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# A COMPARISON OF THE DISCUSSION AND EXPERIMENTATION METHODS OF PRESENTING RELATED INFORMATION

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# A COMPARISON OF THE DISCUSSION AND EXPERIMENTATION METHODS OF PRESENTING RELATED INFORMATION

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By

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My sincere appreciation to Dr. J. V. Melton for the cooperation, advice, and assistance given to me in writing this thesis. I wish also to express my gratitude to my wife, Eve, for her constant encouragement and understanding during the trying time of writing a thesis.

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# CHAPTER I

# INTRODUCTION

## Introduction to the problem

In working with students in the general shop, numerous instructors have observed that methods of instruction appear to vary in effectiveness with different students. This difference, however, is usually a general observation, based on personal judgment rather than on scientific observation. Since the problem of methodology or effective communication is of concern to many instructors in industrial arts education, an experimental study of two teaching methods was the subject of investigation for this report.

The results of a comparison of teaching methods should be of value and interest not only to teachers of industrial arts at the elementary and secondary level, but also to those engaged in the preparation of industrial arts teachers in college. This study should also be of value in vocational education, in the other practical arts, and in general education.

## Need for the study

The gap between teaching and learning has to be bridged by methodology. The function of method, according to Maley, is to find common procedural grounds between the teacher

and the learner.[1] Methodology is a matter of communication.

It was on the question of effectiveness of "common procedural grounds" that this investigation was undertaken.

## Statement of the problem

This study was a comparison of the discussion method and the experimental method of presenting related information of factual nature to eighth grade junior high school students in the general shop.

An attempt was made to determine the most efficient method of presentation in terms of the gain and retention of factual knowledge.

## Hypotheses

The four hypotheses that were examined in this study were: (1) There will be no significant difference in the initial ability of the control group over the initial ability of the experimental group. (2) There will be no significant difference in the effects of the training on different ability groups as measured by the pretest. (3) There will be no significant difference in the gain of factual knowledge in the experimental group over the gain in factual knowledge of the control group. (4) There will

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[1] Instructional Methods, American Council of Industrial Arts Teacher Education (Bloomington: McKnight and McKnight, 1957), p. 136

be no significant difference in the retention of factual knowledge in the experimental group over the retention of factual knowledge of the control group.

## Population

The population for this study was eighth grade boys enrolled in an Industrial Arts General Shop at the Northwest Junior High School in Kansas City, Kansas. The total enrollment at Northwest is approximately 1,200 students. The maximum general shop enrollment is 144 students, with six class periods of 24 students in each class.

The data collected were related to the initial gain in factual knowledge and the retention of factual knowledge. The data were analyzed to determine which method, if either, was better in relation to these data.

## Definitions of terms

The following terms were defined to give a definite understanding of the terminology as used in this study.

> Discussion Directed Group. Discussion that is controlled by its leadership, fixed agenda, or some other group structure, to move through its stated agenda.[2]

> Experiment. The trial of planned procedure accompanied by control of conditions and/or controlled variations of conditions together

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[2]Carter V. Good, Dictionary of Education (New York: McGraw-Hill Book Company, 1959)

with observations of results for the purpose of discovering relationships and evaluating the reasonableness of a given hypothesis.[3]

General Shop. A shop having various activities based on selected industries, usually housed in one room and under the direction of one teacher.[4]

Industrial Arts. An area of education dealing with socio-economical problems and occupational opportunities involving experiences with a wide range of materials, tools, processes, products, and occupations typical of an industrial society.[5]

Junior High School. Usually a school that enrolls pupils in grades seven, eight, and nine.[6]

Methodology. The theory of the nature, place, and kinds of methods used in teaching.[7]

Objective Test. A test so constructed that different scorers working independently will arrive at the same or essentially the same score for a given performance; usually based on alternate responses, multiple-choice, matching, or completion type questions; scored by means of a key of correct answers, any answer disagreeing with the key being regarded as incorrect.[8]

Related Information. (ind. ed.) knowledge necessary for a thorough understanding of the equipment, tools, materials, processes, and skills of a given area.[9]

## Techniques used in the two methods

### Discussion Method.

1. Prior assignment of material to be covered.

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[3] Ibid., p. 215 [4] Ibid., p. 499 [5] Ibid., p. 499

[6] Ibid., p. 306 [7] Ibid., p. 345

[8] Ibid., p. 562 [9] Ibid., p. 457

2. Class discussion of material.
3. Test over materials.

Experimental Method.

1. Prior assignment of materials to be covered.
2. Performance of experiments with materials and equipment.
3. Test over materials.

## Limitations of the study

The results of this study were limited to situations where the population was similar to the students in the general shop classes at the Northwest Junior High School. The study was limited to the related information unit on abrasives and to the two different ways of presenting this related information. It was limited by the validity of the data collecting instrument and the validity of the evaluation of the data collected.

## Evaluation instruments

The evaluation instruments in this study were objective tests designed to evaluate the information that groups of students received in the experiment. An objective type test was used. It contained alternate responses, multiple-choice, matching, and completion type questions. A pretest was administered prior to the time of the experiment to ascertain the amount of factual knowledge already possessed by the students. The day after the experiment was performed the objective test was again given to ascertain the actual

amount of gain in factual knowledge. The second administration of the test was followed by a third administration designed to ascertain the amount of retention of factual knowledge by the students. The retention test was given twenty-one days after the gain test.

