INDIVIDUAL INSTRUCTION SHEETS IN INDUSTRIAL ARTS - THEIR VALUE AND EXTENT OF USAGE

by

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Chapter I

INTRODUCTION

Individualized instruction in industrial arts classes has become a problem of major concern to the instructors. Classroom enrollments began to increase as far back as 1930, when our country was in the throes of a great depression and tax burdens forced a less-favorable pupil-to-teacher ratio. Since World War II, enrollment increases and teacher shortages have served further to intensify the problem. Industrial arts instructors are often unprepared to cope with the increased number of students alloted to them. It has been found that individual instruction, so vital to industrial education presents a pressing problem. Other reasons for the need of individual instruction are (1) the irregular entrance and attendance of students; (2) the type of equipment used in the shop classes; (3) the nature of the teaching device or project; (4) individual differences in intelligence and ability which has made a great change in the modern methods of teaching. Leighbody (15, p. 160) stated as to individual differences:

> "Results of careful studies in the psychology of learning make it seem probable that no two individuals learn at exactly the same rate.

> "The greater the difference between the lowest and the highest learner in class, the greater the need for special consideration of individuals and, generally speaking the more difficult the task of carrying on profitable instruction."

Selvidge (23, p. 181-182) on the problem of individual instruction had this to say:

> "Individual instruction is necessary for satisfactory solution to the problem, but individual oral instruction is very expensive, impracticable, and in many respects inefficient. A teacher who relies upon individual oral instruction can handle only a small number of pupils, and the cost is out of all proportion to the value of the instruction as compared with other plans.
>
> "We are notoriously inaccurate, diffuse, and verbose in our oral instruction, and pupils are even more inaccurate in their understandings and recollections of our instructions. For these reasons it appears to be unwise to rely to any considerable degree upon individual oral instructions.
>
> "In this respect the written assignment sheet has a very distinct advantage over oral assignments."

Many attempts have been made to solve the problem of individual instruction through the use of written and printed instructional material. School boards and administrators often attempted to economize and the purchasing of books and other commercially published materials was sometimes discouraged. It was therefore, often left up to the instructor to formulate and provide his own written instructional material.

In referring to this matter of teacher-written instructional materials Leighbody (15, p. 71) states that:

> "Teacher prepared instruction sheets are often superior to any other form of written material because they present the new ideas in the exact way which the individual teacher wishes the pupils to receive them. They can be prepared to fit the teacher's own manner of presentation, and adapted to his other teaching materials."

The written instruction sheet appears to offer the most satisfactory solution to the problem of individual instruction, and when carefully prepared, serves the purpose admirably.

THE PROBLEM

Statement of the Problem

The purpose of this study is to: (1) find the extent to which industrial arts instructors are using individual instruction sheets; (2) learn whether the instructor is aided in the problem of individual instruction through the use of these sheets; (3) determine if instruction sheets are of possible value to the students in industrial arts classes; (4) determine if there is a significant difference in the extent of their use in different sections of the United States.

In an attempt to answer some of these questions, a controlled experimental study was conducted in an

industrial arts teaching situation. To supplement the experiment, a survey was made by questionnaires, mailed to 346 industrial arts instructors in 26 different states and in various sections of the United States.

Importance of the Problem

The problem appears to be significant due to the large increase in industrial arts classes in the schools today. This increase is due to two main factors: (1) an increase in the population of the nation; and (2) a rise in the popularity of industrial arts classes. We find this particularly true of the west coast states. Los Angeles, as an example, is in need of one new eightroom elementary school each week. This statement was made by Dr. Kermit Seefeld at the industrial arts section of the 1956 Convention of the National Education Association, Portland, Oregon, based upon a study conducted by the Los Angeles School Administration and reported to the American Vocational Association in December 1954, by Assistant Superintendent Howard Campion. The same problem is common to many Pacific Coast communities, at all school levels. For example, since 1949, the Kern County Union High School and Junior College District in California has constructed three four year high school plants and a new junior college, and has enlarged five other high schools in the district.

The district is already in need of another new four year high school.

Industrial arts teachers, due mainly to the enlarged enrollments, must find some method to individually aid more students. As class enrollments increase, instructors have less time to spend with individual students. In the industrial activity type of classes, students require more individual attention. In the past thirty years, there has also been a large demand for the general shop (multiple activity) type of class situation where two or more groups of students will work in a variety of subject areas at the same time. A shop situation of this type demands more of the instructor by virtue of the need for greater emphasis in individual progress and a still further division of time between many activities. Newkirk (17, p. 48) says that "individual instruction sheets are absolutely essential to the teaching of a well organized general shop course." Other leaders in industrial arts education feel that individual instruction sheets might be an aid to the instructors with large enrollments and to the instructors in the general shop.

Definition of Instruction Sheets

For the purpose of this study, the definition of instruction sheets as proposed by Selvidge (22, p. 5) is to be used.

> "The instruction sheet is a teaching device designed to present to the student in a permanent form, the necessary instructions, information and directions for performing a task successfully."

Individual instruction sheets may be teacher prepared or those found in book form, such as the Douglas and Roberts series, "Units in Hand Woodworking." (9)

Leighbody in his book, Methods of Teaching Industrial Arts Subjects (15, p. 76), says that "the writing of good instruction sheets is a task which requires considerable thought and planning." Anyone who contemplates using instruction sheets should make a thorough study of the available material and become acquainted with many of the good examples of instruction sheets.

Types of Instruction Sheets

Experience in organizing materials for instruction sheets and in using them has resulted in a variety of types. Selvidge classifies four distinct types in his book, Individual Instruction Sheets, namely: (1) operation sheet; (2) information sheet; (3) assignment sheet; (4) job sheet. (22, p. 13-15) Each are discussed briefly by Ericson (10, p. 70-71).

> "Operation Sheets. The operation sheet, as pointed out by Selvidge, differs from other instruction sheets in that it is based upon an operation or unit of performance within a trade and not upon a job. Its use

would seem to be more applicable in trade or vocational teaching, and is based upon learning principles rather than jobs; as, "how to cut a miter", rather than "how to make a picture frame". To the degree that such basic operations are stressed in other shops or classes, this type of sheet will be found useful.

"Information Sheets. This type of sheet is made to cover some unit of information, and does not deal with performance or manipulative procedure. Information sheets consist essentially of textbook and reference material, organized in small units, and arranged from the standpoint and needs of certain age and ability levels. Related information, occupational information, and in fact any of the "facts to be learned" in connection with the shop program, offer opportunities for the use of this type of sheet.

"Assignment Sheets. According to Selvidge, this type of sheet possesses the following characteristics: (a) "A definite statement of the problem is given;" (b) "Sources of information are stated with reactions;" (c) "Questions are assigned to direct the reading, observation, and thought;" (d) "Provisions are made for written answers to these questions.

"Job Sheets. Teachers are probably best familiar with this type of instruction sheet. They are the earliest type. These sheets are designed to cover a job or assignment in manipulative work."

Job sheets most often list the tools and materials required, and then give the procedure for doing a particular job.

The procedure sheet is apparently a later variation of the job sheet. Neither Ericson (10), nor Newkirk (18), nor Selvidge (22) describe or mention this type of sheet. The procedure sheet is somewhat similar to a job sheet.

These sheets list the step by step order for completing an assigned job. They do not show what tools or materials are needed for the job. It will be shown in Chapter IV that procedure sheets are quite popular among the industrial arts instructors of the United States.

Summary

Individualized instruction became a vital concern to industrial arts instructors as far back as 1930. The present influx of students has created overflowing classes, with an increasing lack of time for individual instruction. The instruction sheet is one means of aiding the instructor with this problem of greater need for individual instruction. The individual instruction sheet is a method of teaching to supplement and aid the instructor. Instruction sheets can not ever replace an instructor. The types of instruction sheets are (1) operation, (2) information, (3) assignment, (4) job and (5) procedure.

Chapter II

HISTORY AND BACKGROUND OF INSTRUCTION SHEETS

Early History

In order to gain a better understanding of instruction sheets, a brief background or history is deemed essential. There are two main questions which might be considered:

1. When, and under what circumstances were the first instruction sheets brought into existance?

2. How did instruction sheets find their way into the modern day shop or classroom?

In tracing down the history of a topic such as has been chosen in this paper, it is almost impossible to state definite facts. However, in the course of reading one is able to follow a fairly accurate trail in drawing various conclusions.

The first known use of instruction sheets dates back to the middle of the nineteenth century. In Berlin, Germany, in the year 1856, a Frenchman and teacher by the name of Charles Toussant, and Gustav Langenscheidt, a German writer, joined forces and started a school. It was their idea that they should teach foreign languages by correspondence. They decided they would start by offering French and later adding other languages to their

course. It was these two men who introduced lesson assignment sheets and drill sheets to teach their students. These were of the same general type as those used in many of todays classrooms. The sheets were sent out to the various students with exercises in composition, drill in grammar and other pertinent material. The students studied these sheets, filled them in and answered all questions. They were then returned to the instructor who checked them and returned them with needed corrections, comments, and suggestions. (3, p. 10)

A few years later, a James Stuart, then at Trinity College, and who later became Professor of Mechanics at Cambridge University, instigated the University extension system at Cambridge. Professor Stuart started using the lesson sheet at Cambridge in order to conform with the rules of social conduct. So great was the sense of propriety during this era, that men teachers were forbidden to discuss certain courses with their women students. To combat this problem, Stuart composed a printed lesson which could travel through the mail, and could serve the requirements for written discussion and comment. Through this method it was guaranteed neither instructor nor student would be subjected to any danger. (3, p. 11-12)

Around 1879, Dr. William Harper (3, p. 18) became interested in correspondence teaching and taught Hebrew

via this method to over one thousand students. Harper was so much in favor of this mode of instruction, that upon becoming president of the University of Chicago in 1892, he instituted a university extension program which included a correspondence division.

In evaluating this new division, three factors stood out on the pro side of the ledger:

1. Students were enabled to advance in accordance with their own rate of accomplishment.

2. The material used was organized in such a manner as to allow for, or meet, the individual differences.

3. Schools themselves benefited by being able to offer a much broader program.

The main factor involved in criticism of the correspondence method was that of lack of inspiration which can be felt only when in direct contact with the instructor. In order to overcome this problem, the first well-written and clearly printed instruction sheets came into being in this country. These became known as lesson and assignment sheets.

Influence Brought About by World War I

Prior to 1917 only the influence of correspondence schools had been felt in connection with instruction sheets. However, world conditions were rapidly changing and new

problems came into being. America was at war and over a million men had to be trained for technical jobs as rapidly as possible (24, p. 15). This brought about the rapid rise of a new type of instruction sheet known as the "job sheet".

The special task of training unskilled men for jobs in the United States Army and in the ship yards, became the problem of Charles Allen and Robert W. Selvidge. They devised a series of job sheets which were compiled into instruction manuals. Their main purpose was to train men for specific jobs in the shortest possible time. The men were taught in small groups in order to allow use of initiative, and to give ample opportunity for development of originality and the ability to think for themselves.

