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To the Committee on Graduate Study:

I am submitting to you a thesis written by Cecil W. Cheney entitled "A Proposed Industrial Arts Program for Harry P. Harding High School of Charlotte, North Carolina." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Industrial Education.

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and recommend its acceptance:

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A PROPOSED INDUSTRIAL ARTS PROGRAM FOR HARRY P. HARDING
HIGH SCHOOL OF CHARLOTTE, NORTH CAROLINA

A THESIS

Submitted to
The Committee on Graduate Study
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by
Cecil W. Cheney
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INTRODUCTION

In September 1949, the writer became a member of the staff at Harry P. Harding High School in Charlotte, North Carolina, as Instructor in Industrial Arts. In conference with administrators, it was revealed that they were interested in further development of Industrial Arts Education in the school.

Without any implied criticisms on previous efforts, it is felt that an expansion of present offerings is in order. School authorities are favorable toward a study of the situation which might cast more light on the present services being offered and might point to the possibilities of enlarged services. In any event it is believed that the results of such a study would receive careful consideration at the hands of local administrators and with this thought in mind the problem has been attacked.

CHAPTER I

THE PROBLEM

The major problem to be investigated is, what should be the extent of the industrial arts program at Harry P. Harding High School. The administrators, and those connected with the present industrial arts program, realize that the present program is probably inadequate and that it might be expanded to embrace a wider field of activities. It is the purpose of this study to present a program which will be useful as a guide in future planning. In all probability any expanded program presented will not be added in its entirety at the beginning. An effort will be made to present the various phases of the proposed program in such a manner that one or more activities may be installed as facilities, equipment, and instructors are available.

In planning a program for a school the size of Harding, there are many factors which must be considered. The first consideration must be given to the objectives formulated for the type of industrial arts work that is to be followed. Is the objective to provide a wide, general, exploratory type of experience, where basic skills, consumer knowledge, and understanding of industrial life are the ends sought? If so, the shop offerings should provide a wide range of experiences in a number of activities. If the objective is to provide a more advanced type of training where specialized skills, technical information and knowledge of production methods are the ends, then a different type

of shop layout is required.¹

The size of the school is a factor which must be considered in establishing a program of industrial arts. Smaller schools in many cases will benefit from a general shop organization while large schools can more easily finance a unit shop program.²

The industrial and occupational characteristics of a city or community will often have a decided bearing on the type of industrial arts work which should be offered.

Some industrial arts educators advocate that the program provided in the public schools should be patterned after those industries which are operated in the community.

If education is to keep pace with world conditions, the training of educators should include the gathering of first hand knowledge of community affairs. Let there be opportunities to bring classroom education and education for industry together in a practical way.³

Others believe this is all wrong, that students will familiarize themselves with these industries and occupations through contact and community interests, that they should be offered industrial arts work activities foreign to them and their community.

¹"Industrial Arts in Louisiana," Bulletin No. 627 (Baton Rouge, Louisiana: State Department of Education, January 1948), p. 22.

²Ibid., p. 22.

³Verne C. Fryklund, Trade and Job Analysis (Milwaukee: Bruce Publishing Company, 1942), pp. 22-23.

A fallacious theory formerly existed which was expressed in the assertion that industrial arts offerings should be influenced materially by the industries represented in the community. It must be remembered that today many boys do not work later as adults in the city in which they receive their education. As a part of general education, industrial arts subjects must be representative of trades and industries which are common throughout the nation.⁴

The former concept, to adapt industrial arts offerings to community activities, seems to have greater merit, and this study will be made with that thought in mind. The industrial arts courses as will be presented in a future chapter will be based largely on the occupational distribution of the skilled workers of Charlotte, in relation to the various crafts which they represent. It will probably be difficult to arouse public interest to buy equipment and establish a sheet metal class if there is no sheet metal work carried on in the city. By the same token, if there are several machine shops in a city, employing a number of workers, there will probably be support for some machine shop experiences in the schools.

A further consideration in organizing industrial arts courses is, what grade level or age pupils will be served. The courses presented to senior high students will be more likely to provide specialized skills, more technical information, and to stress the vocational implications of the work. Junior high school students will usually be offered a program which is broad and general and which will provide manipulative activity

⁴John F. Friese, Course Making in Industrial Education (Peoria, Illinois: The Manual Arts Press, 1946), p. 194.

and emphasize the development of understanding, appreciation, interest, and good work habits.⁵

It should also be recognized that courses set up for all age groups at the junior high level will not meet the requirements of another age group at the same level. For ~~example~~, a woodworking course set up for seventh graders would not be the course best adapted to a group of ninth grade boys. It is generally accepted that there is a definite variance in characteristics between the typical seventh grade boy and the ninth grader or even the boy in the eighth grade.⁶

The typical seventh grade pupil will be highly active. He will lack fine coordination in skills, and possess short interest retention. He will, however, be bubbling over with enthusiasm and will be easily motivated.⁷

The typical ninth grade pupil will have advanced in stature and muscular coordination. He is ready to assume a great deal more responsibility and is less dependent upon the instructor.⁸

More will be said about characteristics of each age group when courses for these groups are presented in a later chapter.

⁵"A Guide for the Administration of Industrial Arts," Bulletin No. 1 (Minnesota State Department of Education), p. 10.

⁶Ibid., p. 10.

⁷Loc. cit., p. 10.

⁸Ibid., p. 12.

In short, the problem to be considered is, to present an Industrial Arts program for a combination junior-senior high school with an enrollment of approximately 650 boys which can be used in its entirety or in part and which will not only meet the needs of the pupils but of the community as well.

CHAPTER II

BRIEF HISTORY OF HARRY P. HARDING HIGH SCHOOL

Harry P. Harding High School is now one of three high schools for white students in the city of Charlotte.¹

In 1935, Harry P. Harding High School was built to care for students of junior and senior high school age from the west side of Charlotte. The enrollment the first year, 1935-1936, was 567 students of grades seven through ten.² The next year grade eleven was added and the present organization of grades seven through twelve was completed and in operation during the school year of 1937-1938. In June of 1938, the first senior class graduated from Harding High.³

The original building as was completed in the spring, 1935, included an auditorium, fifteen classrooms, one laboratory which was used for biology classes, and the central offices. The faculty was composed of thirteen teachers and one principal. The school was put in operation in September, 1935.⁴

¹The Charlotte Observer, "Schools to be Evaluated" (Charlotte, North Carolina: October 5, 1949), p. 1.

²James R. Hawkins, Annual Report to Superintendent (Charlotte, North Carolina: June, 1936), p. 3.

³The Charlotte Observer, "School Graduates First Class" (Charlotte, North Carolina: June 2, 1938), p. 22c.

⁴The Charlotte Observer, "Students Will Report to Harding in September" (Charlotte, North Carolina: May 30, 1935), p. 1b.

In 1938, a new section was added to the original building. This included thirteen new classrooms, an Industrial Arts Department, laboratories for home economics and a new gymnasium. These were put in operation in March 1938.⁵

Additional dressing rooms for the gymnasium, a cafeteria with modern kitchen facilities and a new library were added in 1949. This resulted in the addition of five new classrooms from space which was originally occupied by the library and cafeteria. These were put in operation in September 1949.⁶

During the school year of 1948-1949, the enrollment ranged between 1400 and 1450 students, of which approximately 650 were boys. To care for and teach these young people was a staff of forty-five teachers, a principal and vice-principal. There were two full time office secretaries and one cafeteria manager.⁷

Staff members fall into two categories, special and academic. Special interest teachers include: two industrial arts teachers, two in the home economics department, three in physical education, two in music, one in art, one librarian, and one teacher of distributive education. The remaining thirty-three teachers teach the academic subjects.⁸

⁵The Charlotte Observer, "Harding Addition Completed" (Charlotte, North Carolina: February 25, 1938), p. 40.

⁶The Charlotte Observer, "Harding Goes Modern" (Charlotte, North Carolina: July 10, 1949), p. 14c.

⁷Educational Directory Charlotte and Mecklenburg County Schools (Charlotte, North Carolina: 1949-1950), p. 4.

⁸Ibid., p. 4.

All classes in Harding High School, with the exception of three seventh grade sections, are organized on the departmentalized plan. Students move from room to room for their various classes. The three special seventh grade sections are composed of students who are in need of remedial work in some subjects. These students remain with the same teacher throughout the school day except to go to other rooms for instruction in the special interest subjects such as music, art, industrial arts and home economics.⁹

Each new student, when enrolling at Harding High School, is assigned to a home room teacher. He remains with this teacher for one year if entering in the seventh grade. At the beginning of the eighth year he is assigned to another home room teacher. He will stay in this home room for the remaining time he is in attendance at Harry P. Harding High School, which may be for five years. This system has a seemingly desirable feature in that the teacher can become quite well acquainted with the student and his family and can do a more thorough job of counseling and guidance than if he had the student for one year only.¹⁰

All students report to their home rooms at the beginning of each school day for a period of fifteen minutes and for a five minute period at the end of the day for dismissal.

⁹James R. Hawkins, Master Sheet, "Program of Studies" (Charlotte, North Carolina: 1949-1950).

¹⁰James R. Hawkins, Verbal Directives to Staff, September 1949.

Present plans call for a new school to be built on the west side of Charlotte, which will absorb a part of the present student body now attending Harding High School. Upon completion of this school, the Harding plant will be used to house either a junior or senior high school. Definite plans for the separation are still in the tentative stage.¹¹

The west side of the city requires either a junior high or high school to relieve Harding High.¹²

Detailed Description of the Present Industrial Arts Courses

At present, the only two activities carried on in the Industrial Arts department at Harding High School are woodwork and mechanical drawing. Instruction, however, in these two phases of work, is as complete as facilities, tools, and equipment will allow. Students from all grades in the school, seventh through twelfth are represented in the various classes. There are seven woodworking classes and five classes in drawing.

Membership for the various shop courses is determined by grade placement, and by previous industrial arts training and experience. Shop classes are divided into the following groups:

Junior Shop I in grades 8 and 9 is for students with no previous shop experience.

Junior Shop II in grade 9 is for students who took shop the previous year in grade 8.

¹¹N. L. Engelhardt, Educational Expansion Survey for Charlotte (Charlotte, North Carolina: 1949, unpublished), p. 22.

¹²The Charlotte News, "Charlotte's 1950 School Plans Call for Great Expansion" (Charlotte, North Carolina: January 24, 1950), p. 50c.

Junior Shop III in grade 9 is for students who took shop in both grades 7 and 8. Two years of shop have been completed by this group.

Senior Shop I in grades 10, 11, and 12, is for students who did not take shop the previous year in grades 9, 10, and 11.

Senior Shop II and III in grades 10, 11, and 12, is for students who took shop the previous year in grades 9, 10, and 11, or for those who have had one year of shop in junior high.

Senior Shop III in grades 10, 11, and 12, is for students who have had two or three years of shop in grades 7, 8, and 9, or two years in senior high school.¹³

Where schedules will permit, Junior Shop I groups meet five days each week for one semester. At the end of the semester, the classes taking woodwork will transfer to mechanical drawing, and those taking mechanical drawing will begin woodwork. The length of periods for all classes is forty-five minutes.

Junior and Senior II and III classes meet five days each week throughout the year.

The individual classes are organized according to the general unit shop plan.

¹³James R. Hawkins, Information and Suggestions About Registration (Charlotte, North Carolina: September 1949, unpublished), p. 1.

This type of shop is probably more numerous than any other at the present time. They are shops in which the subject matter experiences are confined to a single field in industry, such as woodworking, metal working, or printing. Such shops are commonly identified as general metal, or general wood, hence they are general unit shops.¹⁴

In the narrow interpretation of the term unit shop, each boy would not only be working with the same material, but would also be using the same tools and be performing many of the same operations.

A unit shop may be defined as one which deals primarily with the tools, processes, materials, and information of a single occupational area.¹⁵

Mechanical drawing courses at Harding High School are organized along the same pattern as the woodworking courses. The primary difference is that two years of drawing is the maximum which may be elected. Exceptions are made to this in cases where a student shows outstanding ability in drawing or where there is an expressed desire to follow drafting as an adult career. Girls are permitted to enroll in mechanical drawing which is not true in the case of woodwork.¹⁶

¹⁴H. O. Thomas, "Industrial Arts in Louisiana" Bulletin Number 627 (Baton Rouge, Louisiana: State Department of Education, January 1948), p. 19.

¹⁵Gordon O. Wilber, Industrial Arts in General Education (Scranton, Pennsylvania: International Textbook Company, 1948), p. 101.

¹⁶James R. Hawkins, op. cit.

Content and Method (Woodwork)

Educationally, woodwork ranks high among the industrial arts subjects. It was the first of the industrial occupations to be subjected to educational analysis and teaching methods, and it has served as the basis for the development of shop activities in all the industrial arts subjects. Few households are without tools of some sort and there are comparatively few adults who do not make some effort to use them. The woodwork courses of the school should definitely aim to give a practical acquaintance with the principal woodworking tools which will function in the later life of the pupil. It is generally believed that some knowledge of the use of woodworking tools should constitute a part of the educational equipment of every adult.¹⁷

There is no reason why woodworking should not serve as a basic course to which the thoughtful and versatile teacher may add much in related material from other industrial arts subjects, with little added expense in equipment and supplies.¹⁸

In general, the purposes of woodworking courses are more easily accomplished through the individual rather than the quantity-production method of work and instruction. By this method a knowledge and mastery of tools and fundamental processes are acquired, and if the courses are well devised, opportunity is provided for originality and initiative and

¹⁷William E. Roberts, Woodworking in the Junior High School (Peoria, Illinois: The Manual Arts Press, 1930), p. 12.

¹⁸Ibid., p. 13.

for the development of appreciation and the creative impulse through selection and design.¹⁹

The following will be a detailed account of the courses as they are presented to various grades receiving instruction.

Junior Shop I

Since boys falling under this grouping are new to the institution, more time is spent with them on orientation than is spent with boys who have had previous shop experience. The instructor tries to familiarize them with the strange surroundings and make them feel at ease. Policies and rules of the shop, shop fees, and paying for materials, required projects, what the instructor expects from the students, and what the student can expect from the instructor, are all explained in detail. Questions during this discussion are encouraged and answered.

After the orientation periods, students are shown each machine in the shop and given an explanation of its uses and also a demonstration of how it is used. The reason for this is not that the students will be using the machines, since Junior Shop I work is all done with hand tools, but to satisfy that natural curiosity which most boys have regarding power machines. It is also felt that this policy will reduce the answering of numerous questions in future classes. The boys are then shown a model of the first project they will make, and the various steps concerning its construction are explained. Next comes a study of

¹⁹Ibid., pp. 19-20.

the various hand tools which will be used in the building of the project. As discussion for each tool is completed, the instructor demonstrates its proper use and then allows students to practice on scrap lumber.

When a study of all tools to be used has been completed, stock is given to the student and he begins work under the watchful eye of the instructor. Correct techniques are stressed throughout the course. Although holding to close dimensions is not emphasized for this group of students, it is felt that squaring and trueing of surfaces is very important. Before any project is considered as done well, all edges and ends must be squared and surfaces true. Demonstration by the instructor is a method which is used constantly throughout the construction of first projects. Careful selection of the first project is deemed important. It is expected to be simple, inexpensive and to require the use of as many basic hand tools as possible. Book ends are an example of what is considered an acceptable project for beginners. Tools which may be used in constructing book ends are: plane, file, cross-cut saw, coping saw, hammer, screw driver, hand drill, try-square, and dividers or compass. Emphasis is placed on the proper sanding of projects, since it is felt that a good finish cannot be obtained on a rough surface.

Students are permitted to choose their own finish from a selection of stain, enamel or natural finishes. Lecture and demonstration methods are used in the teaching of applying and rubbing the various finishes.

Upon completion of the first project, the student is assigned a second one. He may, on the second project, choose one of three to complete. Typical projects from which he may choose are: tie or towel racks, small footstool, whatnot shelf or bird house. If time permits, the student, on his third project, can build anything of his choice, providing he stays within limits of his ability.