## Review of literature

The review of related literature has been limited to writing and research in teaching by means of the experimental method.

In his book, Creative Teaching, Struck says that, "creative teaching calls for an active problem solving attitude toward life rather than one that is passive in nature. In creative teaching a number of mental habits are formed: Open-mindedness, suspension of judgment until all the facts are known, looking for causes, and evaluation on basis of facts." [11]

Basically, that is what Maley discussed in a magazine article published in 1959.[12] Working in conjunction with the Montgomery Junior High School in Montgomery County, Maryland, Maley and the general shop teacher, Keeny, inaugurated a total experimental program for one class of ninth

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[11] Theodore F. Struck, Creative Teaching (New York: John Whiley and Sons, 1938), p. 569

[12] Donald Maley, "Research and Experimentation in the Junior High School," The Industrial Arts Teacher, XVIII, March-April, 1959), p. 12

grade boys.

The class was treated with a different attitude than the normal shop class. There were twelve students in the class and the students were volunteers; they were issued billfold identification cards, lapel badges, and personal clip boards. The class was called "The Industrial Arts Research Laboratory". In this report Maley referred to the teacher's comments on the class: "the teacher is not an answer man but one who facilitates and enables the findings of answers".[13] This class did experimental research with products and materials, but the results of this method of teaching were not reported as a scientific experiment.

Scientific research has been done on the experimental method of teaching. Bitner, in a doctoral dissertation in 1961, compared the conventional method of teaching and the experimental method of teaching sixth grade arithmetic. The conventional method was defined as: telling, showing, demonstrating, explaining, and the use of textbooks. The experimental method was defined as a self-discovery method in which students explored, experimented, and discovered arithmetic facts. The following conclusions were made: (1) no significant differences in the mean performance of the post-test, (2) retention favored the experimental method of teaching, (3) mean performance on transfer favored

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[13] Ibid., p. 15

the conventional method of teaching.[14]

In a doctoral study by Riggs in 1961, two groups of college freshmen enrolled in general chemistry were used for a comparison of two methods of teaching. One group used a laboratory manual as a guide for study, the other group used the research or experimental format as a guide. The conclusion in this study was that no significant difference was found in the research or experimental method of teaching.[15]

Earl, in a book published in 1960, suggested that in our age of advanced technology the transition between high school and college life to life as an adult would be easier if research, problem solving, or the experimental method of teaching were used in our schools. This method of teaching, according to Earl, "would develop a desire in young people to inquire, search, create, investigate and explore the concepts of life.[16] Earl's statement appears to support Maley's statement that the teacher must

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[14]Alfred Bitner, "A Comparison of Two Methods of Teaching the First Case of Percent", Dissertation Abstracts, XXII, No. 2, p., 3942

[15]Virgil Riggs, "A Comparison of Two Methods of Teaching College General Chemistry Laboratory", Dissertation Abstracts, XXIII, No. 1, p., 165

[16]Arthur Earl, Experiments with Materials and Products of Industry, (Bloomington: McKnight and McKnight, 1960), pp. 7-8

create an atmosphere in which the learner is free to explore and to discover.[17]

The review of related literature has indicated that there have been conflicting opinions as to which of the methods, conventional or experimental, is the better method to be used in teaching.

## Summary

Some methods of teaching appear to have been more effective than others. Since method is the gap between teaching and learning, the present study was done in an attempt to ascertain which of two teaching methods was more effective, the discussion method or the experimental method.

The population was students enrolled in the general shop classes at Northwest Junior High School. The evaluation instruments were objective tests given to the discussion group and the experimental group over the related information unit on abrasives.

The review of the related information indicated a difference of opinion as to which method of teaching was more effective.

[17] Donald Maley, Classroom Research American Council of Industrial Arts Teacher Education (Bloomington: McKnight and McKnight, 1964), p.p. 136-184

# CHAPTER II

## NATURE OF THE STUDY

### Introduction

The analysis of covariance was selected as the method of interpreting the data collected on this experimental study of two different methods of presenting related information.

Random selection was used to assign classes to the two groups in the experimental design. An objective test was designed to be used as a pretest, gain test and retention test. The related information unit, the schedule of events, and a detailed comparison of time used by the two groups will be discussed.

### Analysis of covariance

The general shop students in this study had been assigned to class prior to the time of the study. Northwest Junior High School uses achievement grouping in the academic classes, but not in the shop classes. However, if students of higher intelligence are grouped in a class of English or mathematics, at that time, they cannot be enrolled in the general shop classes. Therefore, some indirect grouping does occur in shop classes. Since prior arrangements could not be made for the assignment of students to classes, the method of analysis of covariance was used.

Analysis of covariance is a statistical method that may be used in comparing two different methods of teaching and determining if there is any measurable difference between the conventional method and the experimental method of teaching. Since it is impossible to treat one group in two ways simultaneously, it is necessary to deal with two or more groups, each of which is treated differently from the others. A valid comparison of the gains made by the several groups requires that allowances must be made for initial differences between the groups. The statistical technique called analysis of covariance is generally regarded as the most rigorous means of making such adjustments and furnishing sound interpretable results.[1]

Analysis of the results of this study was based on a manual published by the Education Testing Service. This manual was written for people who were not familiar with the complex statistics of educational experimentation and yet wanted to analyze experimental results in a sound fashion.