> "To prevent learning by 'Rule-of-thumb' the method of teaching was mostly through jobs, questions, problems, and guided discussions. Directions were given on how to use the job sheets, and, regarding sources of information the following suggestions were given:
> 1. Study of instruments assigned.
> 2. Study of various manuals assigned.
> 3. Discussion with other men on the job.
> 4. Appeal to the instructor in the final analysis." (24, p. 15-16)

When the war came to an end, the job sheet was an established fact, and before long found its way into the public schools via the industrial arts departments. Men who had used this type of instructional material during the war years, remembered the advantages it offered in training soldiers. Many were shop teachers, and upon their

return to the classrooms they decided to try this new technique on their students.

Since the job sheet was not originally intended for classroom use, necessary revisions and additions had to be made. The switch from terms of production to instruction had to take place.

General Reactions Toward Instruction Sheets

At this time instruction sheets came in for a great deal of thought and criticism. Some of the thoughts of men in the field of education on this controversial subject, might be given a bit of consideration.

Mr. William H. Dooley (7, p. 111) who was in charge of the Navy Yard Continuation School for the New York Board of Education, said that instruction sheets prepared "with questions and answers" on them, did not have the general educator's approval. However, he found them to be an effective method of instruction for short-term trade courses and believed their use for this purpose, should be encouraged.

In their book, Vocational Education in a Democracy, Charles Prosser, (director of the William Dunwoody Industrial Institute), and Charles Allen, (the Federal Board of Vocational Education), stated: (20, p. 285)

> "Job sheets, technical information sheets and hand books are tremendous labor saving

> devices for the instructor, although they do not, of course, relieve him of the responsibility of instructing. He needs to direct the self-activities of vocational students more and talk less. He needs to give help more when needed and less when not needed."

A warning came from Arthur Payne (19, p. 100) not to use instruction sheets as a method of "canned thinking"; for the teacher not to rely on them to such an extent as to feel absolved of the necessity for teaching. He felt that the sheets were excellent sources for individual assignment for those students who were either trailing or leading their classes, and that the student with low mentality and ability would find them of particular value. He felt the teacher should never hand these sheets of information out "cold", but rather after using the inductive-development method with his students. In other words, hand the instruction sheets out last thing, assuring each student of possessing uniform data, instructions, and dimensions.

It was the general opinion that instruction sheets, if used correctly as a supplement to regular teaching: (1) could be a vital addition to the classroom; (2) could never be used as a substitute for a good instructor; (3) if used as a reference for the work being accomplished, they would prove a time-saver to teacher and pupil; (4) that there should be a choice of job sheets involving the

same skills so the pupils might have some choice and less regimentation. (12, p. 76-79 and 21, p. 248-250)

Even while the issue of whether instruction sheets would prove an asset or a liability to the teaching profession was still in progress, advances in their use were being made.

Two books of job sheets in home mechanics appeared. Bedell and Smith (2) in publishing theirs, let it be known that the sheets were to be used as teaching devices, not as teacher substitutes. They felt that in the hands of the students these sheets would develop good habits of work. Their aim was to guide pupils without taking away interest, rather than to present a solution of the problem.

Tustison (27) felt his sheets would be of maximum value for group or individual instruction, especially where the nature of the subject and lack of equipment made class instruction impossible.

After the introduction of job sheets in home mechanics, calls went out for a similar set for woodwork classes. Tustison joined forces with a woodshop instructor and wrote a set of job sheets for a practical woodworking course (4). It was found that there was inadequate instruction in classes where a variety of things were going on, when the modern trend of providing for individual needs came about. These sheets all followed a specific setup:

1. Job specification

2. Reason for the job
3. Material needed
4. Tools required
5. Procedure
6. Questions
7. References
8. Record (name, class, date begun, date finished, instructor's grade)

In 1931 we find an editorial in the Industrial Arts and Vocational Education Magazine (16) stating the fact that instruction sheets are still in the process of development; that the movement toward them was still young. It was noted that many teachers all over the country were working on this problem. Metz, the editorial writer, felt that few instructors possessed the skill required to produce good material; that much of what was developed hardly justified the time spent. This was not all felt to be waste however, as in order to perfect any new idea there is usually a lot of random effort in order to reach an adequate solution.

First it must be determined what is expected to be accomplished in a given unit. Then, a worthwhile method of conveying the subject matter must be found. In doing this, the information matter must be gathered, collated and arranged; the problem selected; the test devised; and all written up plainly and understandably, with good illustrations, half-tones or line drawings.

The General Shop Is Introduced

The economic depression was felt in the schools along about 1932. The demand was for a broader curriculum, especially within the field of industrial arts. The general shop came into being, and with it, an increase in the size of the classes. It was felt by many that here was the true set-up for use of instruction sheets, most especially the job sheets. Still the controversy continued as to their use.

The following are the most widely believed defects of instruction sheets. They were summed up by Newkirk and Stoddard in their book, The General Shop. (18, p. 50-51)

1. Give special favor to the pupil who reads well.
2. Deprive pupil of a chance to analyze the job and find out for himself what is to be accomplished.
3. Take away the pupil's opportunity to plan the doing of the job.
4. Decrease the amount of personal contact with the teacher.
5. Are accompanied by reference materials not written in accordance with the aim of the instruction sheet, with the result that the pupil becomes discouraged in attempting to get the meaning of the reference.
6. Are not conducive to thorough demonstration by the teacher.
7. Employ a subjective method of grading.

8. Do not provide the pupil sufficient opportunity to ask questions.

9. Lack related information.

10. Utilize words that are not selected according to research studies of the pupil's vocabulary.

In spite of all the deficiencies noted in the individual instruction sheet, they were still playing a prominent part as an instructional device. From this it was almost an assured deduction that their prominence would increase in the future as more and more of the deficiencies were overcome.

SUMMARY

Early History

Lesson assignment and drill sheets first appeared in Berlin, Germany, in 1856, in connection with a correspondence school. Further development took place under the supervision of James Stuart at Cambridge University. In 1879, Dr. Harper instituted a Correspondence Division at the University of Chicago, making use of lesson and assignment sheets.

Influence Brought About by World War I

Job sheets came into existence when men had to be rapidly trained for technical jobs in the army and ship

yards. Allen and Selvidge compiled job sheets into instruction manuals to quickly train men for specific jobs. After the war, teachers returning to their classrooms brought the new type of instructional material back with them and converted it to classroom use.

General Reactions Toward Instruction Sheets

Instruction sheets were highly criticized. They were accepted for short-term trade courses, but did not gain approval of general educators. On the other hand, they proved to be labor saving devices if not used as a method of "canned thinking". Care was taken to see that they were used as a supplement to teaching and not as a teacher substitute.

New manuals of instruction or job sheets were published and many more teachers were working out ideas for improved instruction sheets.

The General Shop Is Introduced

The economic depression was felt in the schools by 1932. This apparently speeded up the development of the "general shop". Because of the many areas of work covered in a general shop, and the need in individual instruction, many believed that it offered the ideal situation for instruction sheets. The controversy as to whether they

should be used remained the same, but they still played a prominent part in many a classroom.

Chapter III

A CONTROLLED GROUP STUDY

Four questions are involved in this study. The two to be considered in this chapter are: (1) to determine whether individual instruction sheets are an aid in the problem of individual instruction and (2) to determine if they are of specific value to students in industrial arts classes.

Introduction

Two groups of students were used in this effort. These groups were made up from students regularly enrolled in second-year metalworking classes, in a four year high school of 1200 total enrollment and in which "metalwork" is one of the recognized "majors" for graduation. All of the students in the two groups were "metals majors" and had already completed one semester of metalwork under another instructor. The students for these groups were not "hand picked" but were as nearly equal in class size, native ability, intelligence and age as could be expected from a normal enrollment. Under the registration system used at this high school there is no way by which students could be "selected" for a study of this type. Before school starts, students appear to register for their classes

in a manner very similar to that used in many colleges. At the end of registration teachers are given the enrollment slips. Prior to that time no teacher knows about the size of his classes nor what students he is to have for that year.

Previous to a determination of equality ratings of the two groups it was decided to use Group A as the "experimental" group, in which the teaching process would make the fullest possible use of individual instruction sheets, and Group B as the "control" group in which instruction would be by the more convential methods. Samples of the operation sheets, information sheets and job sheets used by Group A will be found in the Appendix. Identical projects were constructed by each group, with students allowed to proceed at their own individual pace. Textbook assignments (homework), notebooks, examinations and shop management were the same for these groups. Each group received identical lectures and demonstrations, except that Group A received instruction sheets prior to the lectures and demonstrations. An explanation of the controlled experiment and its purpose was made to both groups before work began.

Method of Equalizing Groups

Several factors were considered in checking the "equal abilities" of the two groups. Size of class, age

of student, grade in school, I.Q. scores, and mechanical abilities were compared.

I.Q. scores were obtained from cumulative files in the school office. The Macquarrie Test for Mechanical Ability was given to both groups. This test was furnished by the school and was the only one available. The directions manual for the Macquarrie test states:

> "There is no such thing as general mechanical ability. Each job and trade calls for its own basic pattern of characteristic aptitudes. This battery of seven subtests provides objective measurement of the aptitudes which underlie successful performance of a wide variety of jobs of a mechanical nature."

Table 1 compares the various factors for the two groups, which appear to be nearly equal in all major respects. (See Table 1, p. 24)

Socio-economic backgrounds of the students was not considered in equalizing these groups. The majority of students in this high school are from farm or farm labor families and the school is located in a rural farming area.

Both groups maintained approximately the same number of students throughout the school year. Group A started with 23 and finished the year with 25, twenty of whom stayed to complete the school year. Group B began with 25 and finished with 24, 19 remaining throughout the school year. The Macquarrie test given June 3, 1957, considered

TABLE 1

Number of students per group:

Group A ---------- 23
Group B ---------- 25

Average grade level in each group:

Group A ---------- 10.21
Group B ---------- 10.22

Average age of students in each group:

Group A ---------- 15.58
Group B ---------- 15.50

Mechanical ability, average percentile rank:

Group A ---------- 56
Group B ---------- 59

Average I.Q. score of each group:

Group A ---------- 84.8
Group B ---------- 85.1

only those students who had previously taken the same test on September 21, 1956. Farther along in this chapter, it is explained how the eight students, who did not receive this test were evaluated.

Determining Value of Instruction Sheets

To determine if there was any value in using individual instruction sheets, examinations were given every week and projects were graded for accuracy and workmanship as they were completed. The Macquarrie Test for Mechanical

Ability was administered a second time before the school year was completed. Table 2 shows the scores made on this test as administered in September 1956, while Table 3 shows the scores for the same test, given in June 1957. In comparing the scores of the tests taken on those two dates, it can be seen that Group A improved to a greater degree than Group B. Group A moved from the 58th percentile rank to the 52nd percentile rank, while Group B improved only from the 59th percentile rank to the 55th rank. Although the same test had been administered the second time, it was felt that a sufficient period had elapsed between the two so the final results would be unaffected.

Table 4 shows students U and V received an "F" grade for the semester. See also Tables 3 and 4. Most students improved during the year, although four dropped in percentile rank. One (F) Group A, 3 (J, R, T) Group B.