Information which is covered with the Junior Shop I group in the form of related material is:

1. An orderly plan of procedure
2. The ability to read a working drawing
3. How to figure board measures
4. Read the board measure scale on framing square
5. Characteristics of various woods
6. Kinds and use of glue and its preparation
7. Characteristic differences in saws
8. Characteristic differences in planes
9. Ability to make a bill of material
10. Sizes and characteristics of nails
11. Sizes and kinds of wood screws
12. Common hand tools, names, uses, and care
13. Determining auger bit sizes
14. How to apply various finishes
15. Safety practices in use of hand tools
16. Methods of cutting and milling lumber
17. Methods of drying lumber
18. Standard dimensions of lumber.²⁰

Junior Shop II

In addition to hand woodworking, two other phases of work are introduced with this group. One is fiber furniture weaving, featuring the use of art fiber cords, and the other is a limited amount of machine woodworking.

²⁰"A Guide to Teaching in the Oak Ridge Schools" (Oak Ridge, Tennessee: September 1945), p. 163.

The work in fiber furniture weaving is offered to provide a wider range of experiences and because weaving is a craft which is characteristic of the southern highland section.

The orientation period for Junior Shop II is much the same as for Junior Shop I, except not so extensive. These boys have spent one year in the shop and are expected to be familiar with most of its policies and practices.

There is one required project for Junior Shop II boys. This is in fiber furniture weaving and is usually a woven serving tray. Freedom of color and design are encouraged. Weaving has been quite popular with boys of this group. Second and even third projects are often made, although only one is required. If a second weaving project is desired, the student is encouraged to bring a chair from home which needs bottoming or build a footstool and weave a rush seat. This craft is especially popular with boy scouts since it affords them the opportunity of earning several different merit badges. As many as three merit badges, weaving, woodwork, and wood turning, can be earned by the construction of one project, such as a footstool, where weaving is used.²¹

After completion of one required project, Junior Shop II boys are given their choice of projects, either in wood or weaving, or a combination of both. Care is again exercised by the instructor in an

²¹Hand Book for Boys (New York: Boy Scouts of America, 1932), pp. 466-525.

effort to see that a boy does not choose a project which is beyond his working ability.

Junior Shop II boys are also introduced to the scroll saw, drill press and wood lathes. Instruction and demonstration is given in the proper use and care of these machines, safety practices in relation to their use, the range of work which can be safely done, and adjustment for various speeds. The instructor is especially careful that each boy is instructed in the proper type of drill or bit which can be safely used in the drill press. Damage to work, machine, or boy can result from improper use of machines. Information which Junior II boys are expected to know is that listed for the Junior I class and in addition:

1. Composition of weaving materials
2. Various kinds and uses of weaving materials
3. How to make an ellipse by the pencil and string methods
4. How to divide an ellipse into equal parts with dividers
5. Methods of tying off ends of weaving stakes
6. Machine safety practices
7. Tongue and groove and dowel edge glueing
8. Woodworking hardware
9. Common wood joints
10. Drill and machine bit sizes
11. Use and care of drill press
12. Correct drill speed for different drilling operations
13. Adjust and care for lathe
14. Know the names and uses of lathe chisels
15. Mount work between centers
16. How to use inside and outside calipers
17. How to lay off patterns on lathe
18. How to use screw chuck
19. How to mount work on face plate
20. How to sand on the lathe
21. How to apply finish on the lathe
22. Use and care of scroll saw
23. How to fasten blades in scroll saw
24. Know the range of work that may be done

25. Principles of operation of scroll saw
26. Types of blades which may be used in scroll saw
27. Composition of typical finishes such as: shellac, oil varnish, oil paint, oil stain, and lacquer.
28. Proper method of applying finishes
29. Use of rubbing compounds
30. Types of rubbing compounds
31. Purpose of wood filler
32. Application of wood fillers.²²

Typical projects which are made by Junior Shop II boys are woven serving trays, footstools with or without turned legs and with rush seats, magazine racks, tables, fruit and nut bowls, table lamps, book cases, bedside tables, and similar articles.

Senior Shop II and III

As was stated earlier, this group is composed mainly of junior and senior boys who have had at least two years shop experience.

In addition to the regular orientation period given to Junior Shop I and II boys, the Senior Shop group is reminded that they will be expected to be more or less on their own in regard to selection of projects, design and routine problems. They are expected to do more outside work in the form of reports on related information than has been their experience in the past. This group is discouraged from making trinkets and knick-knacks and are encouraged to make more difficult projects, such as furniture, which are worthwhile and welcome in any home. Senior Shop II and III boys are permitted free choice of projects for construction.

²²"A Guide to Teaching in the Oak Ridge Schools", op. cit., p. 165.

As stated, the only restriction is that the project is difficult enough to act as a challenge, but not beyond the student's working ability. Each boy is required to perform one turning exercise on the lathe. If he does not care to make a turning project, he is assigned an exercise by the instructor.

Students from this group are allowed free usage of all the machine tools in the shop. In cases where this privilege is abused on a certain machine, the student is restricted from using that machine for a certain length of time. Considerable time is spent in discussing and demonstrating the proper methods in using or operating the various machines found in the shop. Safety practices and procedures are stressed, not only during the orientation period, but throughout the year, with particular emphasis on the safe range of operation for machine. Whenever possible, the school safety engineer is called in to give lectures and demonstrations on safety practices.

Informational units for which Senior Shop II and II boys are held responsible are as follows:

1. All units required of Junior I and II boys
2. Knowledge of principles of operation of band saw
3. Rules of safe operation of band saw
4. Knowledge to adjust blade tension and blade guides
5. How to saw curves
6. Knowledge of range of work which may be done on band saw
7. How to rip and cut off stock
8. How to cut a band saw tenon
9. Proper band saw blade for a specific job
10. How to replace dull or broken blades
11. Know the rules for safe jointer operation
12. Know the range of work which may be done on jointer
13. How to joint a straight edge
14. How to cut a taper

15. How to cut a bevel or chamfer
16. How to cut a rabbet
17. Knowledge of safety rules for circular saw
18. Know range of work which may be done
19. Know how to adjust the saw for depth or angle of cut
20. How to cut grooves
21. How to cut dados
22. How to cut tenons
23. How to use a moulding head
24. How to cut miters
25. Know the rules of safe operation for surfacer
26. Know how to care for and adjust surfacer
27. Know how to adjust for depth of cut
28. Knowledge of feed control
29. Maintenance, grinding, and honing of cutting tools
30. Care and use of portable electric sander
31. How to change sander belts
32. Care and use of portable electric router
33. Knowledge of belts, proper grades for specific jobs
34. Safety rules for sander and router
35. Knowledge of spindle shaper, its care and use
36. Safety rules for shaper.²³

Typical projects made by Senior Shop II and III boys are:

Table lamps
 Floor lamps
 End tables
 Dining tables
 Coffee tables
 Cedar chests
 Lawn furniture
 Desks
 Trellis.

Industrial Arts Woodwork Enrollment

Table I illustrates the distribution of students taking shop according to their grade level. It will be noticed that Senior Shop II

²³Ibid., p. 177.

TABLE I

ENROLLMENT IN INDUSTRIAL ARTS WOODWORKING CLASSES
FIRST SEMESTER 1949-1950

Title	Section	Period	Total	Enrollment by Grades					
				7	8	9	10	11	12
Junior Shop I	I	2	24	23					1
Junior Shop I	II	3	23	20	3				
Junior Shop I	III	8	23	21					2
Junior Shop II	I	5	16			8	5	2	1
Junior Shop II	II	7	18	2	15	1			
Senior Shop I	I	1	18				6	5	7
Senior Shop II and III	I	4	17				6	1	10

and III were combined to make one class since there was insufficient demand to warrant the organizing of two individual classes for this group. It will also be seen that in some cases, students with twelfth grade standing were permitted to enroll in Junior Shop I. These cases are unusual and are allowed only when a student with no previous shop experience has a schedule which will not permit him to be enrolled in Senior Shop I. The usual standard used in shop placement is the amount of previous shop experience rather than grade placement.

Work space is provided for a maximum size class of 18 pupils. As can be noted the Junior Shop I classes are in excess of this number, which has resulted in an overcrowded condition.

Present Facilities of the Industrial Arts Department

The Physical Plant

The Industrial Arts Department of Harry P. Harding High School is located on the first floor of the main school building. This is undesirable since the noise from the machines in the shop are likely to disturb other classes.

The Industrial Arts Department consists of a woodworking shop which measures 30 feet by 50 feet and a mechanical drawing room 22 feet by 30 feet. These two rooms are separated by a combination lumber and finishing room which is 10 feet by 30 feet in size. The lumber room has an outside entrance which facilitates the ease of stacking lumber and delivering supplies. The finishing room is equipped with built-in

cabinets for storage of paints, finishes and combustible solvents.

At the end of the shop opposite the lumber and finishing rooms are two small rooms which are 10 feet by 15 feet in size each. One is used by the two instructors jointly as an office and the other is used for a project storage room. The office is equipped with built in lockers for storage of supplies. Shelves which reach from floor to ceiling have been built along three walls of the storage room. All floors are of wood construction with the exception of the lumber finishing room, which has tile floors. All hand tools are stored in a centrally located, open cabinet in the woodworking shop. Since each tool space is silhouetted with paint, tools are easily located and checked at the end of each class period.

In the opinion of the present instructors, the shop is crowded, lacks storage space for projects, glued up materials and tools. In many respects it would be more desirable to have the shop housed in a separate building and isolated from the school building proper. The primary argument for this, of course, is to eliminate the machine noise as well as dust from the main school building. The preference for separate shops has been expressed by Mays and Casberg as follows:

A very desirable scheme for a trade school, where sufficient land is available, is to plan a group of small buildings so that either a single shop or a group of similarly equipped shops occupy separate buildings, all grouped around a central building in which are located administrative offices and classrooms.

Since so many considerations are involved in proper shop design, it is the opinion of the authors that a detached shop building is the most desirable scheme.²⁴

Power Tools

The number of machine tools in the woodworking shop at Harry P. Harding High School are adequate to care for the present program. Some of the tools, however, are old and somewhat worn and will need to be replaced or reconditioned at the end of the present school year. Power tools which are owned and operated by the school are as follows:

One Delta 10 inch tilting arbor, belt drive, bench saw

One Walker-Turner 6 inch belt drive jointer

One Delta 14 inch band saw with floor stand

One Walker-Turner 24 inch scroll saw, direct drive,
with floor stand

One Park 20 inch, single surface, planer

Two Delta lathes, 36 inch centers, 12 inch swing

One Delta, floor model drill press

One Delta, spindle shaper with stand

One Stanley, 6 inch double grinder with shields
and floor stand

One Stanley, portable electric router with straight
and circular guide

One Porter-Cable portable, electric, belt sander with
dust bag.

²⁴Arthur B. Mays and Carl H. Casberg, School Shop Administration (Milwaukee, Wisconsin: The Bruce Publishing Company, 1947), p. 28.

The above power tools are equipped with the various accessories which make them adaptable to do a number of different operations.

Hand Tools

It is not felt necessary to name each hand tool which is owned and used by industrial arts classes. It is sufficient to say that there is an ample number of the common hand tools to supply each boy in a class of 18 with a complete set. As for the special hand woodworking tools, there are sufficient numbers to care for any special job which a boy may be inclined to do. It has been the policy of the school to buy the best quality tools and, consequently, replacement due to breakage has been small.

Mechanical Drawing

Mechanical drawing at Harry P. Harding High School is considered and taught more as a part of general education than for vocational purposes. The course is planned to introduce elements from all main phases of mechanical drawing as student skills are increased and informational experiences are broadened. Much stress is laid on the informational side of drawing since it is felt that this phase of the course is equally as important as the skills which can be developed.

The purpose of the Mechanical Drawing course is to give the student a broad familiarity with the language of industry which is a language understood by craftsmen the world over. It is felt that if the student can read the language, he can better understand the industrial civilization in which he lives.

An exploratory or introductory course is offered for seventh and eighth grade classes. This type of work is planned to give the student a chance to familiarize himself with the terms and general application of drawing to his particular liking and to afford him the opportunity to put into practice the use of certain arithmetical terms and geometrical figures of which he has read, but for which he has heretofore found little or no application.²⁵

Courses for high school age boys are more advanced and may include such phases of drawing as machine, architectural, structural, sheet metal, furniture, and pictorial.

The mechanical drawing classes at Harry P. Harding High School are scheduled and classified in much the same manner as are the wood-working classes which were outlined earlier in this report; namely in relation to grade placement and previous drawing experience. Junior Drawing I is seventh and eighth grades with no previous experience. Junior Drawing II is ninth and tenth grades with one year drawing and Senior Drawing II and III are eleventh and twelfth grades with two or more years of previous drawing.

Seventh and eighth grade classes, where schedules will permit, rotate to woodwork at the end of one semester in drawing. Grades nine through twelve remain in drawing classes for a full year's work.

²⁵"Industrial Arts in Louisiana," Bulletin No. 627 (Baton Rouge, Louisiana: State Department of Education, 1948), p. 78.

Junior Drawing I

Seventh grade boys upon first entering the shop are assigned to drawing desks, and the usual lecture relating to rules and policies is given. In addition, there is a discussion on the subject of mechanical drawing, why it is taught, and its value in relation to other shop work as well as to a number of professions.

Drawing paper and a small piece of masking tape are next passed out and instructions given on how to place paper on the drawing board with the tape. Grades and selection of pencils is explained. Use and care of the T-square is explained along with a discussion of the scale and foot ruler there on. Only the use of the full scale and how to care for the scale is explained at this point. Also explained is how to properly sharpen a pencil and the importance of a sharp pencil. The 30° - 60° triangle is introduced with an explanation of its use, care, and how to use it.

A large sample title block on the blackboard is utilized in the discussion of its use, and method of laying out. Students use this form in making their own title block, and lettering it.

Simple wooden blocks of various shapes and dimensions are distributed and as the drawings are completed, more complicated blocks are used until all students have completed at least one drawing. Drawings at this point are checked for mistakes such as: double lines, smears and flaws in lettering. The latter is not stressed, however, for it is felt that

seventh and eighth grade boys are too immature to develop any appreciable degree of skill in lettering. Extra time in lettering is not required, except on title block and as interest is shown.

Simple straight line orthographic projections are drawn and dimensioned and drawings submitted for check. All errors are checked with red pencil.

The 45° triangle is explained and its use for projecting in a working drawing is taught.

Simple straight line isometrics are introduced to maintain interest and promote neatness. Best drawings are selected by the instructor and posted as an incentive to other boys. This is done for boys in grades seven through twelve. Information gained in Junior Drawing I is listed as follows:

1. Drawing supplies and equipment
2. Kinds and grades of pencils
3. Uses and types of measuring devices
4. Sizes and uses of triangles
5. How to test a T-square
6. Uses of drawing
7. How to clean drawings
8. Terminology of drawing
9. Erasers used in drafting
10. Knowledge of relation of views
11. How to read the scale
12. Rules for dimensioning
13. Skills developed by mechanical drawings.²⁶

²⁶"A Guide to Teaching in the Oak Ridge Schools", op. cit., p. 162.

Junior Drawing II

Junior Drawing II sessions begin with a summary and review of the work done in the Junior Drawing I. First projects are then assigned.

These consist of:

1. Simple straight line problems
 - a. Orthographic projections from individual prints
 - b. Isometrics of completed orthographic projections
2. Problems involving use of compasses
 - a. Explanation of care and use of compasses
 - b. How to work from center lines
 - c. Simple orthographic projections, with circles are completed from individual prints
 - d. Problems of working drawing and geometry using basic drawing tools are assigned throughout the eighth grade. (Basic tools used are T-square, 30° - 60° triangle, 45° triangle, scale and compasses.)²⁷

Care is taken to check each drawing carefully and make errors obvious with red pencil. Informational units taught are:

1. All units given to Junior Drawing I
2. Rules for dimensioning
3. Different types of lettering
4. How to clean drawing tools
5. Types of drawings
6. Spacing of letters and words
7. Meaning of scale drawing
8. How to draw to scale
9. How to letter
10. Use and care of compasses.²⁸

Senior Drawing II and III

Senior Drawing classes are a continuation of Junior Drawing I and II. Work done in these two years is reviewed carefully for several sessions

²⁷Ibid., p. 163.

²⁸Ibid., p. 163.

before new assignments are made. More difficult work is assigned and individual projects are encouraged. Often times a boy will want to make a working drawing to be used in one of the other shops. This type of work is desired and encouraged. If the student does not see a need for creating his own drawing, he is assigned a simple straight line orthographic projection from the text, Mechanical Drawing, which is written by French and Svensen. Problems are advanced in difficulty according to the individual ability of each student. Inking is done, but only to the extent that some experience is afforded in the use and care of the inking pen. It is not common practice to ink all drawings in the Senior classes.