> Analysis of covariance represents an extension of analysis of variance to allow for the correlation between initial and final scores. Covariance analysis is especially useful when for various reasons it is impossible or quite difficult to equate control and experimental groups from the start: A

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[1]Henry S. Dyer and William B. Schrader, Analyzing Results of an Educational Experiment, (New Jersey: Educational Testing Service, 1960), p. 1.

> situation which often obtains in actual experiments. Through covariance analysis one is able to effect adjustments in final or terminal scores which will allow for differences in some initial variable.[2]

## Group selection by randomization

The six classes of students were divided into two groups of three classes each. Assignments of the classes to the two different methods of teaching were by random selection.[3] Six tool checks were placed in a can, the tool checks were numbered from one to six; each check number corresponding to the hour of each class it was to represent. A flip of the coin by an independent second party determined that the first tool check drawn out of the can would be assigned to the experimental group; the second tool check drawn would then be assigned to the control group. Checks were drawn and alternate assignments made until the classes were divided into two groups of three classes each. The selection of the tool checks from the can was done by an uninterested second party. The results of the random selection are shown

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[2]Henry E. Garrett, Statistics in Psychology and Education (New York: David McKay Company, 1958), p. 295

[3]Allen L. Edwards, Experimental Design in Psychological Research (New York: Holt, Rinehart and Winston, 1962) p. 20

in Table I.

TABLE I

RANDOM ASSIGNMENT OF CLASSES TO CONTROL GROUP AND EXPERIMENTAL GROUP

| Control Group | Experimental Group |
|---|---|
| Hour one | Hour two |
| Hour three | Hour four |
| Hour six | Hour five |

As previously mentioned, it was impossible to select the students for this study; therefore a design similar to the Nonequivalent Control Group Design was used. The

Experimental design

The Nonequivalent Control Group Design. One of the most widespread experimental designs in education research involves an experimental group and a control group, both given a pretest and a posttest, but in which the control group does not have pre-experimental sampling equivalence. Rather, the groups constitute natural assembled collectives such as classrooms, as similar as availability permits, yet not so similar that one can dispense with the pretest. The assignment of x to one group or the other is assumed to be random and the other the control of the experimenter.[4]

$$--\frac{O}{O}----------X----------\frac{O}{O}--$$

Figure I

NONEQUIVALENT CONTROL GROUP DESIGN.

[4]N. L. Gage, Handbook of Research on Teaching (Chicago: Rand McNally and Company, 1963), p. 217

original design is shown in Figure 1, page 13. The modification of this design, the one which was used in this experiment is shown in Figure 2.

$$\frac{O_P}{O_P} \text{ - - - - - - - } \frac{X_E}{X_C} \text{ - - - - - - - } \frac{O_I}{O_I} \text{ - - - - - - - } \frac{O_R}{O_R}$$

| Pretest | Experimental | Posttest | Posttest |
|---|---|---|---|
| Pretest | Control | Posttest | Posttest |

$O_P$ - Observation pretest (Pretest of factual knowledge)

$X_E$ - Experimental teaching method group

$X_C$ - Discussion teaching method group

$O_I$ - Observation initial. (Gain in factual knowledge)

$O_R$ - Observation retention (retention of knowledge)

Figure 2

EXPERIMENTAL STUDY DESIGN

## Test form used

The pretest used as a predictor in the analysis of covariance was a teacher-made objective test.

Mechanical reasoning scores were not available for the students used in this study. Intelligence scores available would not necessarily reflect prior knowledge of abrasives by the students. One test form was used for the pretest, gain test and the retention test. Time allowances were made between each testing session to reduce over exposure to the one test form. The objective test used is included in Appendix B, page 40.

## Objective test key

A test key was used in scoring each test. If the answer or answers on the student's test paper corresponded with the answer or answers on the key, it was counted correct; if it did not correspond with the key, it was counted incorrect. The test key used is shown in Appendix B, page 42.

## Related Information

The related information unit selected to be used in this study was on abrasive paper. This information was selected for two reasons. One, it appeared to be clearly related to the type of experiment that was selected. Two, it came in the course of study at this time. Each student received a copy of the related information sheet, shown in Appendix C, page 44. The related information sheet covers all points that would appear on the test.

## Schedule of study events

Table 2 shows the schedule of events as they happened during the twenty-two day period of this study.

TABLE II

TIME SCHEDULE OF STUDY EVENTS

| Day | Event | Control Group | Experimental Group |
|---|---|---|---|
| 1 | Pretest | X | X |
| 6 | Assignment | X | X |
| 7 | Experiment | X | X |
| 8 | Gain test | X | X |
| 22 | Retention test | X | X |

## Comparison of time

An attempt was made to equalize the time used at school by each group in the study. A total of forty-five minutes of school time was used for review, discussion, and experimentation. This total does not include the time used by students in taking the three tests. The manner in which the forty-five minutes were used in each group is shown in Table III.