On the test day (September 21, 1956) each class had three absences which accounts for the different number of cases in Tables 2 and 1. Approximately one hour is required to administer this test and time could not be arranged at a later date to handle those who had been absent. On the June 3 test day, Group A had one student absent while Group B students were all present.

In grading projects, accuracy and neatness of workmanship were considered, with accuracy given the highest

TABLE 2

Individual scores on the Macquarrie Test for Mechanical Ability administered September 21, 1956.

GROUP A		GROUP B	
Student	Score	Student	Score
A	31	A	31
B	32	B	31
C	35	C	32
D	35	D	35
E	35	E	49
F	45	F	50
G	50	G	50
H	50	H	50
I	55	I	52
J	60	J	52
K	65	K	67
L	65	L	69
M	70	M	69
N	70	N	69
O	75	O	70
P	75	P	70
Q	75	Q	70
R	80	R	71
S	84	S	75
T	85	T	75
		U	83
		V	85
Average percentile rank		Average percentile rank	
58.60		59.09	

regard. Accuracy would show a closer relationship to mechanical ability, although workmanship is an indicator of this aptitude. In checking accuracy, longitudinal measurements were held to plus or minus 1/32 inch. Other

TABLE 3

Individual scores on the Macquarrie Test for Mechanical Ability administered June 3, 1957.

GROUP A		GROUP B	
Student	Score	Student	Score
A	25	A	25
B	25	B	25
C	25	C	25
D	30	D	30
E	30	E	35
G	35	I	45
H	35	G	50
F	50	H	50
I	50	J	55
J	55	K	60
K	60	L	65
M	60	M	68
L	65	N	69
N	65	O	69
O	75	P	70
P	75	Q	70
Q	75	R	75
R	80	S	75
T	85	T	80
S	Absent	F,U,V	Drop
Average percentile rank		Average percentile rank	
52.10		55.05	

points, such as certain hole locations, were allowed 1/64 inch plus or minus. A tolerance of 1/2 degree was specified on one project with an important angle. Workmanship was considered in the over-all finished project. This involved the lack of scratches, quality of finish, neatness of joints and clean manner in which threads were cut.

Subject areas concerned with project construction were sheet metal, bench metal, smithing, and foundry work. Part of one project was turned on a machine lathe. For this machined part, Group A received a simple procedure sheet. A drawing, which both groups used, was placed on the chalk board. Each group was given a demonstration on "running" the lathe and making this particular part. Two parts were required for the project.

RESULTS

Manipulative

In grading the standard projects for both classes it was found that Group A constantly did better work than Group B. Group A students submitted neater work and were more accurate in their measurements. The reason for better work on the part of Group A was directly traceable to the job sheets they had received prior to start of projects. These contained plans and procedure for construction of the particular project. Group B had to copy drawings from a chalk board or from file copies. Although demonstrations were given to both groups at appropriate times, Group B did not receive definite written procedures for the construction of projects. On one project Group A did not receive a drawing and, like Group B, had to copy a plan from

the chalk board. The finished projects were not as accurate as those which this same group had previously completed from job-sheet drawings. For this particular job, Group A did have a procedure sheet showing the steps necessary to complete the project. It must be that in the process of copying, some of the dimensions were misread or incorrectly copied. In this simple test case, although accuracy was down, the workmanship was still as it had been -- higher in Group A than in Group B.

Another apparent reason for the increase in accuracy and better workmanship shown by Group A, was the extra time available for the instructor to work with slower, less-adept students. Average and better students in this group did a great deal more work without help from the instructor, which allowed him to work more closely with the less-able students.

Another simple test was used which seems to uphold the use of instruction sheets. For that part of one project requiring machine work, a "run" was timed between one boy from each class. Each used the same lathe during different periods. Both were informed they were to be timed and asked to do their very best. This put both under some pressure, although neither seemed exceptionally nervous. Neither had handled a lathe before and both had witnessed their group demonstration. The student from

Group A had a procedure sheet. This student made one part in 35 minutes and the second in 30 minutes. The student from Group B required 45 minutes on each of the two parts. Although one test of this type is not conclusive it seems to point out that an orderly, pre-planned procedure is an aid in manipulative work.

Better than 50 per cent of the students in Group A were able to turn out one-and-one-half of the required parts in a 55 minute period. Only 30 per cent of Group B students were able to do the same. Progress was so slow in Group B that a second lathe was put into operation so this project could be finished by the required deadline. Each student was asked to keep an accurate time record on the construction of these two pieces.

All other factors having been equal, it can be assumed students in Group A were aided by the simple procedure sheets that had been provided for them.

Academic

The I.Q. scores indicate the reading level of the students in both groups to be about the same. The Pitner Test of Intelligence is the basis of the I.Q. scores. This likeness in reading level is the reason for little or no difference in connection with textbook assignments.

Academic differences seem to lie in related information not found in the textbook. Each group was advised to take notes during lectures and demonstrations. As Group A had received instruction sheets before lectures or demonstrations, they had an outline to follow. Although students in Group B took fairly complete notes they were by no means as complete as the material given Group A. Both groups were required to maintain notebooks. Group A students therefore had more complete information which they could study for examinations.

In both groups were students who cared little for school. Those in Group A apparently felt they were "getting a good deal" and did not have to work so hard. Consequently this type student did better work in Group A than in Group B.

Tables 4 and 6 show final grades turned into the school office for both first and second semesters of the school year.

First semester grades (Table 4), show Group A had a better average grade by .54 grade points. Table 6 indicates both groups improved and that Group A improved more than Group B. One reason for the improvement shown by Group A, perhaps coincidence, is that two students who received "F" grades for the first semester, left school shortly after the second semester started.

TABLE 4

Final grades as turned in to the school office for the first semester.

GROUP A	GROUP B
A	A
A	B
A	B
B	B
B	B
B	B
B	B
B	C
B	C
B	C
B	C
C	C
C	C
C	C
C	C
C	C
C	D
C	D
C	D
D	D
D	F
D	F
Grade point average	Grade point average
2.54	2.00

The grade point average was figured on a 4, 3, 2, 1 basis, "A" being 4. Tables 5 and 7 give the percentages of various letter grades as obtained by both groups. It is of interest to note the grades are somewhat evenly distributed, which is purely accidental. Table 7 does not show this balance of grades.

TABLE 5

Grade distribution for first semester grades.

GROUP A	PERCENTAGE	GROUP B	PERCENTAGE
A --- 3	13.65	A --- 1	4.55
B --- 8	36.40	B --- 6	27.30
C --- 8	36.40	C --- 9	40.85
D --- 3	13.65	D --- 4	18.20
		F --- 2	9.10

Itinerant Students

Schools in rural and farm areas will have a certain amount of itinerant enrollment. When new students enrolled in Group A, they were given the back issues of all individual instruction sheets and instructed in their use and purpose. Taking into consideration the time of enrollment, they were given either the present job sheet or the sheet presenting the next project and allowed to proceed. In Group B, new students were shown the project at hand, given a drawing to copy and allowed to proceed with the project. Students enrolling late in classes require a considerable amount of the instructor's time. More time was available to assist itinerant students in Group A than in Group B.

In both groups, new students were introduced to one of the better regular students who would offer assistance whenever the instructor was not available. This method worked well in both groups and can be recommended as a good procedure whether or not instruction sheets are in use.

Students who entered Group A after classes were under way, appeared to integrate more rapidly than those who entered Group B late. It was not proven that itinerant students improved, but from observation it is known they did use instruction sheets to good advantage. Itinerant students in Group B missed a great deal of background information presented before they entered class. It was suggested they obtain previous information from their classmates notebooks, but these students never did well on their first examination. Itinerant students of Group A, in possession of this background information, as a general rule did quite well on first examinations.

Advantage to Instructor

One recommendation for instruction sheets is that the instructor will have more time for individual student attention, guidance, counseling, shop maintenance and problems involved with teaching. The author found with this type instructional aid, time was allowed to assist students in their shop work and to offer limited counseling. If a student's problem is such that it can not be handled in the time alloted, he is referred to the counseling staff or invited to come in during lunch hour and/or after school.

TABLE 6

Final grades as turned in to the school office for the second semester.

GROUP A	GROUP B
A	A
A	A
A	B
A	B
A	B
A	B
B	B
B	C
B	C
B	C
B	C
B	C
B	C
B	C
B	C
C	C
C	C
C	C
C	C
C	C
C	D
C	D
C	D
C	D
C	
Grade point average	Grade point average
2.84	2.22

The author found little extra time to handle problems of maintenance or preparation. If vital work occurred classes had to be overlooked or the job fitted in when and where it could be arranged. This held true in all six of the author's classes, with the exception that there were less interruptions during Group A's class.

TABLE 7

Grade distribution for the second semester grades.

GROUP A	PERCENTAGE	GROUP B	PERCENTAGE
A --- 6	24.00	A --- 2	8.33
B --- 9	36.00	B --- 5	20.83
C ---10	40.00	C ---13	54.18
		D --- 4	16.66

Student use of Instruction Sheets

Throughout the year, students in Group A did use instruction sheets to advantage. From spot checks made during the year more than 60 per cent of the students in Group A had their job sheets with them as they worked. All students, in both groups, kept their notebooks in lockers located within the shop area. If members of Group A did not have their instruction sheets with them they were close at hand and easily obtained.

Grading sheets maintained by the students were used in both classes. This allowed each student to know his grade at all times. Perhaps this grading sheet, and the explanation made before class work began led to some competition between the two groups and had some effect on the total outcome of this study. A sample grading sheet will be found in the Appendix.

Discipline

Discipline is another factor aided by the use of instruction sheets which seems to be overlooked by most individuals. Moral character was a factor not considered when equalizing Groups A and B. At that time, discipline was not regarded as a factor affected by the use of instruction sheets, and did not become obvious to the author until late in the school year.

The fact that Group A had instruction sheets and were using them effectively kept the individuals of this group out of considerable trouble. Many times, in Group B, students had to wait until the instructor was free and able to assist them. During this interval general "horseplay" became evident. Consequently there was a greater percentage of discipline problems in Group B than in Group A.

Summary

Individual instruction sheets are an aid to industrial-arts instructors. Students do use them to good advantage. Instruction sheets aid students in shop work as well as in related academic work. They are an aid to students of all abilities with the exception of the very lowest. Through their use, many of the low ability students are forced to

read. Discipline problems are decreased, and instructors are allowed more time for individual instruction.

Chapter IV

TABULATED RETURNS FROM THE QUESTIONNAIRE SURVEY

The controlled experiment covered one phase of the problem of determining the value of instruction sheets. Two questions remain to be answered: (1) Are industrial arts instructors using instruction sheets? If so, to what extent? and (2) Is there a significant difference in their use in different sections of the United States? The answers to the fore-going questions were obtained from the questionnaire survey.

Method of Obtaining Data

Letters were sent to administrators, supervisors and state consultants selected from a mailing list furnished by School Shop Magazine (6, p. 112-120), so as to give a representative cross-section of the United States. The original contacts (to men in forty states) brought usable mailing lists from twenty six states. A master list was compiled from the twenty six states, and questionnaires were sent to three-hundred-forty-six teachers chosen at random. A transmittal letter with each questionnaire, stated the problem and the purpose of this study. Copies of these two letters and the questionnaire will be found in the Appendix.