Informational units are:

1. All units for Junior I and II Drawing
2. How to show breaks in materials
3. Occupational information
4. Inking a drawing, kind of ink and how to do it
5. Methods of making blue prints
6. How to sketch free hand
7. Principles of tracing
8. Different views, sectional, and auxiliary
9. Meaning of different type lines
10. Knowledge of basic geometry used in drawing
11. Kinds of pens best suited for lettering
12. Important points in checking a drawing
13. Purpose and use of pictorial representation
14. Different types of lettering and their uses in drawing
15. Dimensioning rules for drawing
16. Common drawing symbols and their uses
17. Methods of estimating cost of small building
18. Construction of foundations
19. Construction of various types walls
20. How to draw a simple floor plan
21. How to read house plans
22. How to read detail drawing
23. How to read specifications in connection with working drawings.²⁹

²⁹Ibid., 182.

Table II will give an indication of the number of students enrolled in drawing classes. The three seventh grade classes represented in the table are from special opportunity rooms. These students are in need of remedial work in one or more subjects and are required to take shop and drawing one semester each. There are five other seventh grade classes which may take shop as an elective but not drawing.

Two of the thirty students represented in Section II of Senior Drawing II are girls who are taking their second year of drawing.

TABLE II

ENROLLMENT IN MECHANICAL DRAWING CLASSES
FIRST SEMESTER 1949-1950

Title	Section	Period	Total	7	Enrollment by Grades					
					8	9	10	11	12	
Junior Drawing I	I	2	27	27						
Junior Drawing I	II	3	29	29						
Junior Drawing I	III	4	28	28						
Senior Drawing II	I	7	31					1	30	
Senior Drawing II	II	8	30			1	6	19	4	

CHAPTER III

GENERALLY ACCEPTED OBJECTIVES OF INDUSTRIAL ARTS

Practically all writers of industrial arts have drawn up lists of objectives which are desirable and which offer a goal for those in the field to attain. They are often worded differently but when scrutinized closely will frequently mean the same thing. Although all of those in the field of teaching will have objectives of their own, it is still well to check these objectives against those of men who are authorities in the field.

It is the goal of general education to first provide a sound foundation and knowledge of the basic skills, then to provide experiences which will develop a happy, successful and useful citizen. Not necessarily a citizen in the narrow sense that he will be a voter, but in the sense that he will make his community a better place in which to live.

It is the duty and responsibility of industrial arts education to supplement this general training with training which is concentrated and specific, and to provide experiences which will aid the individual through skills and knowledge to be more useful as a producer and more appreciative as a consumer.¹

¹"Standards of Attainment in Industrial Arts Teaching," American Vocational Association, 1934, p. 15.

Objectives for which industrial arts teachers should assume a large measure of responsibility may be stated as follows:

1. To develop in each pupil an active interest in industrial life and in methods of production and distribution.
2. To develop in each pupil the ability to select wisely, care for and use properly the things he buys or uses.
3. To develop in each pupil an appreciation of good workmanship and good design.
4. To develop in each pupil a feeling of self-reliance and confidence in his ability to deal with people and to care for himself in an unusual or unfamiliar situation.
5. To develop in each pupil an attitude of pride or interest in his ability to do useful things.
6. To develop in each pupil the habit of an orderly method of procedure in performance of any task.
7. To develop in each pupil a habit of self-discipline which requires one to do a thing when it should be done, whether it is a pleasant task or not.
8. To develop in each pupil an attitude of readiness to assist others when they need help and to join in group undertakings. (Cooperation)
9. To develop in each, a habit of careful, thoughtful work without loitering or wasting time. (Industry)
10. To develop in each pupil a thoughtful attitude in the matter of making things easy and pleasant for others.
11. To develop in each pupil a knowledge and understanding of mechanical drawing, the interpretation of the conventions in drawing and working diagrams, and the ability to express his ideas by means of drawing.
12. To develop in each pupil elementary skills in the use of the common tools and machines, in modifying and handling materials, and an understanding of some of the more common construction problems.²

²Ibid., p. 12.

Too often one thinks of the shop as a place for making things rather than learning things. It is considered that the primary function of a shop is a place where skills should be taught, and by all means this should be true. The tools and machines in most shops are for this purpose. However, one must not overlook the other very valuable assets which shop work has to offer. Information and experiences must be selected so that they are directly related to the objectives of the course. A need is often seen by the student in industrial arts for such related work as mathematics, science, and drawing. Since this is true, it is easy for the instructor to lead the student into more detailed work in these subjects. This will not only be an aid to his doing better hand work, but will carry over to his academic work.

Many educators believe that there is no bold line of demarcation between shop teaching and the duties of other teachers. All teachers are committed to the ultimate welfare and daily growth of each child. Whenever cooperative planning will lighten the load of the two departments, this advantage should be taken, but duplication can not be condemned when two instructors, out of different backgrounds, present identical items. To trace the development of the trade occupation being sampled is not to infringe upon history. To discuss the location of raw materials detracts nothing from geography. To give practical application to a formula does no harm to mathematics or science. To deal with the practical problems of employment does not weaken the social sciences. It is true, however, that teachers of subject matter have devices and

techniques at their disposal which shop teachers may not be able to employ.³

Any information which deals with life and work would seem to be a legitimate responsibility of the industrial arts teacher. Technical information about materials, processes and progress of industry is in this particular field. If it is well taught, the field will be greatly strengthened. Despite this discussion, as was suggested earlier, industrial arts has been and must remain a strongly manipulative subject.⁴

In most cases, with junior high school age boys, interest in shop work need not be developed. Most boys are eager to work with their hands. A skillful instructor will capitalize on this natural interest to introduce phases of the work other than skills. Examples of this might be accepting responsibility, appreciation of good design or co-operation with fellow members, all of which are extremely important to the total development of the child.

Maris M. Profitt, of the United States Office of Education, has the following statement to make about industrial arts:

Industrial arts is a phase of general education that concerns itself with materials, processes and products of manufacture, and with the contribution of those engaged in industry. The learning comes through the pupil's experience with tools and materials and through his study of resultant conditions of life.⁵

³Homer J. Smith, "Industrial Arts Information," Industrial Education Magazine, Vol. 41, January, 1949, p. 6.

⁴Ibid., 7.

⁵Maris M. Profitt, "Industrial Arts, Its Interpretation in American Schools," Bulletin No. 34 (Washington, D. C.: United States Office of Education, 1937), p. 14.

As a part of general education, it is the specific function of industrial arts to provide experiences which will develop certain traits, habits, and points of view which have been neglected in other phases of general education.⁶

Profitt believes that the objectives are the attitudes, habits, and accomplishments which the pupil is expected to acquire in some measure, as a result of the experience provided for him in the fields of industrial arts and which it is believed will aid in making him a happy, useful, and successful citizen.⁷

The objectives which are followed in the Harry P. Harding High School Industrial Arts Department are closely related to those listed by Warner. They are in condensed form:

1. Exploration
2. General guidance
3. Household mechanics
4. A vocation, hobbies
5. Social habits and insights
6. Consumers knowledges and appreciations
7. A degree of skill
8. Correlation or integration
9. Vocational purposes (for from 0 to 17 percent)⁸

Mechanical drawing, a phase of industrial arts, has objectives which are somewhat different. Robert's list of these are as follows:

⁶Ibid., p. 11.

⁷Ibid., pp. 10-11.

⁸F. Theodore Struck, Creative Teaching (New York: John Wiley and Sons, Inc., 1938), p. 16.

1. Mastery as an added means of expression through the acquired ability to use the universal language of drawing
2. Increase in the power of correct and accurate expression
3. Increase power of visualization
4. Development of a creative instinct
5. Development of appreciation through ability to intelligently interpret mechanical phases of environment
6. Development of accurate and precise thought habits
7. Broaden the educational and social vision through a better understanding of industry
8. Aid to other school activities
9. Preparation for more advanced technical work
10. Broadening the field of vocational choice.⁹

Robert's list of objectives as best suited to the teaching of industrial arts woodwork are as follows:

1. Aid through concrete relationships, in giving meaning and purpose to other school subjects
2. Develop the social spirit through cooperative relationships with other departments in the school
3. Add to the pupil's educational and social development through acquaintance with industrial activity.
4. Develop personal traits of patience, perseverance, industry, responsibility, and integrity
5. Develop habits of accuracy, thoroughness and neatness
6. Encourage a just pride in personal achievement
7. Provide opportunity for development of the creative instinct and originality and initiative in selection, design and execution
8. Give application to some of the fundamental principles of design.
9. Develop appreciation of good workmanship and good taste in home furnishing
10. Contribute to the economy of the home

⁹William E. Roberts, "Manual Arts in the Junior High School," Bulletin No. 11, 1924, p. 18.

11. Give a knowledge of the practical use of woodworking tools.
12. Render service in the school, home, and community.
13. Enlarge the field of vocational choice.¹⁰

In a survey carried on by the Illinois Industrial Education Association, Selvidge's list of objectives was sent to 61 shop teachers. The first six of these are listed below in the order of their importance as established by the questionnaire sent:

1. To develop in each pupil elementary skills, in the use of the more common tools and machines in modifying and handling materials, and an understanding of some of the more common construction problems.
2. To develop in each pupil an appreciation of good workmanship and design.
3. To develop in each pupil the ability to select wisely, care for, and use properly the things he buys or uses.
4. To develop in each pupil an attitude of pride or interest in his ability to do useful things.
5. To develop in each pupil the habit of an orderly method of procedure in the performance of any task.
6. To develop in each pupil an active interest in industry and in industrial life, including the methods of production and distribution.¹¹

Of the 61 teachers who were sent questionnaires, 37 picked number one as most important. Thirty picked number two; 28 number three; 27 picked both number four and number five, and 24 picked number six.

¹⁰Ibid., p. 48.

¹¹Kenyon Scott Fletcher, "Emphasis on Specific Objectives of the Shop Teacher," Industrial Education Magazine, Vol. 39, September, 1937, p. 200.

A similar survey was recently conducted in the North Central Association. In this study, a list of 37 objectives were sent to 721 industrial arts instructors, teaching in cities with populations of 10,000 or more. The instructors were asked to list the objectives in relation to their post war importance. Two hundred seventy-four useable replies were received and the following 15 objectives are listed in the order of their importance as seen by the North Central Association instructors:

1. Pride and interest accomplishments
2. Desirable habits and attitudes
3. Planning
4. Exploratory opportunities
5. Skills and techniques
6. Appreciation
7. Vocational guidance
8. Knowledge of industrial procedures
9. Consumer knowledge or related information
10. Self-expression and problem-solving attitudes
11. Vitalization of academic subjects
12. Leisure time interests
13. Social-economic cooperation
14. Prevocational purposes
15. "Handy-man" activities¹²

The objectives of industrial arts definitely seem to be identical with the principal accepted objectives of any good school program. If properly administered, the industrial arts program can contribute its full share to the education of the whole child. The subject matter, the teaching methods, the activities in which the pupils engage, provide some of

¹² Glenn D. Warrick, "Industrial Arts Objectives," Industrial Arts and Vocational Education, Vol. 36, No. 7, September, 1947, p. 287.

the finest situations for developing ethical character, creating a sense of good citizenship, promoting thrift, developing a keen appreciation of fine things produced by good craftsmen, and for building a clear understanding of the problems which confront those who do the manual work of the world.¹³

¹³Bulletin No. 34, op. cit., p. 66.

CHAPTER IV

OCCUPATIONAL DISTRIBUTION

In considering the various courses or activities which might be included in an expanded industrial arts program, it seems only logical that some basis for justification should be established before installing a new course. As was previously stated, the basis for the courses which will be outlined in the following chapter is an analysis of fields of trade and industrial employment in Charlotte, North Carolina, and Mecklenburg County of which Charlotte is a part.

Students of industrial arts in Charlotte are fortunate to be living in an area where trade and industrial employment is as diversified as it is in Mecklenburg County. According to a statement released by the Charlotte branch of the United States Employment Service, practically every trade which can be adapted to a school industrial arts program is represented within the county. Due to this condition, it would seem that any industrial arts course chosen, would have some pre-vocational value, since there are definite employment opportunities in all trades.¹

Table III shows the numbers employed in non-manufacturing occupations in Charlotte and Mecklenburg County, North Carolina, in 1949,

¹"Employment Records 1949" (Charlotte, North Carolina: United States Employment Service, Charlotte Branch).

TABLE III

NUMBERS EMPLOYED IN NON-MANUFACTURING OCCUPATIONS IN
CHARLOTTE AND MECKLENBURG COUNTY, NORTH CAROLINA
IN 1949 WITH ALLOCATIONS TO SPECIFIC FIELDS

Type of Business ^a	Number Employed ^b	Wood Work	Auto Mechanics
1	2	3	4
Wholesale and Retail Trades	24,714		
Service Except Domestic	14,307		968
Transportation, Communication and Utilities	9,072		50
Construction	3,424	1,250	
Finance, Real Estate and Insurance	3,290		
Total	54,807	1,250	1,018

^a"Industrial Classification Code" (Washington, D. C.:
United States Government Printing Office, Volume 1, 1942), pp. 87-
139.

^b"Employment Records 1949" op cit.

with allocations to specific fields. The fields to which certain employees were allocated in the table are given column headings to correspond to generally accepted industrial arts fields. The data on numbers employed were secured by personal interview with the statistician in the United States Employment Service, Charlotte Branch.

Of a total of 21 industries listed in "The Standard Industrial Classification Manual," only three are not represented in Mecklenburg County.² These three are: ordnance, tobacco manufacture, and manufacture of rubber products.

In referring to Table III it will be noted that it is comprised of those enterprises operating on a non-manufacturing basis. Table IV lists industries which do manufacturing of finished or semi-finished products.

All of the 18 types of industries represented in Charlotte are listed in the two tables, but not all of them can be considered as being adaptable to an industrial arts program. Of the five non-manufacturing industries, only transportation, communication, utilities, and service (except domestic), seem to be applicable. It would have been desirable to have a breakdown on the number of men employed in the various jobs connected with construction or the building trades, but these figures were not accessible for all trades. Some labor unions were unwilling to

²"The Standard Industrial Classification Manual," Vol. 1, Part 1 (Washington, D. C.: United States Government Printing Office, November, 1945), pp. 7-67.

divulge the number of men on their rolls and a check of the construction companies was of limited value since there is normally a rather constant turnover of labor in the building trades. It was found by personal interview with employers that the same men might be on the pay roll of as many as three or four companies in a single month, so any figures from employers which could be tabulated would be somewhat invalid. Figures released from the Charlotte Local Carpenter's Union revealed that there were approximately 1250 carpenters employed in Charlotte and of this number, approximately 500 were residents of the Charlotte area.

It was found that 50 of the 9,072 people employed in transportation, communication, and utilities were working in the status of mechanics on the repair and upkeep of busses and other transportation equipment. These 50 men were put in column 4 of Table III under the heading of auto mechanics. Also in column 4 of Table III were 968 people who were part of the 14,307 which made up the group under the general heading Service except Domestic. These 968 people were those employed by auto service and repair shops within the city. Only shops which employed three or more service men were listed. Service stations were not included in this list, although it is recognized that in many instances they do some mechanical work such as minor replacement and adjustments, lubrication, and tire repair. Of 32 service stations contacted, only one reported having a full time mechanic who was qualified to handle major jobs. One thousand eighteen, which is the total of column 4 in Table III

TABLE IV

NUMBERS EMPLOYED IN MANUFACTURING OCCUPATIONS IN
CHARLOTTE AND MECKLENBURG COUNTY, NORTH CAROLINA
IN 1949 WITH ALLOCATIONS TO SPECIFIC FIELDS

Type of Business ^a	Number Employed ^b	Wood Work	General Metals	Machine Shop	Printing
1	2	3	4	5	6
Textile Mill Products	7,362				
Food and Kindred Products	3,880				
Printing, Publishing and Allied	1,207				535
Machinery Except Electrical	704			530	
Iron, Steel and Their Products	677		560		
Electrical Machinery Equipment and Supplies	635			397	
Apparel and Other Finished Products	550				
Chemical and Allied	492				
Paper and Allied Products	396				
Furniture and Fixtures	350	317			
Transportation Equipment	350		305	10	
Stone, Clay and Glass Products	343				
Lumber and Wood Products	285	272			
Total	17,231	589	865	937	535

^a"Standard Industrial Classification Manual" (Washington, D. C.: United States Government Printing Office, Volume 1, November, 1945), p. IX.