TABLE III

COMPARISON OF TIME ALLOTTED TO THE TWO GROUPS DURING THE EXPERIMENT

| Time Allotted | Control Group | Experimental Group |
|---|---|---|
| Home study of related information | Yes | Yes |
| Review of related information on the day of experiment | 10 | 10 |
| Discussion time for the Control group | 25 | 0 |
| Lecture time for the Experimental group | 0 | 10 |
| Time used in experimentation | 0 | 15 |
| Question and answer period | 5 | 0 |
| Summary time for experiment | 0 | 5 |
| Review time for gain test | 5 | 5 |
| Review time for retention test | 0 | 0 |
| | 45 | 45 |

## Summary

Analysis of covariance was selected because it made the most of the available data and provided the most valid interpretation of the data. The experimental design selected made use of a pretest, the experiment, a post-test, and a retention test. The actual experiment was the use of a related information unit, presented in two different ways. Students were tested over this information by the use of an objective test. Time allowances were made between each test to minimize the carry-over of facts from one test to the next.

## CHAPTER III

## THE CONTROL GROUP

### Introduction

The control group was presented the related information unit by the discussion method. A pretest, a gain test, and a retention test was given to the control group on the same day as the experimental group. The test results of the control group are given in this chapter.

### The control group

Actual class numbers differ from the numbers of students used in the experiment. This was due to absenteeism of students. If a student was absent the day of a test or the day of the experiment, he was not used as part of this study. The class hours, the actual numbers in each hour and the number of students participating in the control group are shown in Table IV.

TABLE IV

CLASS HOUR, ACTUAL NUMBER OF STUDENTS IN EACH GROUP, AND NUMBERS OF PARTICIPATING STUDENTS IN THE CONTROL GROUP

| Hour | Actual number | Study number |
|---|---|---|
| One | 20 | 18 |
| Three | 19 | 15 |
| Six | 22 | 20 |
| Total | 61 | 53 |

## The pretest

Six days prior to the date of the experiment a pretest was given. This was the first time that the students in the General Shop Classes became familiar with the experiment. The following information was given to the six shop classes. "You are going to participate in an experiment using two different methods of teaching. Today you are going to have a test. It will not count as part of your six weeks grade; however, do your best on this test to see if your group can do better than the other group of students in this experiment; next week you will have another test as part of this experiment, more information will be given to you at that time." The pretest was given and the results are recorded in Table V.

TABLE V

CONTROL GROUP PRETEST RESULTS

| Range | Median | Mean score |
|---|---|---|
| 22 | 14 | 14.62 |

## Method of instruction

The discussion method was used in presenting the related information unit to the control group. On Monday,

the day prior to the actual experiment, students in the control group were given related information sheets. The students were instructed to take the sheets home and study them and that the next day, in class, the information would be covered. A test would be given over this information on Wednesday.

## The discussion

On Tuesday additional related information sheets were passed out and a ten minute review period was provided. Sheets displaying samples of abrasive papers were placed on the benches for students to observe during the discussion; also sheets showing the different grits of abrasive papers were provided. After the review period, a twenty-five minute discussion of abrasives was held. This discussion covered the different aspects of abrasives, abrasive papers, forms, types, glues, grits, and terminology and definitions. After the discussion period, time was provided for questions and answers. Students were reminded that on Wednesday they would be tested over this information.

## The gain test

On Wednesday, students in each class of the control group were given five minutes review time before the gain test. The results of the gain test for the control group

are given in Table VI.

TABLE VI

CONTROL GROUP GAIN TEST RESULTS

| Range | Median | Mean score |
|---|---|---|
| 16 | 28 | 27.32 |

## The retention test

Fourteen days after the gain test and twenty-one days after the pretest, the retention test was given. Students were not told in advance about the retention test. On the day the test was to be given, no review time was allowed. The test was administered and the results recorded. The results of the control group retention test are given in Table VII.

TABLE VII

CONTROL GROUP RETENTION TEST RESULTS

| Range | Median | Mean score |
|---|---|---|
| 16 | 28 | 26.79 |

## Summary

The control group consisted of three classes, meeting

the first, third and sixth hours. The control group classes were assigned by random selection. An objective type test was used as a pretest to ascertain the amount of factual knowledge already possessed by the students. The mean score of the pretest was 14.62. The control group was presented the related information unit by the discussion method. On the day following the discussion a gain test was given to ascertain the amount of gain in factual knowledge by the students. The mean score of the gain test was 27.32, a gain of 13.06 points. On the fourteenth day after the gain test a retention test was given to discover the amount of loss in factual knowledge by the students. The mean score of the retention test was 26.79, a loss of .53 of a point.

# CHAPTER IV

## THE EXPERIMENTAL GROUP

### Introduction

The related information unit was presented to the experimental group by the experimental method. A pretest was given to the experimental group prior to the experiment. The day following the experiment the gain test was administered. Fourteen days after the gain test a retention test was given. The tests and the related information unit were given to the experimental group on the same day as the control group. The results of the experimental group tests are reported in this chapter.

### The experimental group

Actual class numbers in the experimental group differ from the number of students that participated in the experiment. The difference in numbers was due to absenteeism of the students. Table VIII, page 24, shows the class hour, actual number of students in each hour and the actual number of students participating in the experimental group.

TABLE VIII

CLASS HOUR, ACTUAL NUMBER OF STUDENTS IN EACH GROUP AND NUMBERS OF PARTICIPATING STUDENTS IN THE EXPERIMENTAL GROUP

| Hour | Actual number | Study number |
|---|---|---|
| Two | 20 | 19 |
| Four | 22 | 20 |
| Five | 21 | 16 |
| Total | 63 | 55 |

## The pretest

The pretest was administered to the experimental group on the same day as it was given to the control group. All information and instructions were the same for both groups. Pretest results for the experimental group are in Table IX.