Responses were made by two-hundred-fifteen teachers, or 62 per cent of the total. Nine of the respondents were no longer in the teaching field, and their questionnaires were blank. The two hundred and six usable returns represented a 59.5 per cent return. Responses to the individual items were tabulated on a master chart for the development of the data and comments presented herewith.

Data Compiled From the Questionnaire

The questionnaire was divided into three parts, the first to be answered by all participants, a second part by those who do use instruction sheets, and a third part for response by those who do not use instruction sheets.

There were six questions in the first part, to be answered by everyone contacted. The tabulated returns will be found in Tables 8 through 13.

TABLE 8

Enrollment of your school. Twenty-seven did not indicate the size of their school.

SCHOOL SIZE	NUMBER	PERCENTAGE
0 - 500	47	26.25
501 - 1000	51	27.92
1001 - 1500	49	27.37
1501 - 2000	22	12.37
2001 - 2500	7	3.91
2501 - 5000	3	2.27

Approximately 93 per cent of the schools reported enrollments below 2000. Either the random sampling covered a very high percentage of small and medium-sized schools, or it can be assumed, that schools with enrollments larger than 2000 approximate 7 per cent of the total number in the nation.

Table 9 indicates that 78 per cent of the teachers have enrollments between 16 and 30 students per class.

TABLE 9

Average size of class. Three respondents did not answer.

CLASS SIZE	NUMBER	PERCENTAGE
1 - 15	37	25.13
16 - 30	159	78.33
31 - 45	7	3.45

TABLE 10

Grade levels taught. Three respondents did not answer this question.

GRADE LEVELS	NUMBER
7 thru 9	15
8 thru 10	3
7 thru 12	31
8 thru 12	20
9 thru 12	64
10 thru 12	37
8 only	5
9 only	3
7 and 8	12
8 and 9	6
9 and 10	3
11 and 12	4

Figures derived from the questionnaire and tabulated in Table 10, appear to have no significant value in regards to the problem other than to indicate all respondents taught grade levels seven through twelve.

TABLE 11

Type of shop. Shows the type of shops used. Three did not answer and seventeen indicated they taught in more than one type of shop.

TYPE OF SHOP	NUMBER	PERCENTAGE
Unit shop	93	38.79
General shop	77	32.08
Limited general	50	20.83

It was interesting to note that the general shop, a relatively new concept in industrial arts, did show a good acceptance (53.9%). There seems to be no particular size of school which favors the general shop in its program, although only one school above 2000 enrollment reported a general shop. The unit shop is still more highly accepted. Had the questionnaire furnished a definition of the term "limited general shop" there might have been some changes in the figures shown in Table 11.

Table 12 lists 30 different subjects taught by those who responded. The most commonly included experience areas are wood, metal and drawing. Of these three, metal is the most popular. One-hundred-seventy-five teachers indicated

TABLE 12

Question #1. What subject areas in industrial arts do you teach?

SUBJECT	NUMBER
Wood	145
General Metals	96
Sheet Metal	19
Welding	16
Art Metal	9
Machine Shop	17
Foundry	7
Wrought Iron	2
Forging	1
Bench Metal	7
Drawing	102
Crafts	24
Leather	18
Plastics	23
Ceramics	7
Carving	1
Lapidary	2
Jewelry	2
Auto Shop	17
Electricity	47
Radio	3
Driver Education	1
Photography	1
Graphic Arts	22
Home Mechanics	1
Aeronautics	1
Shop Math	2
Stage Craft	1
Building Trades	1
Metal Fabrication	1

they teach some phase of metalwork. Some of those teaching drawing indicated "mechanical" or "architectural", but most just reported "drawing". Three people did not answer and two stated they taught "general shop" without showing the particular subject areas included.

TABLE 13

Question #2. To what degree do you use individual instruction sheets?

DEGREE USED	NUMBER	PERCENTAGE
Full time	24	11.73
Part time	75	36.69
Occasionally	57	27.80
Not at all	49	23.78

Approximately 76 per cent of the instructors responding to this question are using individual instruction sheets at least part of the time. Two people reported that they use these sheets full time in some of their classes, not at all in others. One person did not answer this question which, considering the importance of this particular item, is a very good return. This question is a key to the original problem and shows that industrial arts instructors are using instruction sheets. To what extent they are used will be the next consideration.

Individual instruction sheets are used by 56 per cent of the industrial arts teachers in all subjects they teach, as reported in response to Question #3 and shown in Table 14. Eleven did not answer this question.

TABLE 14

Question #3. Do you use instruction sheets in all subject areas you teach?

Yes	83	56.85%
No	63	43.15%

TABLE 15

Question #4. How long have you been using instruction sheets?

NUMBER YEARS	NUMBER	PERCENTAGE
1 - 5	45	28.67
6 - 10	49	31.21
11 - 15	19	12.10
16 - 20	19	12.10
21 - 25	8	5.09
26 - 30	3	1.91

It is interesting to note that nearly 85 per cent of the respondents have been using individual instruction sheets from one to twenty years. Since World War II, teacher education schools have placed an increased number in teaching positions, and apparently are emphasizing the value of instruction sheets as teaching aids. As evidence, Table 15 indicates 60 per cent have used instruction sheets 1 to 10 years. In argument, it could be assumed a larger number of respondents have commenced teaching during this period. Eleven did not answer this question.

Of those who use individual instruction sheets, over 52 per cent use the teacher-made variety which indicates that these are by far the most popular. Although the questions did not cover this point, there are probably several reasons why commercial sheets are not used by more teachers. Many of the commercial sheets must be changed to fit a given teaching situation. Several industrial

manufacturing concerns -- Reynolds Aluminum Company, The Nicholson File Company and South Bend Lathe Works to name but three -- produce a commercial type of instruction sheet which may be obtained by requesting them on school stationery. Table 16 shows the response to this question.

TABLE 16

Question #5. What is the source of the sheets you use?

SOURCE	NUMBER	PERCENTAGE
Teacher made	82	52.23
Commercial	5	3.18
Combination	59	37.58

TABLE 17

Question #6. Check the type of instruction sheet(s) you are using.

TYPE OF SHEETS USED	NUMBER
Information	104
Procedure	93
Operation	91
Job	76
Assignment	50

Information sheets seem to be the most popular style used by industrial arts teachers, with procedure and operation sheets running close behind. The author finds that information sheets are the most difficult and most time consuming to prepare, as they require more research and reference work for proper presentation. It is believed a

great deal of material found in information sheets duplicates that found in good textbooks. It is doubtful that there are many schools which can afford an industrial arts program and which at the same time can not afford to provide textbooks for a class. Although information sheets were used during the controlled experiment (with the experimental group only, Chapter III), they provided material supplementary to the textbooks. Both groups used texts and reference materials.

As reported by the teachers (Table 17), job sheets rate fourth in frequency of use, yet the author has found this type of instruction sheet the easiest and quickest to prepare. From information gained by controlled experiment and reported in Chapter III, it is felt that job and procedure sheets are of greater value to the students than are those of other styles. They also allow the instructor more freedom in individual instruction.

TABLE 18

Question #7. Are you using instruction sheets singly or in sets?

Singly	101
Sets	32
Both	9

Obviously the use of instruction sheets in single units is by far the favorite method of handling. A single

unit may contain more than one page but covers only one operation or one subject. "Sets" indicate the coverage of a complete unit of work, a complete term or semester, or even an entire year's work. Generally these sets are in folders or bound manuals.

Question #8. Do you feel that the students use these sheets to good advantage?

A very encouraging report of nearly 92 per cent said that in their opinion the pupils did use their instruction sheets to good advantage. Seven who answered stated that it depended upon the pupil. In many occupations whether a job is done well depends upon who does that job. Whether the students use these sheets to good advantage also depends largely upon how the instructor handles their use in his classes.

TABLE 19

Question #9. Which students do you believe receive the most value from these sheets?

High ability	70
Average ability	36
Low ability	8
Combination of all	31

A low-ability student is generally considered as one of low intelligence, low mechanical ability, and with a low reading level. It can be understood why a student of

this type would not receive as much value from an instruction sheet as one with average or better ability. One of the main functions of instruction sheets is to allow the instructor more time to work with individual students, especially with low ability students. It is the opinion of the majority of those reporting that the "average" and the "above-average" students receives greater value from the use of individual instruction sheets. The apparent reason is that these students are better able to work by themselves and to read understandingly.

TABLE 20

Question #10. Do you feel that these sheets are of greatest value in:

Large classes	25.73%
General shop	21.64%
Irregular classes	14.81%
Limited general shop	14.62%
Unit shop	12.72%
Small classes	10.72%

It has always been the opinion of educational writers that individual instruction sheets are of the greatest advantage in large classes and, since its conception, in the general shop. This appears to be verified by the responses of industrial arts instructors across the nation. Five stated in comment that they believed instruction sheets could be quite important in mixed types of classes, where both beginning and advanced students were taught during the same period.

Question #11. Do these sheets offer you more time for personal instruction?

The responses indicate 66.8 per cent of the instructors using instruction sheets believe they do allow more time for personal and/or individual instruction. An additional 26 per cent feel their use might allow more time for this purpose. This total of nearly 93 per cent verifies what educational writers have long claimed. Only 8 per cent of the respondents believe instruction sheets do not free the teacher by time sufficient to warrant their use. The author is of the opinion that instruction sheets, particularly job sheets, do allow the instructor more time for individual instruction and personal help for his students, both for the low and the high ability groups.

Question #12. Do instruction sheets give you more time for other work?

Responses indicate 48 per cent believed instruction sheets allow instructors extra time for shop maintenance and teaching preparation (demonstrations, examinations, teaching aids, etc.). The author must agree with the 52 per cent who did not feel the use of instruction sheets saved enough time to be of significant value for shop maintenance or the preparation of other teaching materials.

Question #13. Do you believe these sheets help train the student to do his work in a systematic way?

A total of 98 per cent indicate instruction sheets train students to do their work in a systematic manner. Of this number, 82 per cent were positive in their belief and the remaining 16 per cent felt they aided in the training of some students.

In the experimental group (Group A), the author found approximately 60 per cent of the pupils did apparently learn to do their work systematically. This was proven by giving the students a drawing which required them to show in written form the procedure used to construct the project pictured. The steps to be taken had to be listed in the form of a procedure sheet. Only 40 per cent of the students who did not use instruction sheets (Group B) were able to do a commendable job on this same test.

Question #14. Are you using these sheets in connection with demonstrations, lectures, or both?

Twenty three teachers use instruction sheets with demonstrations: eight use them with lectures only. There were 113 (76 per cent) who used both lectures and demonstrations in connection with individual instruction sheets.

Lectures and demonstrations proved a success when used in conjunction with instruction sheets in the experimental group.

Question #15. Do the students receive their sheets before or after the lecture or demonstration?

Reports from 108 respondents indicate the students receive instruction sheets before lectures and demonstrations; 27 after. Seven stated their method varied according to the subject and unit under study. In the experimental group, students obtained copies before lectures or demonstrations, providing an outline to follow as an aid in note taking.