^b"Employment Records 1949," op. cit.

can be considered as approximately the number of men employed in Charlotte as auto mechanics and repair men.

In Table IV, which was prepared in the same manner as Table III, there are several industries which are not considered applicable to this study. Column 2 of Table IV shows the total number of wage earners employed in each industry. Columns 3, 4, 5, and 6 show the actual number of workers from each industry which would be included under the general heading. It should be noted that office workers are not included in this group, but only those actually employed in the skilled trades. Under Column 3, which is entitled woodwork, there are 272 wood workers from the "Lumber and Wood Products" industry. In the same column, 317 wood workers are employed in the "Furniture and Fixtures" industry. If the 1250 carpenters from Column 3 of Table III were added to this group it would comprise a total of 1839 men actively employed in some phase of the woodworking trade.

In Column 4, headed "General Metals," are 560 men from the "Iron, Steel, and Their Products" industry and 305 from the "Transportation Equipment" industry. This heading would include foundry and forging and the sheet metal trades. There are a total of 865 employed in these trades.

Column 5 shows that in the "Machinery except Electrical" industry, there are 530 machinists or machine operators employed. There are 397 men employed in the same trade from the "Electrical Machinery and Equipment" industry. "Transportation Equipment" lists 10 machinists although the majority of their workers are in the sheet metal trades. A total of 937 machinists are represented in column 5.

Of a total of 1,207 people employed in "Printing, Publishing and Allied Trades," 535 are actually employed as printers or engravers. Reporters, copy readers, clerical help and others indirectly working in the printing trade are not included in Column 6 of Table IV.

It will be noticed that printing, although represented in the table, is not included as one of the courses proposed for the industrial arts program. It was purposely omitted due to a conflict which prevails between two organizations whose members are interested in the printing trade in Charlotte, North Carolina. A representative of the Charlotte Local Printer's Union felt that establishing printing classes, on a trade preparatory basis, would be unwise since the union preferred to go out of town in hiring men to fill vacancies. It was alleged that there would be very little, if any demand, for high school graduates to enter the trade as apprentices.³

Although the actual number of union men employed in the printing trade in Charlotte is unknown, it is reported that out of more than 25 shops, only one is operated on a closed shop basis. This shop employs approximately 80 men.⁴

The other organization which is interested in the furtherance of the printing trade is the Printing Industries of Charlotte, Incorporated. This group is made up of employers only, who are interested in providing

³Personal Statement, Member of Charlotte Printer's Local Union, 1949, Charlotte, North Carolina.

⁴Personal Statement, Secretary of Printing Industries of Charlotte, Inc., Charlotte, North Carolina.

greater service to the public and in improving the general welfare of the trade as a whole. Information gained in an interview with the Secretary of this organization was in sharp contrast to that released by the representative of the local union. The group represented in the Printing Industries of Charlotte, Incorporated, are in favor of printing classes in the high schools and have offered full support in instigating such a program. This group suggested that the printing shops of Charlotte could absorb a minimum of from 10 to 15 high school graduates per year as apprentices in the printing trade in Charlotte.⁵

In view of the aforementioned conflict in information and difference of opinion, it would seem unwise to recommend establishing a printing class at this time. It is hoped that at a time when more data are available that training in the printing trade can be justifiably included.

Table V presents data which are a portion of the Annual Report of the Principal of Harding High School, which was submitted to the Southern Association of Secondary Schools and Colleges at the close of the 1946-1947 school year. Its purpose was to ascertain as nearly as possible the occupational status of both the mother and father of each of the students enrolled in Harding High School.

The data were collected in the form of a questionnaire which was distributed in March, 1947, to 1,122 students.

⁵Ibid.

TABLE V.

OCCUPATIONAL STATUS OF PARENTS OF 1,122 STUDENTS OF
HARDING HIGH SCHOOL FOR THE YEAR 1946-1947^a

Occupational Fields	Father Percent	Mother Percent
Professions	4.	1.
Manager or Proprietor	29.	2.
Agriculture	.6	2.
Homemaking	.5	59.
Sales Work	9.	8.
Office Work (secretarial and stenographic, bookkeeping and accounting, clerical)	9.	8.
Skilled Trades	39.	13.
Domestic Service or Housekeeper	.3	3.
Unemployed or on relief	.9	.7
Unskilled labor	4.	2.
Miscellaneous	3.	1.
Unknown	.7	.3

^a"Annual Report of Principal of Harding High School to the Southern Association of Secondary Schools and Colleges" (Charlotte, North Carolina: 1946-1947).

The item in the table which was most significant in this study was the percentage of both mothers and fathers who were employed in the skilled trades. Thirty-nine percent of the fathers were working in the "Skilled Trades" and 13 percent of the mothers were employed in the same occupational field. No attempt was made to break the trades down to specific jobs, so that information is not available.

For fathers, the "Skilled Trades" were the leading occupation with 39 percent of the total employed in this category. The second highest grouping for fathers was "Manager or Proprietor" with 29 percent. As could be expected, "Homemaking" was high for mothers with 59 percent and "Skilled Trades" was second with 13 percent.

The data contained in Table VI is a result of the same questionnaire which was used in Table V. This questionnaire, however, was filled out only by students enrolled in industrial arts classes during the school year 1949-1950. One hundred eighty-seven students participated in the survey. Its purpose was to determine if there had been any material change in the occupational status of the parents of the students of Harding High School during the three years since the last survey had been taken.

Although the percentages in Table VI vary somewhat from those in Table V, the order of arrangement as to occupations is practically the same. "Skilled Trades" is still high for fathers with the surprising figure of 51 percent. "Manager or Proprietor" is still second but with only 17 percent as compared to 29 percent for the entire student body.

TABLE VI

OCCUPATIONAL STATUS OF PARENTS OF 187 STUDENTS ENROLLED IN
INDUSTRIAL ARTS CLASSES IN HARRY P. HARDING HIGH SCHOOL
FOR THE YEAR 1949-1950^a

Occupational Fields	Father Percent	Mother Percent
Professions	3.	.
Manager or Proprietor	17.	1.
Agriculture	.6	
Homemaking		64.
Sales Work	13.	7.
Office Work (secretarial and stenographic, bookkeeping and accounting, clerical)	3.	5.
Skilled Trades	51.	16.
Domestic Service or Housekeeper		
Unemployed or on relief		
Unskilled labor	4.	5.
Miscellaneous	8.	2.
Unknown	.4	

^aQuestionnaire Completed by all Students of Industrial Arts at Harding High School (Charlotte, North Carolina, 1949-1950).

Sixty-four percent of the mothers of Industrial Arts students were recorded as "Homemakers," and 16 percent of the mothers for this group were employed in the "Skilled Trades." This was an increase over the number recorded for the entire student body in the same fields.

Although the data contained in Tables V and VI may not be pertinent to the question of which fields of activity would be more valuable in course selection, it is felt that these data are significant. It would seem that a parent employed in an industrial type of work would support industrial training in the schools with greater understanding than parents employed in other occupational fields. While there is no evidence available to indicate any definite percentage of children following the occupation of the parent, in this locality, it would be natural to expect that a number of them would be in the same or similar occupational field.

Selection of Courses

In considering the various courses which might be installed, in addition to those courses now existing, it would seem that conditions other than the findings from the occupational survey should be considered. Such items as physical plant, student selection, and perhaps parent preference will be taken into consideration, however, as was stated in Chapter III, the primary criteria will be occupational opportunities offered in the industrial plants which the city of Charlotte supports. It is assumed that eventually there will be physical plants with the

necessary machines and equipment provided to adequately care for any industrial arts activity, or group of activities, which might be selected on the basis of employment opportunity.

The fact that greater shop facilities should be provided in the school curriculum and even the provision of separate buildings was among the definite recommendations made by the Educational Survey Committee under the direction of N. L. Engelhardt in 1949. This survey states:

The shop facilities should be enlarged, within a separate building, for a greater variety of shop fields with emphasis upon the general shop as a basis for planning.⁶

In referring to Tables III and IV, it will be noted that the largest number of men employed in a skilled trade which is adaptable to industrial arts, is woodworking, with a total of 1,839. Of this total, 1,250 are employed in the carpentry trade.

Since the tables are to be the primary basis for course selection, it would seem that advanced woodworking with units in carpentry would need to be one of the new courses recommended.

Column 4 of Table III reveals that there are 1,018 men employed in the auto mechanics trade in the city of Charlotte. In view of the fact that this is second highest in the trade field distribution, auto mechanics will also be given consideration as a new course in the expanded industrial arts program.

⁶N. L. Engelhardt, Educational Expansion Survey for Charlotte (Charlotte, North Carolina: unpublished, 1949).

Column 5 in Table IV, "Machine Shop," with 937 men employed, and column 4 of Table IV, "General Metals," with 865 men employed in Charlotte, completes the list of new courses which will be recommended as additions to the senior high school curriculum in industrial arts.

Since these courses are to be recommended with a pre-vocational objective in mind, it would seem reasonable to believe that the unit type shop, as described in Chapter II, would more nearly achieve this objective than one of the other types of shop organizations. To achieve this objective, it would also seem necessary to schedule the four courses for a full year each, with the course of study being as comprehensive and complete as possible for the time allotted.

In considering the course of study to be submitted for the industrial training of junior high school students, an entirely different set of objectives will prevail. Unlike the high school objectives, the concern is less for pre-vocational training and more for short periods of intensive experiences in a wide variety of shop activities.

From the beginning of the development, in the area of industrial arts, that came to be known as the general shop, and that came to be identified chiefly with the development of the junior high school, the emphasis was invariably upon a relatively large number of diversified industrial experiences.⁷

With this thought in mind, the recommendations for junior high school industrial arts training will be organized along the general shop plan as Mays has suggested.

⁷Arthur B. Mays, "Notes on the Historical Aspects of the General Shop," Industrial Arts and Vocational Education, Volume 39, Number 4, April, 1950, p. 140.

The following junior high course has been prepared on the basis of four major areas of activities being included in the general shop course: woodworking, metal work, drawing, and crafts.

The courses have been selected on the basis of their importance and frequency of occurrences in the life of the students and their adaptability to instruction in the school shop, as well as for the potential pre-employment value which may be obtained from experiences gained in these courses.⁸

The general shop activities, as presented in this course of study, will be designed to offer an exploratory background as an aid in choosing advance unit courses. In most cases the general shop course should precede the major area unit shop courses.⁹

The grade placement and sequence of courses is important to the extent that the over-all program assures a breadth of experience in broad areas utilizing many media. Whether students should experience woodworking previous to metal work is debatable. It is important that students experience subject areas in quantity and quality commensurate to their level of maturity.¹⁰

⁸"Industrial Arts General Shop," Bulletin No. 29 (Jefferson City, Missouri: State Department of Education, 1949), p. 8.

⁹Ibid., p. 8.

¹⁰"A Guide for the Administration of Industrial Arts," Curriculum Bulletin No. 1 (Minneapolis, Minnesota: State Department of Education), p. 10.

To insure the greatest breadth, the curriculum is pyramided starting with a broad base, at the required levels and at a time when 100 percent of the youth are theoretically still in school, permitting greater depth and concentration at succeeding levels. After acquiring the necessary attitudes, understandings and skills, the pupils can be permitted to elect further specialization in the advanced industrial arts courses.¹¹

¹¹Ibid., p. 10.

CHAPTER V

A PROPOSED COURSE OUTLINE

In developing a new course of study in Industrial Arts or in changing or expanding those courses now existing, it is well to consider some of the elements which might influence the selection of new courses or the content which they will contain. Some elements which might be considered are the physical plant, facilities and equipment available, type of community, whether it is primarily agricultural or industrial; types of industries, employment opportunities, and the occupational status of parents. Although all of these appear to be extremely important, it seems that the physical plant and available facilities would carry much weight in the selection of new courses, or in expansion of a program already in operation. Certainly it would seem an unwise and uneconomical use of time and effort to select and develop a number of courses of study in different shop activities, if adequate space and facilities were available for only one or two activities. By the same token, the courses should be selected and a course outline developed prior to the construction of new shop facilities, and the buying of tools and equipment. Insofar as possible, the new shop should be planned to accommodate the equipment and supplies needed to teach the course effectively, rather than to select a course that is adaptable to the shop lay out.¹

¹Louis V. Newkirk, Organization and Teaching the General Shop (Peoria, Illinois: The Manual Arts Press, 1947), p. 87.

The modern industrial arts course not only provides the student with an opportunity to develop trade or occupational skills, but the course will also furnish the student with experiences that will help him to meet the problems of everyday life. Particular emphasis is placed on consumer education, those problems involved which includes the intelligent choice and use of industrial products and tools. In addition, it might provide experiences which will develop vocational interests and desirable social traits.²

The course outlines presented in this chapter are the result of a careful study of the industries of Charlotte, North Carolina. They were selected after considering the employment opportunities which these industries might provide. In the process the opinions of a large number of authorities in the Industrial Arts field were secured and their viewpoints regarding a comprehensive industrial arts program were given careful consideration.

In offering the courses in the Junior and Senior High Schools, two plans will be used. The courses for the Junior High School section will be presented in the form of a "General Shop" organization. Courses recommended for use in the Senior High School will be organized on the "Unit Shop" plan. In both cases the areas of activities which make up the course will be presented in outline form. These outline of courses will list recommended informational units, operational units, suggested

²"Shop Course of Study" (Hawaii and Honolulu: Department of Public Instruction, 1935), p. 3.

projects, tool and machine lists, and a supplementary list of references which may be used in related class work.

A course of study can seldom be considered as a finished product. It should be a growing accumulation of the best accepted methods and practices at a given time. It is often a summation of those methods which have been successfully applied.³ It should be of a flexible nature so that it can be easily altered to meet changing conditions. It may be found that some of the units listed in this outline will not be appropriate under certain conditions, or that there is too much content included for the amount of time available. In this and other cases it would certainly be the prerogative, and perhaps the duty, of the instructor to alter the units so that they would more nearly fulfill the immediate needs. It is certainly not the intent of the writer to present this material as an exhibit which is considered to be complete or perfect. The purpose here is to furnish a guide or foundation upon which one may build, with the understanding that it might be changed or modified to meet the needs of a specific situation.

Junior High School General Shop Courses

The General Shop, consisting as it does of a wide range of experiences in several areas of industrial activity, requires that there

³Ibid., p. 3.

be well organized and well planned course material. Much of this material must be planned and organized by the teacher, however, a course outline may be helpful in providing a part of these materials and in serving as a basis for the developing of materials to fit specific situations.⁴

This course outline has been developed to include four major areas of activity. These major areas are: woodwork, metal work, drawing, and crafts. The area in crafts will be further divided to include experiences in leather and plastics. These courses were selected in part, because of their guidance value. In addition, they are considered to be a means of helping the student to locate his interests or aptitudes which would assist him in choosing a specific unit course which he could pursue as a student in a senior high school.

Woodwork

Materials from two different references was used in compiling the following list of 21 informational units:

1. Kinds of lumber used in shops
2. Methods of sawing lumber
3. Characteristics of plywood
4. Uses of plywood
5. Characteristic differences in hand saws
6. Characteristic differences in hand planes
7. Names of common small hand tools
8. Principal uses of common small hand tools
9. Names of wood-boring bits
10. Auger bits-methods used to mark size, name of parts and care of bits
11. Types and sizes of nails

⁴"Industrial Arts General Shop," Publication No. 29 (Jefferson City, Missouri: State Department of Education, 1949), p. 7.

12. Types and sizes of screws
13. Kinds and uses of glue
14. Preparation of glue
15. Names of typical finishes
16. Uses of typical finishes
17. Solvents used to cut finishes
18. Principles of orderly planning
19. Interpretation of working drawings
20. Methods of figuring board feet
21. Safety practices concerning use of hand tools.^{5, 6}

The following 21 operational units are recommended for use in the Junior High School woodworking class:

1. Read a working drawing.
2. Plan an orderly procedure for making a project.
3. Make a bill of material.
4. Measure and lay out with a rule.
5. Square a board.
6. Saw to a line with cross, rip, and hack saw.
7. Assemble and adjust a jack plane.
8. Plane surfaces and edges with jack plane.
9. Check trueness of surfaces with try square.
10. Lay out and check stock with framing square.
11. Saw curves with coping and scroll saw.
12. Bore holes with auger bit.
13. Bore holes with drill press.
14. Fasten wood with nails.
15. Fasten wood with screws.
16. Fasten wood with glue.
17. Cut and trim with wood chisel.
18. Smooth surfaces with sand paper.
19. Apply typical wood finishes.
20. Clean and care for finish brushes.
21. Construct a project utilizing as many of the above operations as possible.⁷

⁵"Industrial Arts in Louisiana," Bulletin No. 627 (Baton Rouge, Louisiana: State Department of Education, 1948), p. 68.

