of the process. However, once we got started on the actual production, they were quite enthusiastic."

2. At the conclusion?

"Near the end, a few again lost interest due mostly to the fact that it perhaps was a little too long and that they had been moved out of certain jobs requiring a great deal of care and accuracy."

B. What did you expect the students to learn?

"The involvement of mass production; social relationships, importance of leadership and followership, the organization of an industrial plant, value in working accurately, simplicity of the task when each person does just one part of the total process, and the value of standardization of parts and thorough planning."

C. What did the students learn?

"Organization of an industrial process, need for cooperation, the value of accurate work, and the value of standardization of parts."

D. What evidence do you have of what they learned?

"Discussions and quiz about methods, etc."

III. Yourself:

A. Will you do this again next year? Why? or why not?

"Yes. I have worked through it once now, and feel that it is a very worthwhile and effective method of teaching the principles and problems of mass production."

B. What will you do differently?

"I believe I will try to find a product that will be used either by members of the class, their classmates, or adults in the community. I would also like to get a product that had more work stations. On the product we did this past fall, I felt we may have had too many at the same job, e.g., three or four layout men. I got the feeling from some of the students that all were not doing their share, in other words, some of the slower students were getting by on faster student's work."

C. What did you like about this technique best this year?

"It is the best way, I feel, to illustrate industrial life to the students and it helps to achieve some of the goals of industrial arts."

D. What did you like least about this technique this year?

"There is the problem of some of the equipment being tied up by the class involved in mass production, since they set up their jigs, etc., which for efficiency's sake can't be set up and taken down every class period."

Results of Student Test: (judgment items)

Answer	1	2	3	4	5
Control group (24 responses)	6	10	13	11	80
Percentage	5%	8%	11%	9%	66%
Mass Production group (14 responses)	6	9	4	9	43
Percentage	8%	13%	6%	13%	61%
Difference	+3%	+5%	-5%	+4%	-5%

Results of Students Test: (information items)

Control group number correct		Mass Production group number correct	
14	-1	15	-2
13	-4	14	-1
12	-3	13	-2
11	-5	12	-1
10	-4	11	-3
9	-2	10	-2
8	-2	9	-1
7	-2	8	-1
6	-1	7	-1
$N = 24$		$N = 14$	
$\overline{X}_2 = 10.4$		$\overline{X}_1 = 11.4$	

The control group for this situation was another 8th grade section of industrial arts that had the same assignments and organization except for the mass production unit. The mean score for the control group was 10.4 answers correct and for the mass production group was 11.4. A t score of 2.7 was derived from this which makes the difference between the means significant $.02 > P > .01$. This would be significant at the .02 level of confidence.

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