Question #16. What method are you using for handling instruction sheets?

Three respondents apparently let students pick up their copies as needed, from an open file system. Eighty-seven issue sheets as needed by the students. In question #7, thirty-two teachers indicated they are using instruction sheets by sets, yet only eleven stated that the sheets are issued by sets. These answers seem to be at variance.

TABLE 21

Give students a copy when needed	87
Give students a full set to start	11
Combination	30
Post copies on board as needed	7
Other methods	8

Question #17. Do your students: A. Keep their copies? B. Turn them in at end of period? C. Turn them in at end of semester?

Eighty-five respondents allow students to retain the instruction sheets while thirty-six collect all copies at the end of the period. Sixteen require copies be returned at the end of the semester.

Question #18. Do the students pay for the instruction sheets?

Five persons require students to pay for instruction sheets. One teacher requires pay only for lost sheets. Although the questionnaire did not ask for a reason, three volunteered that school policy dictated payment for instructional materials.

Question #19. If so (refering to question #18), how much do they pay?

The amounts students were required to pay varied from .03 cents per sheet to three dollars a year. One school used work books which cost 79 cents while another indicated shop fees were charged but did not state an amount. Considering that 157 respondents use instruction sheets, only a very small percentage charged for their use. The purpose of this study was not to determine the right or wrong of charging for instruction sheets. The author feels a charge

for lost sheets may cut down on losses. In the controlled study, students were told before hand that they would be charged for replacement of lost copies. Ten were replaced without charge, due to soiled conditions but none were lost. In many cases it is difficult to keep papers clean and free from oil or grease.

Turning back for a moment to Table #13, Question #2, we find that 49 (24 per cent) of the instructors participating in this study do not use individual instruction sheets. As stated earlier only one person failed to answer that question.

Table 8 shows approximately 93 per cent of the participants reported their school enrollments to be under 2000 students. From those who reported no use of instruction sheets, approximately 93 per cent listed their school enrollments under 2000 students. This again illustrates the fact that 7 per cent of the nation's schools are over 2000 enrollment.

TABLE 22

Shows enrollment of schools represented among the respondents who do not use instruction sheets. One did not indicate school enrollment.

SCHOOL SIZE	NUMBER	PERCENTAGE
0 - 500	19	39.58
501 - 1000	11	22.92
1001 - 1500	11	22.92
1501 - 2000	4	8.33
2001 - 2500	1	2.08
2501 - 5000	2	4.17

TABLE 23

Compares the school sizes of those who use instruction sheets with those who do not use them.

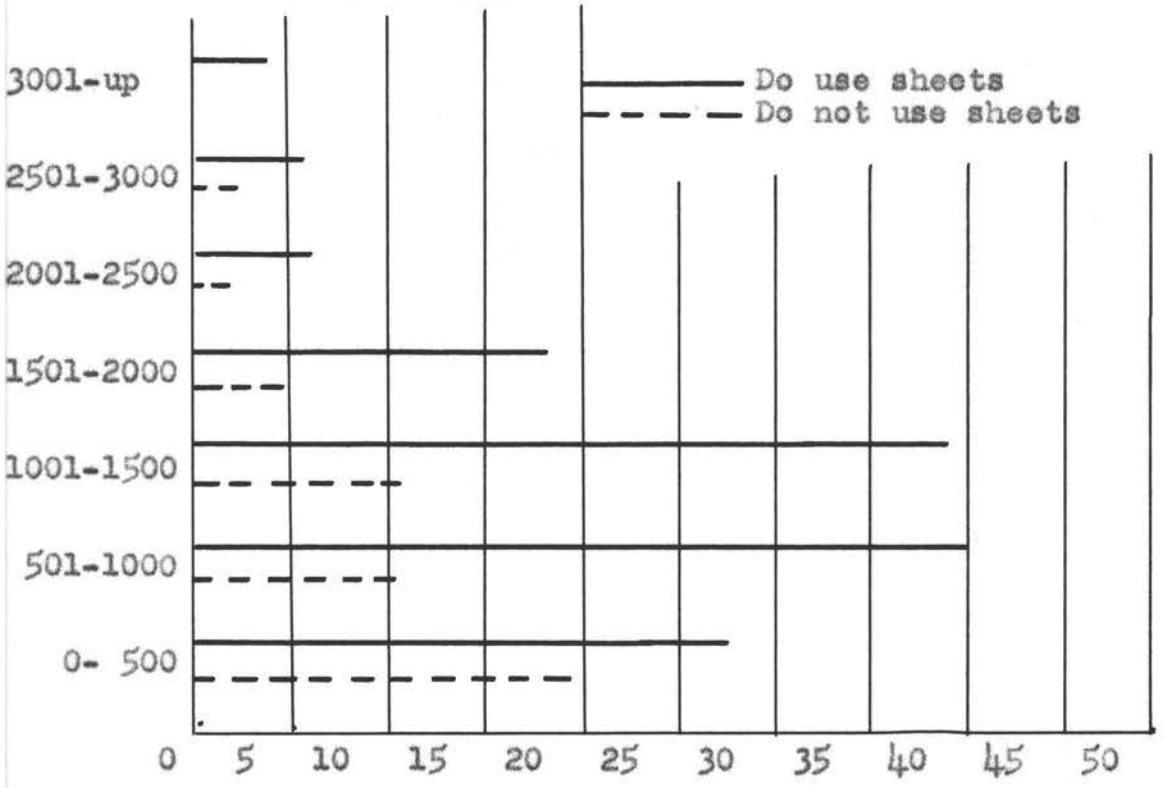

Table 23 shows the greatest rates of teachers not using instruction sheets teach in schools of less than 500 students. Of the 19 in this group 11 have classes under 15 in number. There is an apparent correlation with the responses to question #10, Table 20, in which only 10.7 per cent of those who use instruction sheets reported they are of value in small classes.

Table 24 deduces the fact class size is not indicative as to why instruction sheets are not used by these instructors.

TABLE 24

Indicates the size of classes of teachers who do not use instruction sheets.

CLASS SIZE	NUMBER	PERCENTAGE
1 - 15	15	31.25
16 - 30	33	68.75

TABLE 25

Shows correlation of class sizes between "users" and "non-users" of instruction sheets.

CLASS SIZE	NUMBER USE	NUMBER DO NOT USE
1 - 15	22	15
16 - 30	126	33
30 - 45	7	0

Table 25 indicates most of the instructors using instruction sheets do so in classes of 16 to 30 students. Although only seven respondents have classes of over 30, all use instruction sheets. The surprise is that one of these seven large classes is in a school with less than 500 students.

TABLE 26

GRADE LEVEL	NUMBER
7 thru 12	7
8 thru 12	1
9 thru 12	21
10 thru 12	12

Those not using instruction sheets fall into four grade groups. Table 10 shows a wide scattering of grade levels for those who participated in this study. All of the respondents indicate they are teaching either junior or senior high school levels.

TABLE 27

Indicates type of shop managed by those not using instruction sheets.

TYPE OF SHOP	NUMBER	PERCENTAGE
Unit shop	31	50.82
General shop	15	24.58
Limited general	7	11.48

Of the total (127) who teach in a "general shop" or "limited general shop" a very small number do not use instruction sheets, which tends to prove a statement made by Newkirk (18, p. 48).

> "Individual instruction sheets containing organized instructional material for the use of individual pupils have taken a prominent place in shop instruction. They are absolutely essential to the teaching of a well organized general shop course."

A majority of these subjects (Table 28) are taught in varied combinations. Five subjects are taught as single unit classes by 15 instructors (Table 29). Apparently the subject taught has little to do with the choice of whether or not individual instruction sheets

TABLE 28

Subjects taught by those not using instruction sheets.

SUBJECT	NUMBER
Wood	36
General Metals	19
Machine Shop	4
Welding	4
Sheet Metal	4
Bench Metal	3
Foundry	1
Art Metal	2
Metal Fabrication	1
Auto Mechanics	6
Mechanical Drawing	26
Graphic Arts	3
Leather	2
Crafts	4
Electricity	5
Plastics	2
Shop Math	1
General Shop	2

are used. Again wood, metal and drawing seem to be the predominate subject areas, as was noted also for those teachers who do use instruction sheets.

TABLE 29

Subject areas taught as single unit classes by those not using instruction sheets.

SUBJECT	NUMBER
Wood	5
Drawing	5
Auto Mechanics	3
Machine Shop	1
General Metals	1

The questionnaire was sent to instructors in 26 states. "Uses" were located in all 26 states and "non-uses" were scattered over 19 of the 26 states. Apparently geographical location is not a factor involved in the use of instruction sheets. Teachers seem free to choose the method or methods of instruction they feel will benefit their teaching situation.

TABLE 30

Geographical list made up from the teachers who do not use instruction sheets.

STATE	NUMBER	STATE	NUMBER
Arkansas	2	Missouri	1
California	4	Nevada	1
Colorado	5	New Jersey	1
Connecticut	5	New York	2
Illinois	2	Ohio	2
Kentucky	2	Utah	3
Louisiana	1	Vermont	5
Maryland	1	Washington	4
Michigan	3	Wisconsin	4
		Wyoming	6

Question #20. Have you ever previously used instruction sheets?

Of the 49 who marked "not at all" when asked to what degree they use instruction sheets (Table 13) 32 (65%) indicated they had used instruction sheets at one time. Fifteen (30%) stated they had never used these sheets. Two failed to answer.

Question #21. Do you believe they were of value to your students?

Of the 32 who answered "yes" to question #20, twenty-six (81%) felt that instruction sheets had been of value to their students. Four stated they were of no value. Two persons who answered question #20 in the negative felt they might be of value.

Question #22. What are your reasons for not using instruction sheets now?

Thirty-three stated their reason as the amount of time required for preparation. Table 31 shows other reasons for not using instruction sheets. Several respondents marked more than one reason.

In preparing sheets for the experimental group, from one to three hours were required for preparation of each sheet, dependent upon the style of sheet and the amount of information required. In most industrial arts subjects, basic and fundamental information and processes change very little. Many information or operation sheets can be used with numerous projects or jobs, after they have once been prepared. Instruction sheets (job sheets, procedure sheets) pertaining to a particular project are useful as long as that project is used as a teaching devise.

TABLE 31

Reasons for not using instruction sheets.

REASON	NUMBER
a. No value to student	9
b. No help to teacher	3
c. High cost of producing	7
d. High cost of purchase	8
e. Too much time to prepare	33

The sheets used in the experimental group were prepared by the author, then a mimiograph stencil or ditto master was cut by a student secretary and "run off" by either the business education department or clerical staff of the school. Following the California policy of free education for all, no charge was made for these papers.

Question #23. What method(s) do you prefer rather than instruction sheets?

TABLE 32

Methods preferred in place of instruction sheets.

METHOD	NUMBER
a. Lectures	36
b. Demonstrations	56
c. Book assignments	38
d. Films	37
e. Slides	17
f. Film strips	33

Some of these methods must also be used when instruction sheets are in use. Lectures, book assignments (homework) and demonstrations were used in conjunction with the

controlled experiment. Many films, film strips and slides the author has attempted to use have not proven satisfactory for his teaching situation.