⁶"Industrial Arts for Secondary Schools" (Des Moines, Iowa: State Department of Education, 1948), pp. 82-83.

⁷"Industrial Arts General Shop," Publication No. 29, op. cit., pp. 19-20.

TABLE VII

RECOMMENDED HAND TOOLS AND EQUIPMENT TO SUPPLY SIX
STUDENTS IN THE WOOD WORKING AREA^a

Tools and Equipment	Quantity	Description
Woodworking benches	2	8-vise
Scroll saw	1	24" floor model
Smooth planes	6	8"
Block planes	2	
Marking gauges	6	
Claw hammers	2	12 oz.
Hand screws	12	12"
Bar clamps	6	4'
Cabinet scrapers	3	Flat 4" x 3"
Ratchet braces	2	8" swing
Wood chisels	4	$\frac{1}{4}$ "-3/8"- $\frac{1}{2}$ "-1"
Auger bits	12	Number 4 to 16 inclusive
Rip saw	1	7 point
Cross cut saws	2	8 point
Back saws	6	10"-12 point
Picture frame, saw and vise	1	
Dividers	2	
Spirit level	1	24"
Oil stone	1	Lily white
Expansive bit	1	3"
Try squares	6	8" blade
Framing square	1	24"
Screw drivers	2	3" blade
Screw drivers	2	4" blade
Pliers	2	Combination
Wrench	1	Adjustable-8"

^aCharles P. Parsons, "A Study of the General Shop," (unpublished Master's thesis, The University of Tennessee, Knoxville, Tennessee, 1937), pp. 57-58.

The following list of suggested projects are suitable for Junior High School students:

1. Tie Rack
2. Towel Rack
3. Book Ends
4. Magazine Rack
5. Whatnot Shelf
6. Foot Stool
7. Bird House
8. Jewel Box.

Metal Work

The suggested course in metal work includes two areas of activities; namely, sheet metal and tin can projects, and art metal. It is felt that students can make many functional and attractive projects from tin cans at little or no cost, and at the same time they can acquire many of the basic skills required of metal workers. In addition to tin, it is suggested that opportunity be provided for work in copper, brass, and galvanized iron.

In investigating a number of references, it was found that those informational units compiled in the bulletin issued by the American Vocational Association were most applicable to this study. They are as follows:

1. Kinds of solder and their uses
2. Kinds of fluxes and their uses
3. Names of common sheet metal hand tools
4. Uses of common sheet metal hand tools
5. Care for hand tools
6. Methods of identifying various kinds of sheet metal

7. The meaning of sheet metal gages
8. Standard sizes of soft iron wire
9. Sources and characteristics of tin
10. Sources and characteristics of copper and brass
11. Kinds and sizes of rivets
12. How galvanized iron is made
13. How steel is made
14. Kinds and sizes of drills
15. Safety practices in sheet metal
16. Methods of polishing metal
17. Typical finishes used on metal
18. Occupational information, including success factors, wages and opportunities in the sheet metal trades
19. Various uses of drill press
20. Various uses of bench grinder⁸

The following 26 operational units were taken from the same source used in compiling the informational units for this area of study.

1. Make out a bill of material.
2. Plan procedure for doing a job.
3. Transfer pattern to sheet metal.
4. Cut metal with tinners' snips.
5. Solder tin, copper, and brass.
6. Light and operate a blow torch.
7. Form sheet metal by hand.
8. Turn edges for a hem.
9. Wire edges by hand.
10. Rivet joints with hammer.
11. Punch holes with a solid punch.
12. Punch holes with a hollow punch.
13. Trim with circular shears.
14. Drill holes in metal with hand drill.
15. Trim with cold-chisel.
16. Anneal copper or brass.
17. Give hammer finish to copper, brass, or iron.
18. Apply lacquer finish.
19. Tin a soldering copper.
20. Saw to a line with a hack saw.

⁸ American Vocational Association, Inc., Improving Instruction in Industrial Arts (Washington, D. C.: Industrial Division, 1948), pp. 32-33.

21. Draw and cross file.
22. Sweat a joint.
23. Braze with hard solder.
24. Lay out pattern for funnel.
25. Lay out pattern for sugar scoop.
26. Drill holes with drill press.⁹

The following list of recommended sheet metal projects are suitable for Junior High School work.

1. Ash tray
2. Baking pan
3. Cookie cutters
4. Drinking cup
5. Fruit bowl
6. Funnel
7. Mail box
8. Porch light
9. Spatula
10. Sugar scoop.

Work involved in the art metal area will entail very fine hand work and an effort can be made by the instructor to encourage individual design and develop artistic ability in the student. It is suggested that copper, brass, aluminum, silver, and pewter be incorporated in this area in order to provide experiences in working with a wide assortment of metals.

⁹Ibid., p. 32.

The source of the following informational and operational units is the American Vocational Association bulletin.

Informational Units

1. Interpretation of a working drawing
2. Composition of metals used
3. Kinds of thickness gages and their uses
4. Names of art metal tools
5. Names of finishing materials
6. Names and characteristics of abrasives
7. Grades of steel wool
8. Types of buffing compounds
9. Principles of pattern lay out
10. Methods of transferring designs
11. Principles of engraving by electrical, chemical, and vibration process
12. Reasons for annealing metal
13. Methods of annealing metal

Operational Units

1. Shear metal with snips
2. Cut metal with hack saw
3. Cut metal with file
4. Cut metal with cold-chisel
5. Make a pattern
6. Transfer pattern to metal
7. Drill holes by hand and machine
8. Shape on sand bag
9. Shape an stake or pipe
10. Shape over wooden form
11. Buff by hand
12. Buff by machine
13. File with needle file
14. Solder with gas torch
15. Scribe a circle
16. Fit joint for soldering
17. Sweat with soft solder
18. Engrave a design
19. Burnish an edge
20. Apply wax and lacquer finish.¹⁰

¹⁰Ibid., pp. 24-25.

TABLE VIII

TOOLS AND EQUIPMENT FOR SHEET AND ART METAL^a

Tools and Equipment	Quantity	Description
Snips	2	Combination
Snips	2	Hawkskill
Scribers	8	
Squares	3	12" combination
Rules	2	24" steel
Dividers	6	6" spring
Trammel Points	1	
Punches	6	Prick
Hammers	6	6 oz. Ball peen
Punches	2	1/8" solid
Punches	2	3/16" solid
Punch	1 set	Hollow 3/8" through 3/4"
Seamers	2	Handy
Tongs	2	Bending
Sheet Metal Gage	1	U. S. Standard
Mallets	6	2 1/2" composition
Hammer	1	Tinner's raising
Soldering Copper	6	1 1/2 pound (electric)
Soldering Copper	2	2 pound
Blow Torch	2	Gas
Hammer	2	12-oz., riveting
Hammer	2	12-oz., Tinner's setting
Rivet Sets	2	No. 5
Screwdriver	2	3" blade
Screwdriver	2	4" blade
Screwdriver	1	8" blade
Drill Press	1	Electric (floor model)
Bench Grinder	1	6" Double head (electric)
Vise	1	Drill Press
Vise	6	4" Machinist
Vise	1	Pipe
Work Benches	2	4' x 8' metal covered
Files	2 sets	Needle
Files	6	10" mill

TABLE VIII

TOOLS AND EQUIPMENT FOR SHEET AND ART METAL^a (CONTINUED)

Tools and Equipment	Quantity	Description
Saw Frames	3	Jewelers
Hammers	6	Art metal forming
Hammers	3	Planishing
Hammers	3	Chasing
Chasing Tools	1 set	
Matting Tools	1 set	
Sand bags	6	
Lamps	2	Alcohol
Blowpipes	2	Mouth
Block	1	Dapping
Molds	4	2" - 3" - 4" - 6" Wooden forming
Engraver	1	Electric-Vibration

^a"Industrial Arts in Louisiana," Bulletin No. 627 (Baton Rouge, Louisiana: State Department of Education, 1948), pp. 89-91.

Recommended Projects

1. Ash trays
2. Bracelets
3. Candy dish
4. Desk weights
5. Hunting knives
6. Lapel pins
7. Letter openers
8. Monograms
9. Rings
10. Table lamps.

Mechanical Drawing

Drawing is a universal means of expression. Much of our present knowledge depends upon drawing in some form whether it be the history of early civilization or the development of the most modern engineering projects. The ability to describe the shape and size of objects through drawing and to understand drawings made by others is highly desirable, even though he may not intend to follow an industrial vocation. It is recommended that beginning work in drawing be general in nature and include free-hand sketching, visualization, problem solving, and some work with instruments. It will often stimulate interest and understanding to permit the student to make drawings of the projects which he might

TABLE IX

DRAWING TOOLS AND EQUIPMENT

Tools and Equipment	Quantity	Description
T-Square	6	24"
Drawing Board	6	16" x 24"
Triangle	6	45" - 4" x 4"
Dividers	6	6"-spring
Dividers	6	2"-screw
Scales	6	Architectural
Erasers	6	
Erasing Shield	6	Metal
Protractor	6	
Drawing Desk	6	Adjustable tops
Stools	6	24"

make in other areas of work.¹¹

It is felt that a student completing the basic course in drawing should have knowledge of the following informational units.

Informational Units

1. Names and characteristics of drawing tools and equipment
2. Kinds and grades of drawing pencils
3. Common sizes of triangles, and working combinations for various angles
4. Types of measuring devices
5. Types of drawings
6. Kinds and standard sizes of drawing paper
7. Method of testing T-squares and triangles
8. Types of conventional lines
9. The several uses of drawing
10. Rules for dimensioning
11. Correct order of penciling
12. Trade drafting requirements
13. Relation of drawing to industry
14. Kinds of erasers
15. Care of drawing tools
16. Grades of drawing pencils
17. Meaning of scale drawing

¹¹"Industrial Arts for Secondary Schools," Volume III (Des Moines, Iowa: State Department of Education, 1948), pp. 74-75.

18. Scales found on an architect's rule
19. Spacing of letters and words
20. Interpret drawings
21. Drafting terminology
22. Types of letters
23. Essential features of a good drawing

Operational Units

1. Attach paper to drawing board.
2. Square paper and board with T-square.
3. Trim pencils.
4. Rule lines.
5. Measure with a scale.
6. Draw to scale.
7. Practice spacing lines.
8. Practice lettering.
9. Make vertical upper-case letters.
10. Make inclined upper-case letters.
11. Lay out drawing sheet.
12. Draw guide lines on title block.
13. Block in title space and record strip.
14. Draw different kinds of lines.
15. Plan arrangement of views.
16. Make two views and visualize relationship.
17. Make three views and visualize relationships.

18. Lay off principal measurements.
19. Draw invisible edges.
20. Draw extension lines.
21. Erase pencil lines.
22. Sharpen and adjust pencil lead.
23. Make fillets and rounds with pencil compass
24. Make an isometric drawing.
25. Make an orthographic projection.

Crafts

In order to further diversify the Junior High School General Shop courses, and to provide as wide a range of activities as are practical, it is suggested that an area of activity be included which will comprise those units of work commonly known as crafts. To avoid the possibility of the course becoming too broad and unwieldy, it is felt that in the beginning, the crafts areas should be confined to two units. Plastics and leather work have been selected as those units. If in the opinion of the instructor other units can be added at a later time without jeopardizing the manageability of the course, it is recommended that this be done. Other areas which might be added are: ceramics, weaving, home mechanics, photography, and electricity.

The following informational and operational units are those compiled in two separate references:

Informational Units

1. Uses of plastics in industry
2. How plastic is made
3. Care and storage of plastics
4. Kinds of solvents and cement used
5. Methods of cutting plastics, kind of saws used
6. Methods and reasons for forming
7. Kinds of stains and dyes used
8. Types of screws used
9. Kinds and sizes of drills used
10. Basic principles of design.

Operational Units

1. Make a working drawing.
2. Make a plan of procedure.
3. Make and transfer a pattern to plastic.
4. Saw plastic with hack saw, jig saw, back saw, and jeweler's saw.
5. Drill holes by hand.
6. Drill holes with drill press.
7. Plane plastic with block plane.
8. Shape with file.
9. Smooth with sand paper.
10. Ash with pumice.
11. Polish with compound.
12. Prepare cement.
13. Prepare surface to be cemented.
14. Join pieces with cement.
15. Join pieces with self-tapping screws.
16. Join pieces with drive screws.
17. Form with clamps or bending jig.
18. Carve with electric drill.
19. Decorate with overlay.
20. Decorate with inlay.
21. Color or dye plastic.^{12, 13}

¹²"Industrial Arts in Louisiana," Bulletin No. 627, op. cit., pp. 94-95.

¹³Raymond Cherry, General Plastics (Bloomington, Illinois: McKnight and McKnight, 1948), p. 8.

TABLE X

TOOLS AND EQUIPMENT RECOMMENDED FOR THE PLASTICS

Tools and Equipment	Quantity	Description
Hammer	3	Soft face-
Curves	2	Irregular
Gauge	1	Mortise
Squares	3	Combination
Dividers	2	8"-spring
Punches	2	Prick
Awls	3	Scratch
Scribers	3	
Rules	6	12"-steel
Planes	3	Block
Files	1 set	Needle
Drills	1 set	1/16" to 3/8"-twist
Saws	2	Jeweler's
Saws	2	Coping
Saws	2	Back
Saws	2	Hack
Drills	2	Hand
Files	6	10"-mill, single cut
Drill	1	Electric, high speed hand
Lathe	1	450-6000 r. p. m., wood
Work bench	1	4' x 8' wooden top

Recommended Projects

1. Ash tray
2. Bracelet
3. Desk weight
4. Finger ring
5. Knife pin
6. Lapel pin
7. Letter holder
8. Napkin ring
9. Picture frame
10. Salt and pepper set.

Leather Craft

Leather is a commodity familiar to practically all civilized people of the world. A large majority of these people wear or use some article of leather construction daily, and yet know very little about the sources, the kinds of leather, or how it is processed and worked. The purpose of this unit of instruction is not only to provide an opportunity for the student to make attractive and useful leather articles, but to make information available which will tell the story of leather.

Informational units listed for this area of instruction are those compiled by Cherry in his book on leathercraft.

Informational Units

1. History of leather
2. Tanning and manufacture of leather
3. Kinds of craft leather

4. Types of dyes and stains
5. Names of common tools used to work leather
6. How and where to buy leather
7. Characteristics of various types of leather¹⁴

Operational Units

1. Make designs.
2. Make templates.
3. Lay out and cut leather.
4. Transfer designs to leather.
5. Prepare leather for modeling.
6. Tool leather.
7. Do flat modeling.
8. Do embossing.
9. Use stamping tools.
10. Stipple background.
11. Make thong slits.
12. Cement leather.
13. Prepare surface for dyeing.
14. Dye leather.
15. Punch holes with revolving punch.
16. Punch holes with hollow punch.
17. Punch holes with awl.
18. Attach snap fasteners.
19. Splice lacing.
20. Finish leather project with stain or wax.¹⁵

¹⁴Raymond Cherry, General Leathercraft (Bloomington, Illinois: McKnight and McKnight, 1946), p. 5.

¹⁵"Industrial Arts in Louisiana," Bulletin No. 627, op. cit., p. 76.

TABLE XI

LEATHER TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Skiving knives	3	
Squares	2	7" by 12" steel
Modelers	6	
Tracer	1	
Deerfoot	1	
Ball tools	2	
Thonging chisel	1	3/32" Four Prong
Thonging chisel	1	1/8" Four Prong
Eyelet Setter	1	
Revolving Punch	1	6 tube
Hollow Punch	1	3/16"
Mallets	2	Wood
Snap attaching set	1	
Creaser	1	Single edge
Stone	1	Carborundum
Thong awls	6	
Thonging chisel	1	3/32" single
Thonging chisel	1	1/8" single
Cutting boards	6	Pine
Plate glass	6	10" x 12"
Work Bench	1	4' by 8' wooden top

^aRaymond Cherry, General Leathercraft (Bloomington, Illinois: McKnight and McKnight, 1946), p. 15.