TABLE IX

EXPERIMENTAL GROUP PRETEST RESULTS

| Range | Median | Mean score |
|---|---|---|
| 28 | 12 | 12.69 |

## Method of instruction

On Monday of the week of the experiment, students

in the experimental group were given related information sheets. The students were instructed to take the sheets home and study them. They were also told that this information would be covered in class the next day, and that a test would be given over the information on Wednesday.

## The experiment

On Tuesday students were provided with additional information sheets and were given ten minutes in which to study. The review period was followed by a ten minute lecture on abrasives by the teacher. The general shop has six four-station work benches. The students at benches one and two performed the abrasive wear test. Students at benches three and four performed the abrasive cutting test. Benches five and six performed the moisture resistance test. Students at each bench were provided with work sheets for each experiment, on which to record results and draw conclusions. Work sheets used by the students are shown in Appendix D, page 50. At the end of the allotted time for the experimentation, students were given five minutes to compare their results and draw conclusions. Then one student from each experimental group was asked to present the findings to the class as a whole.

At the end of the experiment, students were reminded that the next day they would be tested over the related information.

## The gain test

On Wednesday of the week of the experiment, the gain test was given to each class in the experimental group. Each class had five minutes review period before the test. Results of the gain test are given in Table X.

TABLE X

EXPERIMENTAL GROUP GAIN TEST RESULTS

| Range | Median | Mean Score |
|---|---|---|
| 25 | 25 | 24.00 |

## The retention test

The retention test for the experimental group was given on the same day as the retention test for the control group. Students were not told in advance of the retention test. Results of the retention test administred to the experimental group are given in Table XI.

TABLE XI

EXPERIMENTAL GROUP RETENTION TEST RESULTS

| Range | Median | Mean score |
|---|---|---|
| 24 | 24 | 23.75 |

## Summary

The pretest was given to the experimental group to ascertain the amount of knowledge already known by the students. The mean score of the pretest was 12.69. The experimental group was presented the related information unit by the experimental method. On the day following the experiment a gain test was given to ascertain the amount of gain in factual knowledge by the students. The mean score of the gain test was 24.00, a gain of 11.31 points. On the fourteenth day after the gain test a retention test was given to discover the amount of loss in factual knowledge. The mean score of the retention test was 23.74, a loss of .26 of a point.

## CHAPTER V

## A COMPARISON OF THE TEST RESULTS FOR THE CONTROL GROUP AND THE EXPERIMENTAL GROUP

### Introduction

In this chapter the test results of the two groups in this study are given. The test results are shown in Table XII. Also there is a discussion on the analysis of covariance and an explanation of the lines of retention.

TABLE XII

COMPARISON OF THE RANGE, MEDIAN AND MEAN OF THE CONTROL GROUP AND THE EXPERIMENTAL GROUP TEST RESULTS

| Group | Test | Range | Median | Mean |
|---|---|---|---|---|
| Control | Pretest | 22 | 14 | 14.26 |
| Experimental | Pretest | 28 | 12 | 12.69 |
| Control | Gain test | 16 | 28 | 27.32 |
| Experimental | Gain test | 25 | 25 | 24.00 |
| Control | Retention test | 16 | 28 | 26.79 |
| Experimental | Retention test | 24 | 24 | 23.75 |

### Lines of relation

The method of analysis of covariance was used in this study to interpret the results of the two groups. Analysis of covariance works on the principle that there is a relation between the score obtained by each student at

the beginning of training and the score obtained at the end of training. In general, students with high scores at the beginning will have high scores at the end, regardless of whether such students are in the control group or the experimental group.[1] This relationship may be visualized as a line of relation between initial test scores and final test scores. If this relationship holds true the lines of relation for the two hypothetical groups, based upon the test data, might appear as shown in Figure 3.