One respondent stated he used a tape recorder, others mentioned bulletin boards, magazines, student assistants (which often works well), patterns and jigs.

Question #25. Would you use these sheets if they were prepared for you?

Twenty-nine (59%) said Yes, fifteen (30%) No. Five failed to answer. Instruction sheets must prove to be of value as the majority of respondents who do not use them would do so if they were prepared for their class situations. Five who answered "No", indicated they would try them if ready-made sheets could meet the specifications of their individual situation.

Summary

Responses were received from 206 (59%) of the questionnaires mailed. Seventy-six per cent of the respondents make use of instruction sheets. Fifty-two per cent of the instructors use the sheets in all subjects taught. Sixty per cent of those who do not use instruction sheets would do so if said sheets would meet their specifications. No significant difference was noted

among the states involved. Respondents indicate instruction sheets are of value to students and allow instructors additional time for personal and/or individual instruction.

Chapter V

SUMMARY AND RECOMMENDATIONS

Summary

The controlled experimental situation (Chapter III) and the questionnaire survey (Chapter IV) provided a correlation of information from which the following implications have been drawn:

1. Seventy-six per cent of the industrial arts instructors participating in the survey use individual instruction sheets; 56 per cent use them in all subject areas taught.

2. Geographical location is apparently not a factor involved in the use of instruction sheets as no significant differences were noted.

3. Teacher-prepared instruction sheets are the most popular type, and information sheets the most commonly used style despite the fact they are the more difficult and time consuming to prepare. Preparation of job sheets requires the least time and work.

4. Approximately 92 per cent of the respondents to the survey believe students do use instruction sheets to good advantage, and learn to work in a more systematic manner. Seven respondents felt the advantage of

instruction sheets to be dependent upon the student and the method of application employed by the instructor.

5. Instruction sheets are used in conjunction with lectures and demonstrations by the majority of industrial arts instructors, and are issued as single units prior to the lesson.

6. Students are allowed to retain copies of instruction sheets free of charge by the largest percentage of survey respondents.

7. The effective integration of itinerant students is greatly simplified through use of individual instruction sheets as proven by the controlled experiment.

8. Classroom discipline problems showed a marked decrease when instruction sheets were properly employed.

9. Neater and more accurate projects resulted from use of job and procedure sheets in manipulative work.

10. Higher academic achievement is attained through student use of operation and information sheets.

11. Individual instruction sheets do create extra time for individual assistance and limited counseling, but do not allow an appreciable amount of extra time for maintenance work or teacher preparation.

12. Forty-nine of the survey respondents did not use instruction sheets, but the major portion of this group had used them in previous years and felt them to be of advantage to students.

13. The amount of time required for proper preparation is the major disadvantage attributed to instruction sheets.

14. Industrial arts instructors would use instruction sheets to an even greater extent if sheets could be commercially prepared to meet various and specific needs of a wider range of classroom situations.

Recommendations

1. Proved of value by the majority of instructors, it is recommended that instruction sheets be used to a greater extent in classrooms where: individual instruction, itinerant students, and discipline problems are evident.

2. To make commercially prepared instruction sheets more acceptable and to conserve the instructor's time, it is recommended they be constructed to cover a wider range of individual shop situations.

3. It is recommended that teacher-education schools devote more time to the preparation and application of individual instruction sheets, stressing simplification of construction.

4. It is recommended that teacher-education schools institute up to date rotating files of various instruction sheets which may be used as reference materials by practicing teachers.

5. It is recommended that further studies be made in the field of individual instruction sheets to determine: (1) methods of simplifying their construction; (2) selection of terminology for reading context to allow more extensive use by students of limited ability; and (3) grade level or levels in which the use of various types of instruction sheets are most effective.

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APPENDIX

LETTER OF TRANSMITTAL TO SUPERVISORS

OREGON STATE COLLEGE
School of Education

Corvallis

Department of
Industrial Education
Industrial-Arts Education
Industrial-Vocational Education

June 23, 1956

Mr. Robert L. Woodward
Consultant in Industrial Arts Education
Sacramento 14, California

Dear Sir:

With increasing enrollment in industrial arts classes, instructors find they have less time for individual student instruction. Some method must be devised to aid the teacher in reaching all of the students for general instruction if normal time for individual assistance is to be maintained.

A study to determine the value and extent of usage of individual instruction sheets in the industrial arts program appears to offer some hope. A great deal has been written on this subject by leaders in the field, most of which indicate high value in the use of these teaching aids. My problem is to determine if they are actually being used, and if so, to what extent they are effective.

Believing that you would be willing to cooperate in this study, I would appreciate having you furnish the names and addresses of several of your industrial arts teachers. I am making an endeavor to contact instructors in industrial arts throughout a wide area of the United States, in order to gain a true analysis of the problem. A report of this study will be made available to all participants, if so desired.

Thank you for your helpful cooperation.

Approved:

Geo. B. Cox, Head
Industrial Education
Department

Respectfully yours,

John B. Hayner
Coordinator

LETTER OF TRANSMITTAL WITH QUESTIONNAIRE

OREGON STATE COLLEGE
School of Education

Corvallis

Department of
Industrial Education
Industrial-Arts Education
Industrial-Vocational Education

November 10, 1956

Mr. Benjamin L. Kaufman
James Munroe High School
New York City, New York

Dear Sir:

The increased enrollment in our schools has again pointed up the importance of and need for individualized instruction. With the larger numbers of students in class some satisfactory method of aiding individual instruction must be used. According to some leaders in industrial arts education, individual instruction sheets might be one solution to this problem.

The enclosed survey questionnaire is designed to check the extent of use of individual instruction sheets. In addition, an attempt to determine the value of instruction sheets will be made through a controlled experiment with a specific set of sheets. In order to determine the extent to which instruction sheets are used, you are asked to answer the following questions. Your cooperation will be of considerable value in the overall experiment.

For the purpose of this study, the definition of instruction sheets proposed by Selvidge is used. "The instruction sheet is a teaching device designed to present to the student in a permanent form, the necessary instructions, information and directions for performing a task successfully." Individual instruction sheets may be teacher prepared for a specific job, operation or set of conditions in a given shop; or they may be from a commercial source, published in workbook form such as the Douglas and Roberts series, "Units in Hand Wood Working."

Only a few minutes of your time will be needed to answer the 25 questions. For your convenience there is

an extra copy of the questionnaire for your files should you wish to compare the results of this study with the answers you have given. A copy of the study will be made available to all who cooperate, either in published form or as a summary. Please use the self-addressed, stamped envelope to return one copy, filled out to give your response to the study.

Sincerely,

John B. Hayner
Coordinator

A STUDY OF THE VALUE AND EXTENT OF USE OF
INDIVIDUAL INSTRUCTION SHEETS FOR INDUSTRIAL ARTS CLASSES

Name_____ State_____
Enrollment of your school____ Average size of your class___
Grades taught 7 - 8 - 9 - 10 - 11 - 12 (Circle grade or grades.)
Type of shop: Unit shop_____ General Shop_____
Limited general shop_____
(Gen. Metal, Gen. Wood)

---

1. What subject area(s) in industrial arts do you teach?
_____, _____, _____, _____.

2. To what degree do you use individual instruction sheets?
Full time___ Part time___ Ocassionally___ Not al all___

NOTE: IF YOU DO NOT NOW USE INDIVIDUAL INSTRUCTION SHEETS PLEASE ANSWER QUESTIONS #20 THROUGH #25.

3. Do you use these sheets in all subject areas you teach? Yes_____ No_____

4. How long have you used instruction sheets in general?
Number years_____

5. What is the source of the sheets you use? Teacher made____ Commercially made____ Combination of these___

6. Check the type of instruction sheet(s) you are using.
a. Information___ b. Operation___ c. Job___
d. Assignment____ e. Procedure___ f. Other___

7. Are you using instruction sheets singly____ or by the sets____?

8. Do you feel that the students use these sheets to good advantage? Yes____ No____

9. Which students do you believe receive the most value from these sheets? a. High ability students____
b. Average ability____ c. Low ability____

10. Do you feel that these sheets are of greatest value in: (Rank in order 1 - 2 - 3 etc.)
a. Small classes____ b. Large classes____ c. General shops____ d. Unit shops____ e. Limited general shops ____ f. Classes with irregular attendance____
g. Other____

11. Do these sheets offer you more time for personal instruction? Yes____ No____ Some____

12. Do instruction sheets give you more time for other work? Yes____ No____ Some____

13. Do you believe these sheets help to train the student to do his work in a systematic way? Yes____ No____ Some____

14. Are you using these sheets in connection with demonstrations____ Lectures____ or both____?

15. Do the students receive their sheets before____or after____ the lecture or demonstration?

16. What method are you using for handling instruction sheets?
a. Give students a single copy when needed_____
b. Give students a full set at start of school term_
c. Post copies on board as needed_____
d. Other_____

17. Do your students keep their copies?_____ Turn them in at the end of the period?_____ Turn them in at the end of semester or year?_____

18. Do the students pay for these instruction sheets? Yes____ No____

19. If so, how much do they pay?_____

NOTE: IF YOU DO NOT NOW USE INDIVIDUAL INSTRUCTION SHEETS PLEASE ANSWER QUESTIONS #20 THROUGH #25.

20. Have you ever previously used instruction sheets in your classes? Yes_____ No_____

21. Do you believe they were of value to your students? Yes_____ No_____

22. What are your reasons for not using these sheets now?
a. Not of value to the student_____
b. No help to the teacher_____
c. High cost of producing_____
d. High cost of purchasing_____
e. Too much time preparing_____
f. Other (name)_____

23. What method(s) do you prefer instead of instruction sheets? a. Lectures_____ b. Demonstrations_____
c. Book assignments_____ d. Films_____ e. Slides___
f. Film strips_____ g. Other_____

24. If you checked OTHER, (in question 23) what are these methods?_____

25. Would you use these sheets if they were prepared for you? Yes_____ No_____

Do you want a summary of this study? Yes_____ No_____

Thank you for your cooperation. Comments and remarks will be welcome. If possible please enclose one or two typical samples of your instruction sheets.

GRADING SHEET

METAL SHOP

Metal 10 B

Through the use of this grading sheet you will be responsible for making out your own grade. You will keep this sheet in your notebook. It will be your responsibility to see that all entries are kept up to date. DO NOT LOSE THIS SHEET. This sheet must be turned in in order to receive a grade.

The grading sheet must be turned in to the instructor not later than Wednesday of the sixth week of each grading period. The instructor reserves the right of determining the final grade from personal observation of the student in class.

A. Attendance and conduct: Each student will be started with 100 points at the start of the semester. The following shows the loss of credits for various offenses.

1. Unexcused absence -- 5 -- (certain conditions will be accepted as excused absence. Check with the instructor upon return to class).
2. Tardiness -- 1 the first offense, double thereafter.
3. Cutting class -- 20 first offense, double thereafter.
4. Dirty work station -- 5 each offense.
5. Undue loafing -- 5 each offense.
6. Unsafe practices -- 10 each offense.
7. Horse play and running in the shop -- 10 each offense.