Suggested Projects

1. Belt
2. Billfold
3. Book mark
4. Cigarette case
5. Coin purse
6. Comb case
7. Dog harness
8. Key chain
9. Notebook
10. Wrist watch band

General Shop References

Following is a list of references which have been compiled as an aid in securing additional information for the various activity areas which make up the Junior High School General Shop course.

Woodwork

Douglass, J. H. and Roberts R. H. Instruction and Information Units for Hand Woodworking. Wichita, Kansas: McCormick-Mathers Publishing Company, 1936.

Fryklund, V. C. and LaBerge, A. J. General Shop Woodworking. Bloomington, Illinois: McKnight and McKnight, 1940.

Hjorth, H. Basic Woodworking Processes. Milwaukee, Wisconsin: Bruce Publishing Company, 1935.

Hjorth, H. Principles of Woodworking. Milwaukee, Wisconsin: Bruce Publishing Company, 1930.

Mechanical Drawing

Blessing, George F. and Darling, Lewis A. Elements of Drawing.
New York: John Wiley and Sons, 1912.

Cook, Thurman C. Simplified Mechanical Drawing. Milwaukee, Wisconsin:
Bruce Publishing Company, 1935.

DeVette, W. A.. A Short Course in Mechanical Drawing. Milwaukee, Wisconsin:
Bruce Publishing Company, 1929.

Roberts, W. E. Beginning Mechanical Drawing Units. Peoria, Illinois: The
Manual Arts Press, 1936.

General Metals

Grayshorn, A. B. General Metal Work. New York: D. Van Nostrand Company,
1946.

Dragoo, A. W. and Reed, H. O. General Shop Metalwork. Bloomington,
Illinois: McKnight and McKnight, 1947.

Kronquist, E. F. Art Metalwork. New York: Whittlesey House, 1942.

Bick, A. F. Artistic Metalwork. Milwaukee, Wisconsin: Bruce Publishing
Company, 1940.

Crafts

Cherry, Raymond. General Plastics. Bloomington, Illinois: McKnight and
McKnight, 1941.

Dubois, J. H. Plastics. Chicago: American Technical Society, 1945.

Cherry, Raymond. General Leathercraft. Bloomington, Illinois: McKnight
and McKnight, 1946.

The Suggested High School Industrial Arts Program

The courses in Industrial Arts to be recommended for students of
high school standing were discussed at some length in Chapter IV.

The primary basis for selection of the courses, as was stated in Chapter IV, was the findings of an occupational survey which was made in 1949 of the city of Charlotte, North Carolina. Some other factors which might influence the courses selected are plant facilities and equipment, availability of qualified instructors, occupation of parents, and interest shown by students. The recommended courses include auto mechanics, general metals, machine shop and advanced woodworking, and a course outline will be developed for each of these courses. It is suggested that these courses, with the exception of general metals, be organized according to the unit shop plan of organization as was described in Chapter II. Since general metals will include experiences in both sheet metal and bench metal, it will be classified as a general unit shop.

It is not claimed that the student who completes a full school year of training in one of the recommended courses will be comparable to a skilled craftsman, or even a journeyman worker. It is felt, however, that he will acquire many of the necessary basic hand and machine skills as well as some related trade information which will enable him to secure employment in the trade of his choice. In all probability the student will enter employment as an apprentice or trainee. If he can secure employment and keep his job as a result of his high school shop training, it is felt that the course has rendered a service to the student as well as to the community.

In the opinion of some educators, the shop training given in schools is of no value whatever in holding a job in industry. Magill's views on the subject are as follows:

The term 'industrial arts' has been applied to this work implying that the shop activities are drawn from industry. Modern production methods are so elaborate, equipment so complex and expensive, and available school time so short, that the work cannot in any appreciable degree represent industrial processes and conditions. It cannot, therefore, provide even rudimentary training for employment nor can it be made sufficiently representative of industrial conditions to yield the vocational guidance values frequently claimed for it.¹⁶

It is the opinion of the writer that the statements made by Magill are extremely arbitrary and should be substantiated by additional facts. It is recognized that the value of school shop training would vary with the type of industry and the complexity of that industry. It is likely that school shop training would be of less value in an industry, such as the automotive industry which employs thousands of men, than it would in a small local machine shop employing 25 men, or less. To say 'it cannot provide even rudimentary training', however, seems to be a very broad statement and the writer questions the validity of the statement. It is common knowledge that there are thousands of both large and small industries, which can provide employment to high school graduates, and it is reasonable to assume that a number of them

¹⁶ Walter H. Magill, Administering Vocational Education (Nashville, Tennessee: Educational Publishers, Inc., 1941), p. 6.

have had industrial arts courses in the high school.

Assuming that there is some prevocational value in school shop training, it appears that the recommendation of additional high school industrial arts courses is in order. They will be presented in outline form in **partially** the same manner as was used in presenting the junior high school shop courses.

Advanced Woodwork

Woodworking is perhaps the most common industrial arts activity found in school shops and there are numerous reasons why this is true. In the first place, it is often the subject with which the teacher is more familiar. In addition it is a subject which can develop a high degree of manual dexterity in the use of common hand woodworking tools, and it can provide training and experience in the use of power tools similar to those found in many home work shops. Moreover, many of the skills acquired in school shops can be utilized in a number of trades or occupations included in the woodworking industry. For example, proficiency in the use of certain hand tools and some information concerning them would be quite helpful in the carpentry trade. Knowledge and skill in using certain power woodworking equipment, as well as hand tools, would be a valuable asset for the cabinet maker or person working in the furniture industry.

According to Tables III and IV, there are 1,839 people in and around Charlotte, North Carolina, who are employed at full time jobs

in some phase of the woodworking industry. In addition to Charlotte, there are many other cities within the state, which have furniture making plants.

The proposed course in Advanced Woodworking will be developed with the thought in mind that it will provide opportunity for experience and training which will be of benefit in aiding graduates to secure employment in the woodworking field, if they so desire. Emphasis will be placed on cabinet and furniture making.

In considering materials for use in compiling a list of informational and operational units, it was found that those units listed in the bulletin published by the American Vocational Association were quite comprehensive and applicable to this proposed course.

Informational Units

1. Characteristics and identity of woods common to the community
2. Working properties of common woods
3. Uses and sources of supply of good cabinet woods
4. Methods of cutting and milling lumber
5. The effect of moisture on wood
6. Standard dimensions for lumber
7. The nominal and actual dimensions
8. Methods of seasoning or drying lumber
9. Methods of making veneer and plywood
10. Kinds of wood finishes
11. Purpose of wood finishes
12. Materials from which finishes are made
13. Solvents used to cut or thin finishes
14. Care of finish brushes and spraying equipment
15. Kinds of glue
16. Preparation of glue
17. Conditions and requirements in use of glue
18. Kinds and sizes of nails and brads
19. Methods of manufacture and sale of nails
20. Kinds of other wood fasteners, corrugated fasteners, clannails and screws
21. Uses of different kinds of screws
22. How sizes and kinds of screws are indicated

23. Kinds and grades of sand paper and steel wool
24. Trade information and requirements; abilities, training and opportunities
25. Rules for safe operation of the common, power woodworking machines
26. Range of work which can be done on the common, power woodworking machines
27. Care and adjustment of common, woodworking power machines
28. Characteristics of different types and periods of furniture
29. Names of hand woodworking tools
30. Woodshop terms and nomenclature
31. Types of wood joints and where used
32. Woodworking mathematics necessary for industrial use.

Operational Units

1. Make sketch or working drawing of a project
2. Make out a bill material
3. Plan the procedure for making a project
4. Use hand tools necessary in making a project
5. Prepare surfaces for glueing
6. Glue and clamp pieces
7. Use wood fasteners, nails, screws, corrugated fasteners
8. Apply finish with spray gun
9. Rub a finish with compound
10. Apply wax and polish
11. Joint an edge on jointer
12. Cut a chamfer or bevel on jointer
13. Surface narrow stock on jointer
14. Cut a rabbet on jointer
15. Use circular saw for ripping, crosscutting, resawing, grooving
16. Use circular saw to cut dadoes, tenons, miters, and tapers
17. Use band saw to cut curves and tenons
18. Use band saw to rip and cross cut
19. Adjust depth of cut on surfacer
20. Adjust control feed on surfacer
21. Plane board to desired thickness on surfacer
22. Use sander on flat surface
23. Use sander on curved work
24. Change belts on sander
25. Cut moulding on straight edge with shaper
26. Cut moulding on circular edge with shaper

27. Cut inside curves on scroll saw
28. Rip and cross cut with scroll saw
29. Center stock for lathe
30. Mount between lathe centers
31. Design and shape a spindle turning on lathe
32. Turn a bowl or dish on face plate on lathe
33. Use the various lathe chisels, gouge, cut-off, skew, round nose
34. Sand on lathe
35. Apply finish and polish on lathe
36. Grind a cutting tool on power grinder
37. Hone a cutting tool
38. Change blades on band saw
39. Install blade in scroll saw
40. Drill with drill press
41. Mortise on drill press
42. Adjust speed of drill press
43. Lubricate machines
44. Change blades or cutters on circular saw.¹⁷

Suggested Projects

1. Bedstead
2. Cedar Chest
3. Chest of drawers
4. Coffee table
5. Dinette set
6. End table
7. Floor lamp
8. Gate leg dining table
9. Knee hole desk
10. Lawn furniture

¹⁷American Vocational Association, Inc., op. cit., pp. 18-21.

TABLE XII

ADVANCED WOODWORKING TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Saws	1	10" circular, tilting arbor
Lathes	2	38" floor model
Jointers	1	8" knives, 48" table
Surfacers	1	24" single surface
Grinders	1	6" double head
Drill presses	1	1/2" floor model
Routers	1	1/4" portable, electric
Sanders	1	Portable, belt type, dustless
Saws	1	24" scroll
Saws	1	20" band, floor model
Saws	1	14" band, floor model
Drills	1	1/4" hand, electric
Work benches	6	4' x 8" wooden top
Vices	24	Woodworking, quick acting
Chisels	2 sets	Lathe
Chisels	1 set	1/8" to 1" inclusive (wood)
Saws	6	Crosscut 8 point
Saws	3	Rip 5 point
Saws	6	Back 10" 12 point
Saws	6	4 1/2" coping
Saws	3	10" compass
Hammers	6	16 oz. claw
Scrapers	10	4" hand
Braces	4	10" swing, ratchet
Drills	2	3/8" breast
Bits	2 sets	1/4" to 1" inclusive auger
Bits	1	3/4" to 3" expansive
Bits	4	1/2" counter sink, rose
Bits	2	5/16" screwdriver
Screwdrivers	8	3" blade
Screwdrivers	3	6" blade
Planes	6	14" jack
Planes	3	9" smooth

TABLE XII

ADVANCED WOODWORKING TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Planes	3	6" block
Squares	12	8" try
Squares	5	16" x 24" steel, framing
Rules	12	24" steel, bench
Gauges	6	Marking
Clamps	6	36" steel, bar
Clamps	8	48" steel, bar
Clamps	4	72" steel, bar
Hand screws	12	10" opening, wooden
Clamps	6	6" "C"
Dividers	3	8" spring
Face plates	4	3" lathe
Face plates	4	6" lathe
Calipers	3	8" outside, spring
Calipers	3	8" inside, spring
Burnishers	1	Scraper
Files	12	12" half round, wood
Files	2	7" auger bit
Mallets	6	2½" wooden
Pliers	4	8" combination
Wrenches	3	10" adjustable
Oil stones	1	8" fine grit
Hacksaws	1	12" adjustable
Paint sprays	1	Portable, with com- pressor

^a"Industrial Arts in Louisiana," Bulletin 627 (Baton Rouge, Louisiana: State Department of Education, 1948), pp. 107-109.

Suggested References

- Hjorth, Herman. Machine Woodworking. Milwaukee, Wisconsin: Bruce Publishing Company, 1941.
- Hjorth, Herman. Operation of Common Woodworking Machines. Milwaukee, Wisconsin: Bruce Publishing Company, 1942.
- Smith, Robert E. Information and Operation Units in Machine Woodworking. Wichita, Kansas: McCormick-Mathers, 1938.
- Swartz, D. J., Gunerman, M. J., and Lafon, Alphonse. Fundamentals of Shopwork. New York: Henry Holt and Company, 1942.
- Wohlrs, Milton. Course in Woodturning. Milwaukee, Wisconsin: Bruce Publishing Company, 1919.

Auto Mechanics

There are relatively few Americans whose economic efficiency does not depend directly or indirectly upon the intelligent use of the automobile, and there are few people who do not get a large share of their personal social satisfaction from the use of the automobile.¹⁸

The average automobile owner considers his car as a mechanism, designed for his use in business and in pleasure. To him it is a vehicle that requires gasoline, oil, water, and air, and occasionally it may need some repairs. As long as the driver can provide the above items and keep the car in repair, he can sit in the driver's seat, manipulate a few controls, and be carried over long distances in a much shorter period of time than could his grandfather.¹⁹

¹⁸Iowa State Department of Education, "Industrial Arts for Secondary Schools," op. cit., p. 106.

¹⁹William H. Crouse, Automotive Mechanics (New York: McGraw-Hill Book Company, 1946), p. 1.

It is said that if all the automobiles in California were mobilized at one time, their number would be sufficient to transport every resident of that state to the Atlantic seaboard in one week. No other means of transportation has ever caught the fancy of the entire nation as has the automobile. It has influenced the entire social structure of the nation. It has managed to wipe out the restricting influences of distance and to weld the nation into a unified group of people.²⁰

The public schools of today can easily justify the inclusion of work in automobile mechanics as a part of their industrial arts program. Such an offering would be the most efficient way to develop an appreciation and understanding of the modern automobile.²¹

A course in auto mechanics could also result in other benefits. It could result in making the student a better judge of automobiles from the viewpoint of a consumer. It could result in large savings on repair bills. If sufficient interest and skill is developed by the student, it could result in the student getting employment in this particular line of work. There are very few towns or cities in the country today which do not have garages or shops equipped to do automotive repair. In each of these shops there are potential employment possibilities for the high school graduate with training in automobile mechanics.

Table III reveals that in 1949, there were 1,018 men employed as automobile mechanics in Charlotte, North Carolina. If this number

²⁰Ray F. Kuns, Automobile Essentials (Milwaukee, Wisconsin: The Bruce Publishing Company, 1949), p. 2.

²¹Iowa State Department of Education, "Industrial Arts for Secondary Schools," op. cit., p. 106.

was multiplied by the cities in the United States of equal size, not to mention the smaller cities, it would tend to indicate the tremendous size of this occupational field.

Men working in the automobile mechanics trade are beginning to specialize in one or more phases of the general area. For example, one mechanic might concentrate on ignition, one may become a specialist in carburetion, and a third may specialize in engine overhaul.

It is recognized that excellent service can be provided in this manner; however, it is felt that a mechanic should acquire a general and thorough knowledge of the construction, principles of operation, and methods of maintenance before specialization is attempted.

In keeping with the ideas as expressed in the above paragraph, it is the purpose of this course to provide general and comprehensive information regarding the automobile. This course, like preceeding courses presented in this study, will be developed in outline form. Both informational and operational units of instruction will be listed.

The following 30 informational units are those compiled in the bulletin published by the Iowa State Department of Education.

Informational Units

1. Important factors in the proper care of an automobile
2. Theory of operation of the engine
3. Responsibility involved in automobile ownership
4. Traffic regulations and driver information
5. Filling station services and products
6. Opportunities in automobile industry
7. Common hand tools required
8. Preferred brands and types of hand tools
9. Care and cost of hand tools
10. Safety practices in automobile mechanic shop

11. Chassis design and construction
12. Parts and function of steering mechanism
13. Types of braking systems
14. Types of axles
15. Function of differential assembly
16. Function and parts of transmission assembly
17. Function and parts of clutch
18. Tire sizes and construction
19. Function of generator and principle of operation
20. Principle of operation of starter
21. Parts and function of the battery
22. Principal internal engine parts
23. Lubrication, types and purposes
24. Function of cooling systems
25. Units which make up cooling system
26. Units which make up the fuel system
27. Function and principle of carburetor
28. Units which make up the ignition system
29. Function of the ignition system
30. Common troubles which will cause operating failures.²²

It was found, after investigation of material from a large number of sources that those operational units compiled for industrial arts for use by the Public Schools of the District of Columbia, were complete and applicable to this study.