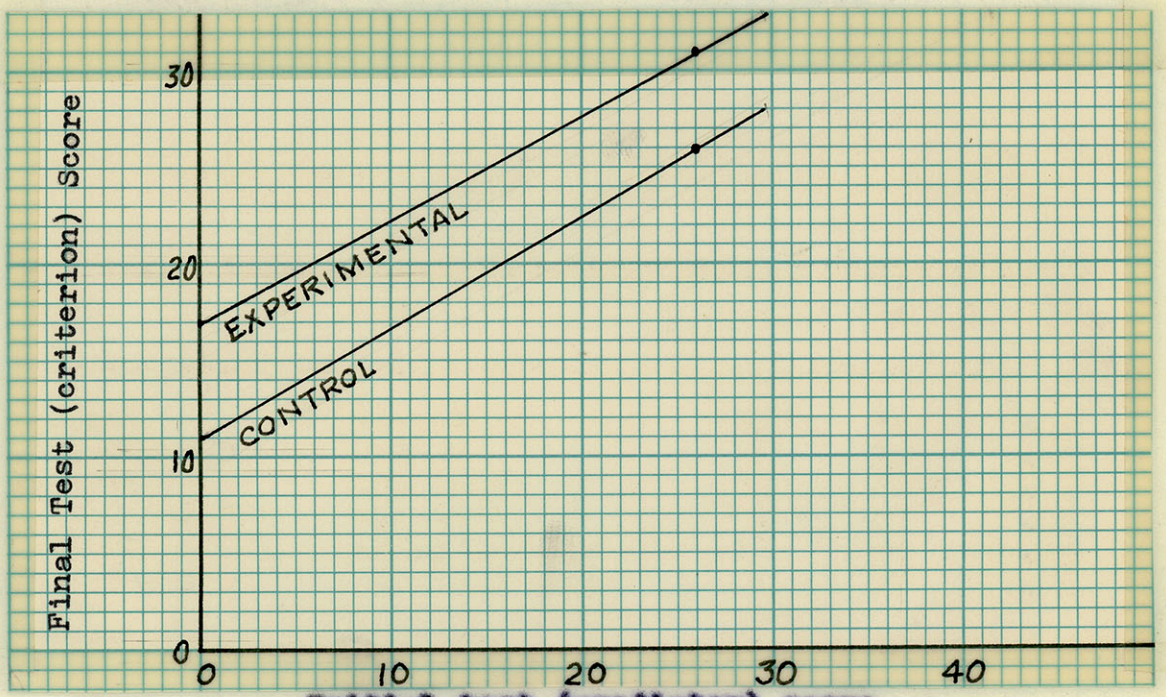


Figure 3

Slopes of the Lines of Relation for the two Hypothetical Groups

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[1]Henry S. Dyer and William B. Schroder, Analysing Results of an Educational Experiment, (New Jersey; Educational Testing Service, 1960), p. 6

If the two lines of relation for these two groups being compared may be regarded as parallel, then the person performing the experiment may measure the vertical distance between the two lines and conclude that one group has done better relative to its ability than has the other group. This difference could then be considered either significant or not significant, depending upon the amount of difference.

In this study the slope of the lines of relation were not regarded as parallel. The lines of relation for this study are shown in Figure 4.

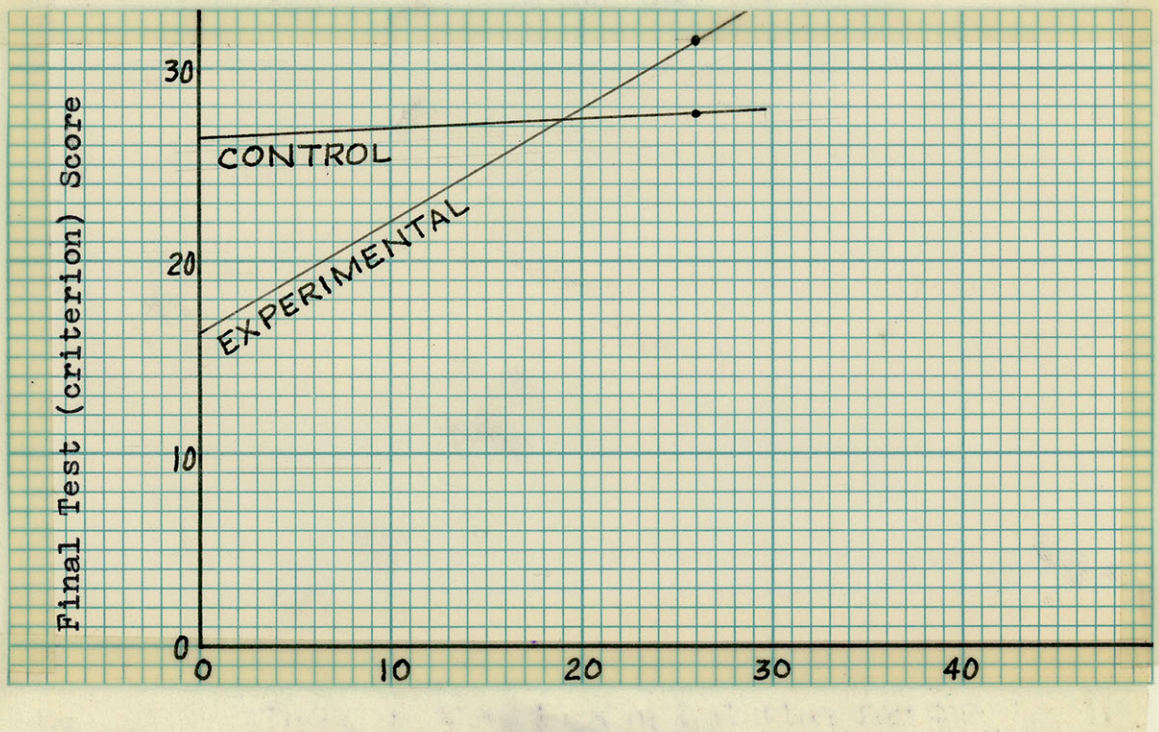


Figure 4

Slopes of the Two Lines of Relation as they Appear in this Study

The slope of one line is noticeably steeper than the slope of the other line. The difference in the slope of the lines of relation indicates that the relative effects of the training were different for different levels of ability, as measured by the initial test. Thus, one particular method of training may have been superior for the high scoring students, but inferior for the low scoring students. It should be noted that results obtained by a more simple method of interpretation would have obscured these two results by merging them into a net result, which would have depended upon the proportion of able and inferior students in the groups studied.[2]

## Summary

Analysis of covariance was used to interpret the results of this experimental study. Analysis of covariance is considered to be a sound method of analyzing educational experimental data. The results of this study indicate that there is a noticeable difference in the slope of the two lines of relation for the two groups. The interpretation of this difference in the slope of the two lines is that the effects of instruction differ for students of different ability. One cannot make a general statement about any

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[2] Ibid., p. 7

general differences between the control group and the experimental group.