Extra credits may be earned at the discretion of the instructor.

B. Class work: The class work grade will be determined from 6 examinations and a notebook. In case of excused absences, examinations may be made up for 100% of the grade. Make up must be made within one week after return to class. Makeups will not be allowed on the final examination. It is your responsibility to see that the makeup examination is given to you.

C. Projects: Projects will be graded only when they are complete. There will be two projects required for each grading period. These are considered minimum requirements and extra credit will be given for projects completed above those required.

GRADING SHEET

A. Attendance and Conduct -- (Subtract credit loss from 100.) 1._____A1 2._____A2 3._____A3

B. Class Work -- (Divide classwork total by 7.)

	1st 6 weeks	2nd 6 weeks	3rd 6 weeks
1.			
2.			
3.			
4.			
5.			
6.			
7.			
Total			
Aver.	B1	B2	B3

C. Project Work -- (Divide project total by 2.)

	Name	Project Grade	Total	Average
1.				C1
2.				
3.				
4.				C2
5.				
6.				C3

TO FIGURE YOUR GRADE

	1st 6 weeks	2nd 6 weeks	3rd 6 weeks
	A1	A2	A3
Add	B1	B2	B3
	C1	C2	C3
Total	T1	T2	T3

Determine grade earned (Total (T) from list below

285 - 300 -- A
276 - 284 -- A-
264 - 275 -- B
250 - 263 -- B-

234 - 249 -- C+
225 - 233 -- C
216 - 224 -- C-
200 - 215 -- D+
188 - 199 -- D
175 - 187 -- D-
0 - 174 -- F

My grade for this period is: _____1. _____2. _____3.

NAME _____ PERIOD _____

INFORMATION SHEET #1

NAME

PERIOD

METAL SHOP

General Safety

Safety is a very important and necessary topic in any shop and so this paper will cover SAFETY briefly. This discussion is of a general nature while those at future dates will cover a specific tool, piece of equipment or operation. Old Man Accident is always present, just waiting for someone to be careless so he can make a big mess of things -- mainly you.

In industrial plants and shops, safety and accident prevention are foremost in the minds of management and union officials, these are highly stressed. Should management or union find some workman using unsafe methods or practices, they may warn him the first time but will fire him if he continues to use these methods.

Accidents cause not only injuries and deaths but are costly to industry in loss of manpower and possibly repair of equipment. Most companies are insured against accidents and so insurance companies are very much interested in safety practices in industrial plants and in their safety programs.

One of the first things the unions did for the working man was to insist upon better working conditions which included safety. At the present time all industries try to equip their machines with better safety devices and are always trying to find better and safer methods of production, and devices for their equipment. Large safety programs are carried on in all industrial plants by both union and management, to better provide for the safety of the working man and woman.

Union, management and most states have safety inspection teams inspecting industrial plants, checking on safety equipment and methods. The State Board of Education in California has inspectors checking school equipment in the shops to insure the safety of the students. They make sure that equipment has all the proper and necessary guards and that it is in good working condition so as not to cause accidents.

In this shop we have some equipment that can be very dangerous if not handled properly. Although this shop is not as dangerous as some, we do have certain safety regulations which must be obeyed not only for your safety but for your classmates' safety as well. These regulations are for two reasons:

First: For you and your classmates protection -- PLEASE FOLLOW THEM.
Second: To protect the equipment, tools and machines and to prevent costly and delaying repairs.

GENERAL SAFETY REGULATIONS

1. Use no machine until you have had proper instruction by the instructor.
2. No running or horseplay in this shop.
3. Wipe up all oil or grease which may be spilled on the floor.
4. Use the correct tool at all times.
5. Watch for hot, sharp, heavy or protruding materials of all sorts at all times.
6. Dress safely. Beware of loose -- ties, sleeves or sweaters.
7. Obey all safety signs.
8. Obey all safety lines.
9. Report all accidents to the instructor.
10. Use your head and be careful.

INFORMATION SHEET #2

NAME

PERIOD

METAL SHOP

Metal 10 B

SHOP WORDS AND TERMINOLOGY

Introduction:

Below you will find a list of words and terms that are important in metal working. They will be used by your instructor so you should be able to use and understand these words and terms yourself.

Shop words and terms:

1. ABRASIVE -- A substance used for grinding and polishing.
2. ALLOY -- A substance composed of two or more metals.
3. ANNEAL -- To subject to high heat, with subsequent cooling, so as to soften thoroughly and to make less brittle.
4. ARC FLASH -- The bright flash made when arc welding -- very injurious to the naked eye.
5. BOTTOMING -- To thread a hole to the bottom with a bottoming tap.
6. BREAK AN EDGE -- To remove the sharp corners, generally done with a file.
7. BURN A DRILL -- To allow a drill to heat and lose hardness and temper. Point changes color.
8. BURRED EDGE -- Roughness, especially on the edge of some piece. Caused by drilling, turning, cutting, etc.
9. CASE HARDENING -- To harden the outside of a piece of metal; to put carbon into the outer surface by a special process.

Information Sheet #2 (cont.)

10. CAST -- To form metal by pouring molten metal into a mold and allowing to harden.

11. CENTER LINE -- A line indicating the center or mid-point of a piece; a line drawn on stock to act as a base line in layout.

12. CIRCUMFERANCE -- The distance around a circle.

13. COLLET -- That part of a threading tool that holds the dies and the guide.

14. COUNTERSINKING -- Chamfering the top of a hole to receive a flat head bolt or screw. Often done to "break an edge" on the hole.

15. C.R.S. -- Cold rolled steel.

16. CROSS FILING -- Filing at an angle to the work -- generally used when doing the first or rough filing.

17. DIAGONAL -- A line joining two opposite corners of a rectangle or square.

18. DIAMETER -- The distance across a circle through its center.

19. DIE -- That part of a threading tool which forms the threads.

20. DRAW FILE -- The method of filing in which a single cut file is held at 90 degrees to the work, producing a smooth finish.

21. DRESS THE MATERIAL -- To remove a burr by grinding or filing.

22. DRILLING -- Making a hole in metal with a twist drill.

23. EXTERNAL -- On the outside.

24. FLUTE -- The spiral grooves of a twist drill or tap.

25. FORGE -- To form by heating and hammering.

26. GAUGE (GAGE) -- A calibrated thickness or diameter; a means of determining a thickness or diameter.

27. REAM -- To produce a hole of accurate size; the hole is always drilled undersize.

28. INTERNAL -- On the inside.

29. KERF -- The cut produced by a saw.

30. LAYOUT -- To draw an accurate outline on the material to be used.

31. LOADED WHEEL -- The pores of the grinding wheel become clogged and filled with some foreign substance -- usually soft metal.

32. MARGIN OF A DRILL -- The raised part which parallels the flutes; this provides body clearance.

33. MIKE -- Shortened form of the word micrometer.

34. MOLD -- The form in which castings are made.

35. N.C. -- National coarse.

36. N.F. -- National fine.

37. PILOT HOLE -- A small hole designed to lead or guide a larger drill into the material.

38. RADIUS -- The distance from the center to the outside of a circle.

39. SKETCH -- A freehand drawing or rough plan of any design.

40. TAPPING -- To cut an internal thread.

41. TEMPERING -- To bring to the correct degree of hardness.

42. WASTE -- That portion of the stock not needed in the finished product.

43. WELDING -- To unite metal parts by heating the parts to be joined and allowing the metals to flow together.

JOB SHEET #1

NAME

PERIOD

METAL SHOP

Metal 10 B

HOW TO MAKE A SCRIBE

Materials:

1 piece cold rolled steel 3/8" x 4"
1 piece drill rod 1/8" x 2"

Tools:

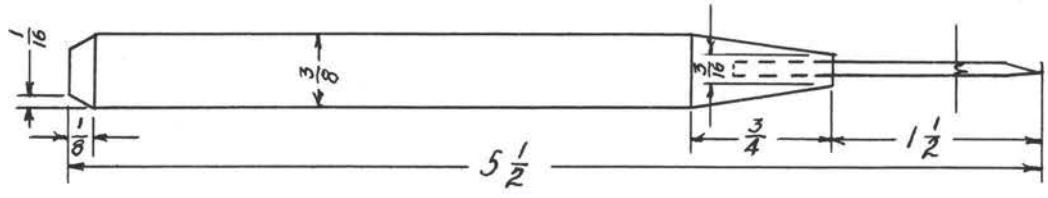
Hacksaw	#31 drill
Steel scale	Steel letter stamps
Files	Abrasive cloth
Center punch	Ball peen hammer
Scribe	Center head

Introduction:

A scribe is a sharpened piece of hardened steel used by metal workers to draw accurate lines when measuring and making layouts. It is the metal workers pencil.

Procedure:

1. Obtain stock and cut to size. 3/8" x 4" CRS
2. File ends square and to length.
3. File 1/8" chamfer on one end.



4. On the end opposite the chamfer, layout center for a hole.
5. Center punch and drill a #31 hole 1/2" deep.
6. File a taper 3/4" long (see drawing).
7. Press in piece of drill rod.
8. Sharpen to a point.

Job Sheet #1 (cont.)

9. Temper drill rod -- straw color.
10. File flat on handle 1/4" x 1-1/2". Center on handle.
11. Stamp last name and first initial on this flat.
12. Clean with abrasive cloth and hand in for grade.

JOB SHEET #6

NAME

PERIOD

METAL SHOP

Metal 10 A

HOW TO MAKE A PARALLEL CLAMP

Materials:

2 pieces 3/4" x 3/4" x 6" CRS	Jaws
2 pieces 7/16" x 6" rd. CRS	Screws
2 pieces 1/16" x 3/4" x 1-3/4" CRS	Screw clamps
2 pieces 1-1/2" x 5/8" rd. CRS	Screw tops
2 10-32 x 3/4" RH machine screws	

Tools:

All common hand tools will be used except for the screw tops. The Sheldon metal lathe will be used to make this part. A separate procedure sheet will be used during the construction of these two pieces.

Introduction:

This type of clamp is used a great deal by tool and die makers, machinists and other mechanics. During the construction of this clamp accurate layout is very important. You will have your first experience running a machine lathe in the making of the screw tops.

Procedure:

I. Jaws:
1. Obtain stock which has been cut.
2. Dress stock.
3. Square one end of each piece.
4. Layout both pieces according to Figure 1.

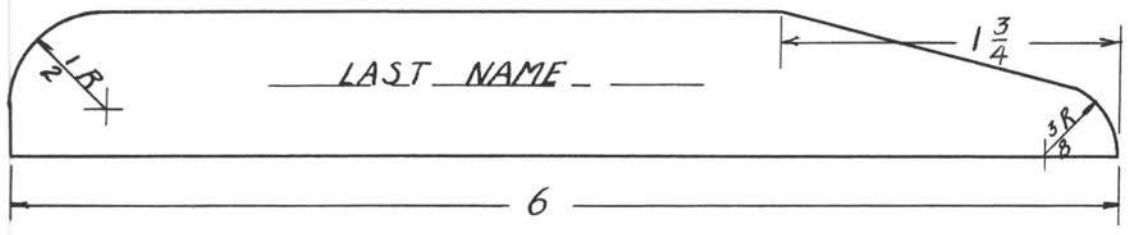


Fig. 1

Job Sheet #6 (cont.)