Operational Units

1. Clean and service cooling system
2. Repair radiator with solder
3. Servicing and packing a water pump
4. Clean and service vacuum feeds
5. Install and adjust carburetor
6. Service lubrication system
7. Test specific gravity of storage battery
8. Test battery voltage and add water
9. Install battery in car
10. Replace battery terminal clamp
11. Drain and refill crank case with oil
12. Check grease in transmission and rear axle
13. Change oil filter units
14. Lubricate fittings with grease gun
15. Remove, clean and install simple motor parts

²²Ibid., pp. 108-112.

16. Grind valves
17. Adjust valve tappets
18. Overhaul cam follower assembly
19. Set valve timing, gear type
20. Set valve timing, silent chain type
21. Remove end play from cam shaft
22. Locate firing order in four, six, and eight cylinder engines
23. Remove and check pistons for wear
24. Check cylinder walls for wear
25. Fit piston rings
26. Check crank shaft bearings for alignment
27. Take up main bearings and rods
28. Align connecting rods
29. Remove engine from frame
30. Assemble engine complete
31. Inspect and replace fuses
32. Replace light bulb and adjust light focus
33. Remove, clean, test, and replace spark plug.
34. Install new ignition harness
35. Remove and install ignition coil
36. Install breaker points
37. Clean, adjust, and align breaker points
38. Time ignition
39. Install or repair starter switch
40. Test generator for charging rate
41. Replace worn generator brushes
42. Adjust generator charging rate
43. Adjust voltage regulator
44. Sand and clean generator commutator
45. Remove and replace generator
46. Remove and replace a tire
47. Repair punctures with cold patches
48. Repair punctures with hot patches
49. Adjust mechanical brakes
50. Adjust hydraulic brakes.²³

²³Public Schools of the District of Columbia, Manual Arts Courses of Study for Senior High Schools (Washington, D. C.: 1947-1948), pp. 3-7.

TABLE XIII

AUTOMOBILE MECHANICS TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Battery service kits	1	
Battery carriers	1	
Battery pliers	1	
Brushes	1	Spoke washing
Calipers	1	8"-outside, spring
Calipers	1	6"-inside, spring
Carbon cleaning brushes	1 set	1/4"-rotary
Scrapers	2	Carbon
Chisels	2	3/8"-cold
Chisels	2	1/2"-cold
Testers	1	Compression
Connecting rod jigs	1	
Piston jigs	1	
Cylinder gauges	1	
Differential hoists	1	1 ton capacity
Dividers	1	6"-spring
Drills	1	Breast
Drills	1	1/4"-portable, electric
Drills	1	3/8"-portable, electric
Drills	1	1/2"-portable, electric
Drill presses	1	Floor model
Clamps	6	4"-MC
Extension cords and lights	4	25'
Flaring tools	1	Tubing
Punches	2	Gasket
Gauges	8	Thickness
Gear pullers	2	
Grease guns	2	Zerke
Grease guns	2	Alemite
Grinders	1	Heavy duty, bench
Hack saw frames	6	
Hammers	8	12 oz., ball pein
Jacks	3	Small, hydraulic
Jacks	1	Caster mount, hydraulic
Motor analyzer and tune up units	1	
Motor blocks for disassembly	5	

TABLE XIII

AUTOMOBILE MECHANICS TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Oil cans	4	1/3-pint
Oil cans	8	6 gallon, waste
Pliers	3	6"-combination
Pliers	3	8"-vice grip
Punches	5	Center
Compressors	3	Ring
Rules	4	6"-Hook
Screwdrivers	4 sets	2"-3"-4"-6"-8" blades
Screwdrivers	2 sets	Phillips, sizes 1,2,3, 4
Extractors	3 sets	Screw
Screw pitch gages	3 sets	30 leaves
Scribers	3	
Spark plug cleaner and testers	1	
Squares	4	12"-combination
Tire irons	3	Straight
Tire irons	3	Curved
Gages	3	Tire pressure
Cutter	2	Tubing
Twist drills	1 set	1/8" to 1/2" inclusive
Work benches	4	4' x 8' metal tops
Vices	4	3 1/2"-mechanist
Pliers	3	Water pump
Wheel pullers	3	
Wrenches	4	6"-adjustable
Wrenches	4	8"-adjustable
Wrenches	4	10"-adjustable
Wrenches	3 sets	12 point box, 1/4" to 9/16" inclusive
Wrenches	3 sets	Open end, 5/16" to 3/4", inclusive
Wrenches	3	12"-pipe
Wrenches	3	18"-pipe
Wrenches	3 sets	1/4"-drive, socket, 1/4" to 7/16", inclusive

TABLE XIII

AUTOMOBILE MECHANICS TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Wrenches	4 sets	3/8" drive, socket 5/16" to 1", inclusive
Wrenches	3	Tappet
Wrenches	3	Sparkplug
Pliers	3	6"-thin nose
Pliers	4	6"-diagonal cutting
Valve spring lifters	3	
Wrenches	4	Torque
Wrenches	3 sets	Allen-1/16" to 1/2", inclusive

^a"Industrial Arts for Secondary Schools," Volume III
(Des Moines, Iowa: State Department of Education, 1948), pp. 152-154.

Suggested References

- Barger, Clarence G. Automotive Mechanics I. New York: American Book Company, 1943.
- Crause, William H. Automotive Mechanics. New York: McGraw-Hill Book Company, Inc., 1946.
- Dykes, A. L. Dyke's Automobile and Gasoline Engine Encyclopedia. Chicago: The Goodheart-Willcox Company, Inc., 1943.
- Kuns, Ray F. Automotive Essentials. Milwaukee: The Bruce Publishing Company, 1935.

General Metals

The general metals courses to be recommended will include sheet and bench metal. These two units were combined to reduce the expense involved as well as the space required if they were organized as individual shops. Since the two trades are so closely related it is felt that these two shop units could be combined without materially affecting either unit.

The class can be divided, with half working in each field for one semester, or other methods of organization can be decided upon by the instructor in charge. In either case, individual course outlines should be developed for each course.

Sheet Metal

The greater part of the iron tonnage of the many mills all over the world is rolled into sheets and sold to manufacturers using sheet metal. Sheet metal has qualities that make it the best material for numerous products used in the home, office, and factory, on the farm, in railroad rolling stock, automobiles, pleasure boats, merchant vessels, etc.

Stringent fire laws are rapidly replacing wood with sheet steel in many structures. It is more economical than wood; it is indestructible, fireproof, light in weight, and very durable, and the finished product presents a pleasing appearance.²⁴

Sheet metal has come to be a popular building material, as well as the leading metal used in the manufacturing of other products, such as bus and truck bodies, air conditioning, and heating units, hotel, bar and cafeteria fixtures. In view of the above, it would certainly seem that because of this general increase in the use of sheet metals, students receiving shop training should be familiarized with the characteristics of sheet metal as well as the methods of manipulation.

Table IV reveals that there were 865 persons in Charlotte, North Carolina, earning their livelihood in the general metals trade. This would tend to indicate that there are employment opportunities for those students, with the interest, aptitude, and ability, who desire to enter the trade as a vocation.

The following list of informational and operational units were secured and compiled from three references.

Informational Units

1. Metals commonly used in sheet metal work
2. Sheet metal safety practices
3. Kinds of solders used with sheet metal
4. Kinds of flux and their purpose
5. Soldering devices
6. Description and name of tools for the following operations:
 - a. Layout
 - b. Cutting metal
 - c. Making a hole
 - d. Bending metal by hand
 - e. Stakes
 - f. Riveting
 - g. Seams
7. Kinds of snips

²⁴L. Broemel, Sheet Metal Workers' Manual (Chicago: Frederick J. Drake and Company, 1942), p. II.

8. Kinds of rivets
9. How rivets are sold
10. Sizes of rivets
11. Names of machines used in sheet metal shops
12. Safety practices when operating machines
13. Care of each machine
14. Gages of sheet metal
15. Knowledge of U. S. Standard sheet metal gage
16. Knowledge of Brown and Sharpe gage
17. Knowledge of Stubs' gage
18. Standard sizes of soft iron wire
19. Characteristics of each of the sheet metals
20. Sources of the common metals
21. Manufacture of galvanized iron
22. Commercial sizes, grades and qualities of galvanized iron
23. Composition of brass
24. Kinds of steel
25. How steel is made
26. Manufacture of copper and aluminum
27. Importance of sheet metal work
28. Opportunities in the sheet metal trade
29. Occupational information
 - a. Training
 - b. Wages
 - c. Success factors
 - d. Apprentice training
 - e. Employee-employer relationships
30. Kinds and sizes of drills
31. Knowledge of decimal equivalent table

Operational Units

1. Read a working drawing
2. Plan a procedure of operations
3. Check materials as received
4. Compute square feet and inches
5. Measure metal for cutting
6. Study parallel line lay out
7. Study radial line lay out
8. Transfer pattern
 - a. Master-pattern
 - b. Pattern on paper and transfer with prick punch
 - c. Transfer directly on paper
9. Make a simple layout
10. Lay out cylindrical pattern
11. Lay out conical pattern

12. Lay out transition pattern
13. Cut with snips
14. Cut with ring and circle shears
15. Punch hole with solid punch
16. Punch hole with hand punch
17. Punch hole with hollow punch
18. Drill holes with hand drill
19. Drill holes with drill press
20. Bend metal by hand
21. Bend metal with a bar-folder
22. Make a hem by hand
23. Fold an edge with bar-folder or pan brake
24. Make a wire edge, hand process
25. Make a wire edge, machine process
26. Wire a curved edge
27. Burr an edge with burring machine
28. Form metal by raising or bumping
29. Form metal by a forming roll
30. Form metal on the crimping machine
31. Form metal on the beading machine
32. Trim with squaring shears
33. Trim with circular shears
34. Light and operate a blow torch or gas furnace
35. Tin a soldering copper
36. Practice soldering
37. Solder tin, copper, galvanized iron, brass
38. Sweat a joint
39. Make a solder lap seam
40. Rivet with tinner's rivets
41. Make a riveted lap seam
42. Turn a lock seam
43. Groove with hand-groover
44. Groove with a grooving machine
45. Make a setting-down seam by hand
46. Make a setting-down seam on a machine
47. Crimp or shrink edges
48. Form metal on squaring stake
49. Form metal on hatchet stake
50. Trim with cold chisel
51. Hand-swage
52. Anneal copper or brass
53. Hammer finish copper, brass aluminum or iron
54. Apply lacquer finish
55. Fold a curved edge
56. Make a double seam on stake or machine
57. Solder aluminum
58. Form with a cornice-brake
59. Form with a taper-edge
60. Layout and form hinges
61. Layout pattern for mitered corner

62. Layout pattern for solid corner^{25,26,27}

Suggested Projects

1. Ash tray
2. Baking pan
3. Bookends
4. Cookie cutter
5. Dish drain pan
6. Fruit or nut bowl
7. Jewel box
8. Letter holder
9. Mail box
10. Match holder
11. Sugar scoop
12. Tool box
13. Waste paper basket

²⁵"Industrial Arts in Louisiana," Bulletin 627 (Baton Rouge, Louisiana: State Department of Education, 1948), p. 87.

²⁶Robert E. Smith, Units in Sheet Metal Work (Bloomington, Illinois: McKnight and McKnight, 1939), p. 2.

²⁷F. E. Tustison and Ray F. Kranzusch, Metalwork Essentials (Milwaukee, Wisconsin: The Bruce Publishing Company, 1936), p. XI.

TABLE XIV

SHEET METAL TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Barfolders	1	30"
Soldering furnaces	6	Johnson
Shears	1	36"
Brakes	1	6' box and pan
Rotary machines	1	Turning, wiring, burring, crimping, beading
Benches	4	10' x 4' (wooden top)
Benches	1	4' x 8' soldering (metal top)
Stakes	1	Blowhorn
Stakes	1	Beakhorn
Stakes	2	Candlemold
Stakes	1	Regular square
Stakes	1	Creasing
Stakes	1	Hollow mandrel
Stakes	2	Roundhead
Stakes	1	Conductor
Stakes	1	Solid mandrel
Stakes	1	Double seaming
Holders	2	8" x 20" stake
Snips	12	Combination
Snips	3	Hawksbill
Snips	3	Circular
Snips	1	Bulldog
Scribers	8	6"
Squares	3	12" combination
Rules	8	24" steel
Rules	2	36" circumference
Squares	1	24" steel
Squares	2	12" steel
Dividers	6	6" spring
Trammel points	1	
Punches	6	Prick
Punches	1 set	1/8" to 3/16" inclusive, solid

TABLE XIV

SHEET METAL TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Punches	1 set	3/8" x 1½" inclusive, hollow
Hammers	3	6 oz. ball peen
Straight edges	1	8' steel
Seamer	2	Handy
Tongs	2	Bending
Sheet metal gauges	1	U. S. Standard
Wire gauges	1	American
Mallets	6	1½" rawhide
Mallets	6	1½" wooden
Soldering coppers	2	2 lb.
Soldering coppers	6	1½ lb.
Hammers	1	Raising
Hammers	6	12 oz. tinner's riveting
Hammers	3	12 oz. tinner's setting
Rivet sets	7	Size 1 through 7
Hand groovers	1	No. 1
Hand groovers	2	No. 4
Screwdrivers	1	3" blade
Screwdrivers	2	4" blade
Screwdrivers	2	6" blade
Screwdrivers	1	8" blade

^a"Industrial Arts in Louisiana," Bulletin 627 (Baton Rouge, Louisiana: State Department of Education, 1948), p. 89.

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Bench Metal

Bench Metal is not a sharply defined area of work where individuals perform specific tasks and develop specific skills. Bench work, as the name implies, is done at a bench, and hand tools are used to a large degree in this type of work. This does not mean that workers in this area are more or less skillful than other tradesmen employed in the metal industry. However, many bench workers are among the most versatile and resourceful tradesmen found in the industry. They are often mature workmen with many years of training and experience. Because of the bench worker's versatility and skill in using hand tools, he is often paid wages that are higher than those received by workers in other metal working areas, and frequently is promoted to positions of responsibility.²⁸

²⁸ Robert E. Smith, Units in Bench Metal Work (Bloomington, Illinois: McKnight and McKnight, 1939), p. 2.

Due to the demand for skilled, hand-craftsmen in the metal working trades and the employment opportunities for those persons qualified for this type of work, it is felt that bench metal is an area of industrial arts activity which should receive more emphasis. It is an activity which can be correlated with most of the industrial arts courses, and especially those in the sheet metal area. In addition tools and equipment for bench metal work can be purchased at a relatively small cost. The opportunities for providing experiences, which will develop and increase the manual skills a student might possess, are practically unlimited. Moreover, many beautiful and functional household articles may be constructed while the student is developing these skills.

In investigating possible sources of material which might be used in compiling informational and operational units for a course in bench metal, it was found that those units contained in a book by Dragoo and Reed and one by Smith, were well suited for the proposed course.

Informational Units

1. Safety rules for metal shop
2. Metals commonly used in bench work
3. Names of common measuring and laying out tools
4. Holding devices, clamps and vises
5. Names of basic hand tools
6. Reasons for tempering and annealing metal
7. Common mathematics required in bench metal work
8. Various methods of numbering twist drill for size
9. Methods of changing iron ore to metallic iron
10. Methods of changing pig iron to steel

11. Types of files
12. Types of abrasives used to cut metal
13. Types of metal finishes
14. Types of metal fasteners
15. Types of rivets used
16. Geographical location of raw metals
17. Employment requirements

Operational Units

1. Plan a job.
2. Draw a design or pattern.
3. Cut stock.
4. Use a hack saw.
5. Use metal files for cutting or removing metal.
6. Drill holes by hand.
7. Drill holes with drill press.
8. Use measuring or laying out tools.
9. Locate the center of circular stock with centering gauge.
10. Calculate length of stock for circular or irregular shapes.
11. Use pliers, shears, and nippers.
12. Cut metal with cold chisel.
13. Shape cold metal in vise.
14. Twist cold metal.
15. Cut thread with a die.
16. Cut thread with a tap.
17. Cut and thread pipe.
18. Produce a hammered finish on metal.
19. Apply oil, lacquer, enamel or wax finish.
20. Sharpen tools on power grinder.
21. Use center punch.
22. Use abrasives on metal.
23. Temper and anneal metal.
24. Case hardened metal.
25. Make an angular bend.
26. Form an eye in metal.
27. Grind metal.^{29,30}

²⁹A. W. Dragoo and Howard O. Reed, General Shop Metal Work (Bloomington, Illinois: McKnight and McKnight, 1947), p. 7.