# CHAPTER VI

## FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

### Findings

The findings in this study are based on the calculations in the Analysis of Covariance. Levels of significance for the following hypotheses are shown in Table XIII.

TABLE XIII

LEVELS OF SIGNIFICANCE

| Level of Significance | Minimum Calculated Value |
|---|---|
| 1 Percent | 2.882 |
| 5 Percent | 1.668 |

[1]

Hypothesis (1) There will be no significant difference in the initial ability of the control group over the initial ability of the experimental group.

Accepted. The errors of prediction in the control group did not differ significantly from those in the experimental group. The difference in the study was .2938.

Hypothesis (2) There will be no significant difference in the effects of the training on different ability groups.

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[1]Henry S. Dyer and William B. Schroder, Analyzing Results of an Educational Experiment, (New Jersey; Educational Testing Service, 1960), p. 22

as measured by the pretest.

Rejected. A significant difference was found. The relative effects of the training were different for different levels of ability as measured by the pretest. This difference was found to be 1.8792. One cannot make a general statement about the general difference between the control group and the experimental group.

Hypothesis (3) There will be no significant difference in the gain of factual knowledge in the experimental group over the gain of factual knowledge in the control group.

Null. Due to the different effects of training on different ability groups, it was not possible to draw a valid conclusion about hypothesis three.

Hypothesis (4) There will be no significant difference in the retention of factual knowledge in the experimental group over the retention of factual knowledge in the control group.

Null. Due to the different effects of the training on the different ability groups it was not possible to draw a valid conclusion about hypothesis four.

## Conclusion

The general conclusions that can be drawn from this study are: One, that the ability of the control group was similar to or equal to that of the experimental group as measured by the pretest. Two, the relative effects of

the training were different for different levels of ability as measured by the pretest.

## Recommendations

The following recommendations are made: One, that further study be considered in this area to ascertain which method of training affects which group and in what manner. It is possible that one particular method of teaching would be superior for high scoring students and that another method of teaching would be effective for low scoring students. If this were found to be true, each method could then be applied to the group on which it would have the greatest effect. Two, it is recommended that further studies of the experimental nature be made in the field of Industrial Arts Education in an effort to bring the best methods of instruction to this field.

# APPENDIX A

CONTROL GROUP INDIVIDUAL TEST SCORES FOR THE PRETEST, GAIN TEST, AND RETENTION TEST

| Student Number | Pre Test | Gain Test | Retention Test | Student Number | Pre Test | Gain Test | Retention Test |
|---|---|---|---|---|---|---|---|
| 1 | 16 | 26 | 32 | 28 | 12 | 34 | 32 |
| 2 | 20 | 16 | 20 | 29 | 12 | 30 | 26 |
| 3 | 26 | 32 | 32 | 30 | 12 | 28 | 20 |
| 4 | 14 | 30 | 22 | 31 | 24 | 32 | 32 |
| 5 | 18 | 14 | 28 | 32 | 6 | 28 | 22 |
| 6 | 16 | 18 | 26 | 33 | 16 | 32 | 30 |
| 7 | 18 | 30 | 32 | 34 | 26 | 28 | 30 |
| 8 | 8 | 26 | 22 | 35 | 18 | 34 | 32 |
| 9 | 8 | 32 | 32 | 36 | 6 | 28 | 10 |
| 10 | 12 | 30 | 30 | 37 | 22 | 34 | 32 |
| 11 | 16 | 32 | 26 | 38 | 12 | 10 | 14 |
| 12 | 10 | 24 | 26 | 39 | 14 | 34 | 32 |
| 13 | 16 | 32 | 32 | 40 | 10 | 28 | 26 |
| 14 | 14 | 26 | 26 | 41 | 10 | 31 | 36 |
| 15 | 16 | 24 | 30 | 42 | 12 | 28 | 30 |
| 16 | 18 | 16 | 26 | 43 | 18 | 28 | 34 |
| 17 | 22 | 34 | 32 | 44 | 6 | 36 | 22 |
| 18 | 14 | 32 | 30 | 45 | 18 | 24 | 28 |
| 19 | 18 | 28 | 16 | 46 | 12 | 28 | 30 |
| 20 | 12 | 18 | 22 | 47 | 12 | 32 | 26 |
| 21 | 4 | 20 | 22 | 48 | 10 | 26 | 32 |
| 22 | 14 | 32 | 28 | 49 | 16 | 28 | 26 |
| 23 | 16 | 12 | 16 | 50 | 16 | 28 | 28 |
| 24 | 10 | 26 | 26 | 51 | 14 | 26 | 32 |
| 25 | 14 | 24 | 28 | 52 | 14 | 30 | 20 |
| 26 | 6 | 28 | 24 | 53 | 16 | 24 | 20 |
| 27 | 16 | 26 | 24 | | | | |