5. Cut long taper first on both pieces.
6. File to finish lines.
7. Layout holes and center punch for drilling. See Figure 2.

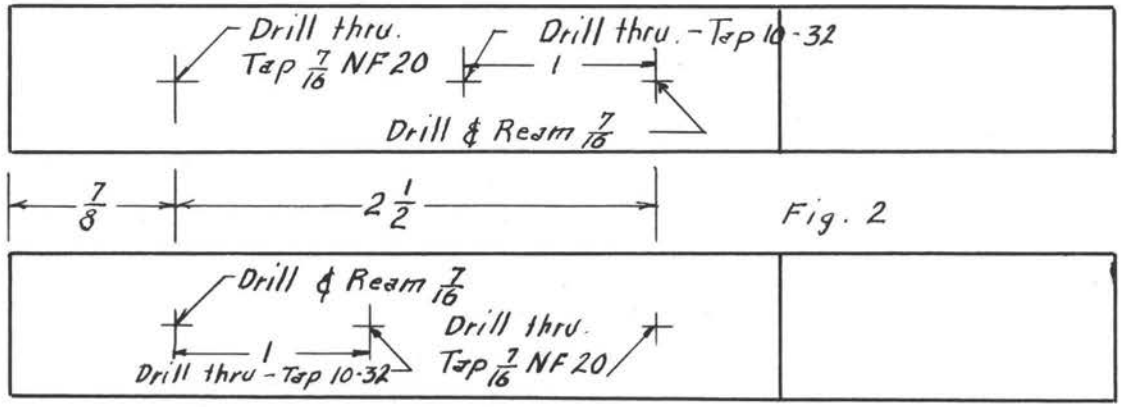


Fig. 2

8. Drill holes to size. Countersink slightly.

NOTE: Use 1/8" pilot drill on all holes first.

9. Ream holes indicated. Use chucking reamer.
10. Tap holes indicated.
11. Stamp name on one side of each jaw as indicated.
12. Draw file and clean up both pieces.
13. Caseharden both jaws.
14. Repolish both jaws with abrasive cloth.

II. Screws:
1. Obtain stock which has been cut.
2. Check length and square up both ends.
3. File slight chamfer on both ends.
4. Thread 4 - 5/8". Use correct dies.

III. Screw clamps:
1. Cut stock.
2. Square stock.
3. Layout according to Figure 3.
4. Locate holes center punch and drill.

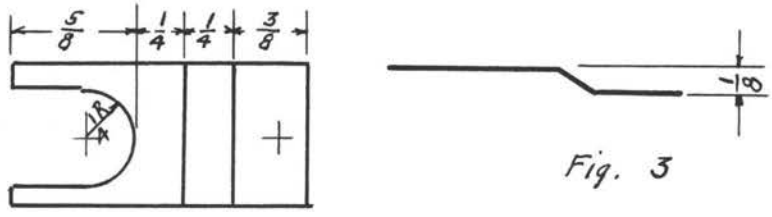


Fig. 3

Job Sheet #6 (cont.)

5. Cut large opening with hacksaw.
6. File to finish line.
7. Bend to shape.
8. Clean with abrasive cloth.

IV. Screw tops:
1. See Figure 4. To be made on machine lathe.

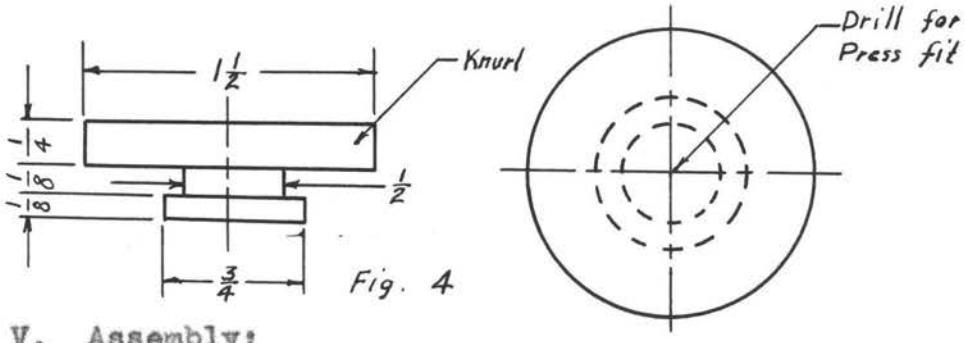


Fig. 4

V. Assembly:
1. Press screws into screw tops.
2. Slide screw into reamed hole from the top of the jaw.
3. Fit screw clamp into place and fasten with machine screw.
4. Locate threaded holes with screws and screw together.
5. Polish where necessary and hand in for grade.

OPERATION SHEET #2

NAME

PERIOD

METAL SHOP

Metal 10 B

HOW TO CASE HARDEN A HAMMER HEAD

Materials:

Hammer head
Casehardening compound (Kasnite)
Mild steel wire

Tools:

Melting furnace
Tongs

Introduction:

Casehardening is a process used widely by industry to surface harden steels. Their methods are very scientific and accurate. Parts which need a hard wearing surface and a core which is tough are generally casehardened.

Terms:

Casehardening -- A process of surface hardening a piece of metal.
Carburizing -- The process of hardening carbon to steel. Casehardening does this to metals.

Procedure:

1. Heat the kasnite in the Johnson melting furnace until it becomes liquid.
2. Tie a piece of mild steel wire around the piece to be hardened and place it in the molten compound.
   NOTE: Be sure there is no water or moisture on the piece to be hardened.
3. Allow the piece to soak in the compound 20 to 25 minutes.
4. Remove from the bath and quench in water.
5. Remove from the quench bath and dry thoroughly.

Operation Sheet #2 (cont.)

6. Piece may be polished. Use abrasive cloth.
   NOTE: The piece is now too hard to be filed.
7. Hand in for grading.

Questions:

1. Why is casehardening used on some jobs? 2 points
2. What is casehardening? 2 points
3. Is the core of the metal changed? 4 points
4. List at least four items that should be case-hardened. 4 points
5. What is carburizing? 3 points

References:

Reference books will be found in both the shop library and school library.

Grades:

Your letter grade may be found by using the following list.

13 - 15 points A
10 - 12 points B
7 - 9 points C
4 - 6 points D
0 - 3 points F

OPERATION SHEET #4

NAME

PERIOD

METAL SHOP

Metal 10 B

HOW TO HEAT TREAT A COLD CHISEL

Materials:

Cold chisel

Tools:

Source of heat
Abrasive cloth
Can of water

Introduction:

The heat treatment of steel is very important part of metal work. Some tools or parts of tools must be strong, tough, hard and some must be able to cut other metals. To make carbon and tool steel stronger, tougher and harder than other metals we heat treat them. Industry uses many methods but we will use only flame treatment. This method has been used by blacksmiths for years. Although it is not as accurate as other methods, it is satisfactory for a lot of work.

Terms:

Hardening -- Hardening is the process of heating till red hot then quenching in water or oil. It is the process of making metal harder.

Quenching -- Quenching is the process of cooling rapidly by plunging in water or oil. This makes metal hard and brittle like glass.

Temper colors -- These are a series of colors caused by heat. They are yellow, straw, brown, purple, blue, grey. The lighter the color the harder the metal.

Procedure:

1. Heat a piece to cherry red (1500 degrees).
2. Quench.

Operation Sheet #4 (cont.)

3. Clean the work with abrasive cloth.
4. Reheat slowly from the head end. Watch for the temper colors to show up.
5. As the color you want shows up on the point or working end, plunge the whole piece into the water and cool rapidly. DO NOT bring the metal to a red heat at this time.
6. Test by trying out the tool. Use it for what it is made to do.
7. Show the instructor the colors you have on your piece.
8. Clean well with abrasive cloth and hand in for grade.

Questions:

1. Why are tools hardened? 2 points
2. What is the meaning of quench? 1 point
3. Can mild steel be hardened? 2 points
4. List the temper colors starting with the hardest. 6 points
5. What color would you use for a cold chisel, hammer head, knife blade? 4 points

References:

Reference books will be found in both the shop library and school library.

Grades:

Your grades may be found by using the following list.

13 - 15 points A
10 - 12 points B
6 - 9 points C
3 - 5 points D
0 - 2 points F

INFORMATION SHEET #4

NAME

PERIOD

METAL SHOP

Metal 10 B

WHAT IS MILD STEEL?

Introduction:

A knowledge of the materials you are working with is very important to you in any field of work. In this case we are working with metals and therefore should have some background of these materials. There are three classifications of steel. (1) Mild steel; (2) Tool steels; (3) Cast irons. At this time we will study only mild steels.

Information:

Steel is made from iron and other materials. The amount of these materials make different types of steel which have many uses. Molten iron is poured into a Bessemer converter and the impurities are burned out. The molten iron is obtained from melting iron ore in a blast furnace. From the Bessemer converter it is poured into molds or ingots. After it has cooled it is rolled into sheets, bars, drawn into wire and rods and many other shapes.

Sometimes other materials are added to make this metal tougher, more wear resistant and easier to machine among other reasons. Some of the materials that are added are sulphur (this helps for better machining), manganese (wear resistance), nickel (toughness and strength). Carbon is added for hardening ability, as long as less than .60% is added it is mild steel. Mild steel cannot be hardened. (Operation Sheet #1.)

Mild steel is used generally where strength and toughness is needed. Shafting, wire, sheet metal and pipe are some of its uses.

To tell if you have a piece of mild steel, hold one end against a grinding wheel and watch the sparks. Mild steel has long sparks with a few forked shaped sparklers on the very end of the spark.

Information Sheet #4 (cont.)

Terms:

Pig iron -- When iron ore is melted it is poured into molds which are called pigs. The iron is then called pig iron.

Bessemer converter -- This is a large barrel shaped vessel into which molten iron is poured and compressed air is forced through it to remove carbon and silicon.

Questions:

1. What is mild steel? 2 points
2. Other than those given in this paper, give five uses of mild steel. 3 points
3. Name three other materials used in the making of steel and tell why they are used. 4 points
4. What percentage of carbon is used in making low carbon steel? 2 points
5. Can mild steel be hardened? 2 points
6. Why is carbon used in steel making? 2 points

Grades:

Your letter grade may be found by using the following chart:

13 - 15 points A
10 - 12 points B
6 - 9 points C
3 - 5 points D
0 - 2 points F

References:

Reference books will be found in both the shop library and school library.

PROCEDURE SHEET

METAL SHOP

Metal 10 A

Procedure For Turning Handles To The Parallel Clamp

1. Obtain stock.
2. Knurl.
3. Face end.
4. Center drill.
5. Drill through to size.
6. Countersink hole -- slightly.
7. Turn to size.
8. Neck to depth.
9. Bevel sharp edges.
10. Cut to length in hacksaw.
11. Face end.
12. Bevel sharp edge.
13. Countersink hole -- slightly.

Drawing for this job is on the chalk board.