³⁰Robert E. Smith, op. cit.

Suggested Projects

1. Bed lamp
2. Bookends
3. Book rack
4. Flower pot holder
5. Hammer
6. Letter openers
7. Pipe rack
8. Scriber and screwdriver
9. Scroll candle holders
10. Shoe rack
11. Smokers stand with ashtray
12. Wall lamp

Suggested References

- Dragoo, A. W. and Reed, Howard O. General Shop Metalwork. Bloomington, Illinois: McKnight and McKnight, 1947.
- Ludwig, O. A. Metalwork Technology and Practice. Bloomington, Illinois: McKnight and McKnight, 1947.
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TABLE XV

BENCH METAL TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Hammers	1	1½-lb. ball peen
Hammers	1	1-lb. ball peen
Hammers	12	12-oz. ball peen
Hammers	1	Cross peen
Hammers	1	Straight peen
Hammers	1	Claw
Punches	6	Center
Hacksaws	6	
Cold Chisels	2	Flat 3/4"
Cold Chisels	12	Flat 1/2"
Cold Chisels	1	Cape 1/4"
Bending jigs	4	
Twist Drills	2 sets	3/32" to 1/2" Inclusive
Files	12	12" Mill bastard single cut
Files	6	8" Mill bastard single cut
Files	6	10" Half round double cut
Files	3	10" Rattail bastard single cut
Files	3	6" Rattail bastard single cut
File handles	50	Assorted sizes
Clamps	6	"C"-2" opening
Clamps	6	"C"-10" opening
Wrenches	1	12" monkey
Wrenches	1	6" monkey
Wrenches	1	10" adjustable
Wrenches	1	6" adjustable
Wrenches	1	10" pipe
Wrenches	1	6" pipe
Cutters	1	1/2" to 1" pipe
Reamers	1	1/8" to 2" pipe
Hand drills	3	1/4" chuck
Nippers	1	6" end cutting
Nippers	1	6" diagonal
Side cutters	2	6"
Pliers	8	8" combination

TABLE XV

BENCH METAL TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Emery wheel dressers	1	Rotary
Oil stones	1	8" combination
Oil cans	3	1/2 pint
Brushes	6	Bench

^a"Industrial Arts in Louisiana," Bulletin 627 (Baton Rouge, Louisiana: State Department of Education, 1948), pp. 90-91.

Machine Shop Practice

Machine shop practice is not confined entirely to the operating of metal working machines. There is also a considerable amount of bench work included, and in order for a man to be proficient as a trade machinist he must have mastered many of the skills required of bench workers and also be adept in operating machines. According to Ludwig, it is seldom that a man will operate all the machines in a large commercial machine shop.³¹ In all likelihood he will confine his efforts to one particular machine and specialize in its operation.

There is no doubt as to the soundness of this practice, particularly when one considers the high degree of accuracy, and speed required of modern day production workers. In the opinion of the writer, the machine operator, even though he may specialize in the operation of one machine, would have a better understanding of the machinist's trade if he had received general machine shop training which included not only the operation of the principal power machines, but also their uses, limitations and their relation to other machines.

In a study concerning machine shop, perhaps it would be well to come to an understanding concerning the meaning of the term machine tool. A machine tool is a power driven machine used to fashion things out of metal. With machines, the work can be done much more precisely

³¹Oswald A. Ludwig, Metalwork Technology and Practice (Bloomington, Illinois: McKnight and McKnight, 1947), pp. 11-18.

than by hand and in most cases faster and with practically no muscular effort.³²

It should be apparent that machine tools do not exist for themselves although they are the only machines capable of reproducing themselves. They are but instruments which make men more productive. They are creators of goods and wealth.³³

The student in Machine shop practice, may perform on machine tools, basic machining operations which will give him an insight into the possibilities of the machine, and prepare him for performing more complex exercises. He will be able to get the "feel" of the machine, and experience the sense of creating, even though the exercise upon which he works may be simple. Then, too, he will not be unfamiliar with the various types of machines when he encounters them in his initial experience in industry.³⁴

The course outline to be recommended will deal primarily with instruction concerning machine tools. It is realized that bench work has a very important function in machine shop practices, however, since that phase of the work was outlined in connection with a previous course it will not be repeated here.

³²"The Machine Tool Primer" (Newark, New Jersey: The Herbert K. Hall Foundation, 1948), p. 1.

³³Ibid., p. vii.

³⁴William P. Turner and Halsey F. Owen, Machine-Tool Work (New York: McGraw-Hill Book Company, Inc., 1945), pp. 1-2.

The recommended course will begin with a review of bench work procedures, since it is assumed that bench work will precede the course in machine shop practice. It will deal primarily with instruction covering the general area of machine shop practices. Included in the course will be instruction and practice in operating the common power tools used in machine shop work. These machines are the drill press, the engine lathe, the shaper, the milling machine, and the grinder. Informational units will not only include these machines, but the elementary phases of machine work will also be made a part of the outline.

Table IV shows that during the year 1949, there were 937 men working as full time machinists in the city of Charlotte, North Carolina. This would indicate that there is an employment market for trainees in this line of work, who possess the necessary skill and qualifications.

The bulletin produced by the American Vocational Association was the source of the following informational units.

Informational Units

1. Names of tool bits
2. Types of chucks and face plates
3. Function of speed indicators
4. Types of threads
5. Meaning of terms such as: pitch, lead, left-hand, right-hand, single and multiple threads
6. Meaning of ratio between pitch and lead
7. Types of lubricants used in thread cutting
8. Types of taps and dies
9. Care of taps and dies
10. Safety practices for each machine
11. Names of hand tools
12. Number and letter sizes of drills
13. Types of drill gages
14. Types and grades of sand paper and emery cloth

15. Types of keys and their proportions
16. Belt measurements
17. Kinds of chisels
18. Shapes of files
19. Various grades of files
20. Sizes and kinds of saws
21. Composition and grades of babbitt
22. Reason for using babbitt bearings
23. Composition of solder
24. Kinds of flux and where used
25. Grades of iron and steel
26. Methods of making cast iron castings
27. Composition of brass
28. Names of standard tapers
29. Kinds of drills
30. Parts of drills
31. Speed and feed of drills
32. Kinds, grades, and speeds of grinding wheels.³⁵

The following operational units are a part of those compiled by the Public Schools of the District of Columbia.

Operational Units

1. Start, run, and stop the drill press
2. Clamp stock to drill table
3. Select proper drill
4. Use center punch to start hole
5. Drill hole without break through
6. Drill to indicated depth
7. Use drill press for reaming, countersinking, counterboring, spot facing and tapping
8. Align taps for squareness
9. Start, run, and stop the lathe
10. Check and oil the lathe
11. Set speeds and feeds of lathe
12. Mount draw in chuck
13. Sharpen lathe tools
14. Mount tool, tool post, tool post ring as to place angle, right, and tool angle
15. Do facing, shouldering and necking on the lathe
16. Check or adjust tail stock
17. Do center drilling, reaming and tapping of uneven work on the lathe.
18. Put work between center, align centers and dogs
19. Do straight turning and knurling
20. Do simple angular turning
21. Start, run, and stop shaper
22. Oil the shaper

³⁵American Vocational Association (Washington, D. C.: Industrial Arts Division), pp. 36-37.

23. Adjust the length of stroke, position of ram, direction of feed, and amount of feed on shaper
24. Adjust clapper box, apron, and swivel head of shaper
25. Set tool post and tool to proper length
26. Clamp work in vice and test for parallelism and squareness
27. Do horizontal cutting with shaper
28. Do vertical cutting with shaper
29. Do combined cutting with hand feed and shaper
30. Start, run, and stop milling machine
31. Oil the milling machine
32. Adjust the milling machine to certain speed and feed
33. Do face milling, plain milling, angular milling, sawing and form milling
34. Select correct cutter and cut key ways and grooves
35. Adjust for correct depth
36. Read micrometers
37. Read vernier calipers
38. Read vernier depth gage
39. Read vernier height gage
40. Determine shape and pitch of thread
41. Sharpen threading tool to master gage
42. Gear lathe to ratio necessary for cutting thread
43. Set thread stop
44. Cut thread on lathe
45. Clean thread with chasing tool
46. Operate the surface grinder
47. Select and mount the proper grinding wheel
48. Place work on chuck, adjust feed and reversing dogs
49. Grind work³⁶

Suggested Projects

1. Ball pein hammer head
2. Bench plates
3. Bench stop
4. Desk weight
5. Drift punch
6. Fillister head screw
7. Hexagon head bolts
8. Parallel bars
9. Tool post rocker
10. "V" blocks.

³⁶Public Schools of the District of Columbia, op. cit., pp. 14-29.

TABLE XVI

MACHINE SHOP TOOLS AND EQUIPMENT^a

Tools and Equipment	Quantity	Description
Arbor presses	1	Floor model
Calipers	4	8" inside
Calipers	4	8" outside
Center gages	4	No. 391
Belt lacers	1	Clipper
Countersink and drills	2	Combination
Drills	2	1/2" hand, electric
Drill presses	1	12" floor model
Drill press vises	2	
Drill press "V" blocks and clamps	3	
Engine lathes	2	10" quick change
Engine lathe attachments and accessories	2 sets	Complete
Grinders	2	Tool, pedestal type
Grinders	1	Surface, general purpose
Metal shapers	1	10" bench model
Metal shaper accessories	1 set	Complete
Micrometers	4	0-1 inch
Micrometers	2	1-2 inch
Micrometers	2	2-3 inch
Milling machines	1	General purpose
Milling machine accessories	1 set	Complete
Band saws	1	20" metal cutting
Oil cans	4	1/2 pint
Punches	8	Center
Reamers	3 sets	1/2" - 5/8" - 3/4" - 1"
Rules	10	6" steel
Surface gages	1	Universal
Surface plates	1	
Screw extractors	1 set	
Squares with centering heads	5	Combination
Drill bits	3	39/64" taper shank
Drill bits	3	5/8" taper shank
Drill bits	3	47/64" taper shank

TABLE XVI

MACHINE SHOP TOOLS AND EQUIPMENT^a (CONTINUED)

Tools and Equipment	Quantity	Description
Drill bits	3	3/4" taper shank
Drill bits	2	63/64" taper shank
Drill bits	2	1" taper shank
Drills	2 sets	High speed, twist, fraction by 64ths. 1/16" to 1/2" inclusive
Vises	6	3 1/2" machinist, swivel base
Wheel dressers	3	No. 55 grinding, carborandum
Wrenches	6	10" adjustable
Wrenches	2 sets	1/4" to 1" inclusive, open end

^a"Industrial Arts for Secondary Schools," Volume III (Des Moines, Iowa: State Department of Education, 1948).

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CHAPTER VI

SUMMARY

That the industrial arts program of Harding High School in Charlotte, North Carolina, could be enlarged and thus render a valuable service to a greater number of the students is recognized by both school administrators and instructors. Previous efforts to expand the program and facilities have been either impossible or impractical due to financial limitations and war conditions.

In 1949, however, the writer was given permission to make a study of the situation and to make recommendations to the administrators of the Charlotte City Schools regarding possible expansion of the industrial arts program at Harding High School. It is realized that additional shop courses cannot be added to the curriculum at the present time due to the fact that there is no shop space available for these courses. There is some assurance, however, that additional building space will be available in the not too distant future if the recommendations of the Engelhardt survey are carried out. New or additional shops should be constructed to fit the proposed course of study rather than to develop the course of study to fit the shops. It is the hope that the planning of the new shops will be definitely influenced by the adoption of an expanded industrial arts course of study.

In making the study, prior to the recommending of new or additional courses, the writer chose as a basis for the selection, industrial

employment opportunities for graduates, in and around the city of Charlotte, North Carolina. In order to secure data which could be considered as valid, it was necessary to make an occupational survey of the industries and businesses of Charlotte which would seem to be applicable to industrial arts activities. By this is meant to ascertain the number of persons employed in occupations which have a definite parallelism in some of the generally accepted industrial arts courses. The total number of people working in each industry was secured, and this number was further reduced to include only those people who could be classed as skilled workers. As a result of the survey, it was found that the number of skilled workers fell into five major classifications. These were woodworking trades, automobile mechanics, machinists, other metal workers, and those in printing and allied fields. The largest single body of skilled workers were those following the woodworking trade. Their total number was 1,839. The second largest group of workers employed in a trade which could be adapted to school shop work were those employed as automotive mechanics. Their total number was 1,018. This number included men working on the maintenance and repair of private automobiles and also the group employed in the upkeep of buses and trucks. The group of workers comprising the machinist's trade made up the third largest group with a total number of 937. The number of men working in the iron, steel and sheet metal trades numbered 865. It is felt that this group employed in a variety of metal working occupations would be best served by the type of industrial arts shop which is called general metals.

The survey showed that there were 535 skilled workers representing the printing trades in Charlotte, North Carolina. This was the fifth largest number of skilled tradesmen employed in a trade which could be considered as adaptable to an industrial arts program.

The textile industry, with a total of 7,362 workers, is a large and growing industry in and around Charlotte. It employs more persons than are in all of the trade groups previously mentioned. Due to the type of work involved, however, it was not considered as an occupation which could be adapted to school conditions. It is a matter of common knowledge that the great proportion of the work performed in the textile industry involves the operation of large, complex, and expensive machines. For that reason the group employed in the textile industry was not considered in this study.

Data contained in this survey were obtained from a variety of sources. Agencies which were cooperative and helpful were The Charlotte Branch of the United States Employment Service, The Charlotte Chamber of Commerce, and some of the Charlotte Local Trade Unions. Many individuals and groups from the different industries and businesses were also quite helpful. The methods used in collecting these data were largely by personal interview augmented by telephone conversations.

As a result of the occupational survey carried out in Charlotte, North Carolina, the following trades were chosen as a basis for the industrial arts course development: woodworking, automotive mechanics, machinists and metal working. Due to a distinct difference in opinion between two groups interested in the printing trade, that trade was not

included in the list for which courses of study were developed. Some members of organized labor in Charlotte expressed the opinion that printing as a part of the industrial arts curriculum, was of little value. Some of the employer group, however, were in disagreement with the above beliefs and pledged their aid in establishing such a course. Because of these differences, it is felt that further study is advisable before definite recommendations should be made.

In developing course outlines for the courses which are referred to as Advanced Woodworking, Auto Mechanics, General Metals, and Machine Shop Practice, the writer has made an effort to collect, evaluate and assemble materials which will be of valuable aid to the industrial arts instructor. The things to do and the things to know have been listed under the headings of "Operational" and "Informational" units. Also included with each course outline is a list of tools and equipment necessary to carry out the operational units. This serves as a partial index to the doing skills which may be acquired in the course. A list of supplementary references which is of value affords additional study material for the informational units.

In addition to course development for the above activities which are intended for use by high school age students, a General Shop Course was developed for use in the Junior High School.

Activities included in this course were woodworking, mechanical drawing, metal work and crafts. Metal work would include units in sheet metal and also art metal. Plastics and leatherwork were included in the

crafts area. These diversified areas of activity in the General Shop program were chosen to provide opportunities to develop basic skills and secure experiences which would be useful in the advanced high school courses. It is also felt that after a student has participated in the many activities which are included in the General Shop, he can choose specialization in one of the advanced courses with greater wisdom and meaning.

It is not intended that the proposed course outlines as developed should be considered final or complete. They are provided for the use of the instructor as a basis for further additions or alterations as conditions might warrant. Neither is it intended that completion of any course will result in a boy being a skilled craftsman. It is believed that the courses provide opportunities to acquire the basic fundamental skills required in the several trades, as well as related trade information. This will enable the boy to progress at a greater rate of speed, should he choose to enter a trade involving these skills and knowledge. It is also felt that participation in the program will result in the development of fundamental abilities that are broadly useful and that find application in phases of life other than industrial.

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