EXPERIMENTAL GROUP INDIVIDUAL TESTING SCORES FOR THE PRETEST, GAIN TEST, AND RETENTION TEST

| Student Number | Pre Test | Gain Test | Retention Test | Student Number | Pre Test | Gain Test | Retention Test |
|---|---|---|---|---|---|---|---|
| 1 | 14 | 32 | 34 | 29 | 16 | 24 | 28 |
| 2 | 8 | 24 | 22 | 30 | 10 | 28 | 6 |
| 3 | 10 | 10 | 24 | 31 | 16 | 14 | 24 |
| 4 | 20 | 32 | 28 | 32 | 14 | 14 | 18 |
| 5 | 10 | 10 | 8 | 33 | 12 | 28 | 20 |
| 6 | 16 | 22 | 24 | 34 | 18 | 32 | 30 |
| 7 | 8 | 26 | 26 | 35 | 12 | 30 | 28 |
| 8 | 22 | 30 | 22 | 36 | 18 | 34 | 32 |
| 9 | 14 | 12 | 8 | 37 | 6 | 26 | 22 |
| 10 | 14 | 22 | 28 | 38 | 18 | 32 | 32 |
| 11 | 12 | 24 | 30 | 39 | 12 | 24 | 22 |
| 12 | 2 | 16 | 12 | 40 | 2 | 16 | 14 |
| 13 | 14 | 16 | 20 | 41 | 30 | 34 | 34 |
| 14 | 16 | 20 | 26 | 42 | 18 | 28 | 34 |
| 15 | 16 | 26 | 26 | 43 | 14 | 12 | 18 |
| 16 | 12 | 24 | 32 | 44 | 18 | 26 | 20 |
| 17 | 12 | 24 | 12 | 45 | 2 | 28 | 24 |
| 18 | 8 | 16 | 10 | 46 | 10 | 30 | 30 |
| 19 | 8 | 22 | 24 | 47 | 14 | 28 | 36 |
| 20 | 10 | 20 | 14 | 48 | 12 | 22 | 16 |
| 21 | 8 | 22 | 28 | 49 | 6 | 28 | 22 |
| 22 | 12 | 34 | 36 | 50 | 18 | 34 | 34 |
| 23 | 14 | 28 | 36 | 51 | 12 | 16 | 18 |
| 24 | 10 | 30 | 30 | 52 | 12 | 26 | 28 |
| 25 | 14 | 26 | 22 | 53 | 12 | 28 | 24 |
| 26 | 8 | 8 | 20 | 54 | 8 | 10 | 10 |
| 27 | 10 | 24 | 24 | 55 | 12 | 34 | 34 |
| 28 | 18 | 34 | 28 | | | | |

# APPENDIX B

# ABRASIVE TEST

Total Score _____ Last Name First _____

Read all directions thoroughly before answering the questions on each unit. Write your name on this test paper. If you do not have a pen or pencil raise your hand.

## ALTERNATE RESPONSE

Place a + in the blank provided if the answer is true. Place a 0 in the blank if the answer is false. This section will be scored right minus wrong. If you do not know the answer do not guess.

____ 1. Sand is used to make sandpaper.

____ 2. End grain should be sanded in only one direction to obtain a smooth finish.

____ 3. Sandpaper, emery wheels, oil stones, and rubber stones are all considered abrasives of one type or another.

____ 4. Sanding is the process of smoothing a soft material with a harder material which grinds away and wears down the softer surface.

____ 5. Always sand across grain to obtain the smoothest finish.

This section is worth a total of 20 points, 2 points for each question. Right minus wrong.

Score _____

## MATCHING

Match the best answer in the right column with the words in the left column. Put the proper letter in the blank.

| | | | |
|---|---|---|---|
| ____ 1. | Garnet | A. | Most expensive |
| ____ 2. | Silicon Carbide | B. | A natural abrasive |
| ____ 3. | Least expensive | C. | Made from bauxite ore |
| ____ 4. | Aluminum oxide | D. | Used mainly for metal |
| | | E. | Flint |

# OBJECTIVE TEST KEY

**Alternate Response** — **Total Possible 10**

| | |
|---|---|
| 0 1. | |
| + 2. | |
| + 3. | |
| + 4. | |
| 0 5. | |

| Number Missed | Score |
|---|---|
| 0 | 10 |
| 1 | 6 |
| 2 | 2 |
| 3 | 0 |

**Matching** — **Total Possible 8**

| | |
|---|---|
| b 1. | |
| d 2. | |
| e 3. | |
| c 4. | |

| Number Missed | Score |
|---|---|
| 0 | 8 |
| 1 | 6 |
| 2 | 4 |
| 3 | 2 |
| 4 | 0 |

**Multiple Choice** — **Total Possible 8**

| | |
|---|---|
| d 1. | |
| c 2. | |
| a 3. | |
| d 4. | |

| Number Missed | Score |
|---|---|
| 0 | 8 |
| 1 | 6 |
| 2 | 4 |
| 3 | 2 |
| 4 | 0 |

**Completion** — **Total Possible 10**

| | |
|---|---|
| Sandpaper | 1. |
| four | 2. |
| glueing | 3. |
| coarse to fine | 4. |
| Rough to smooth | |

| Number Missed | Score |
|---|---|
| 0 | 10 |
| 1 | 8 |
| 2 | 6 |
| 3 | 4 |
| 4 | 2 |
| 5 | 0 |

# OBJECTIVE TEST KEY

**Alternate Response** — **Total Possible 10**

| | |
|---|---|
| 0 1. | |
| + 2. | |
| + 3. | |
| + 4. | |
| 0 5. | |

| Number Missed | Score |
|---|---|
| 0 | 10 |
| 1 | 6 |
| 2 | 2 |
| 3 | 0 |

**Matching** — **Total Possible 8**

| | |
|---|---|
| b 1. | |
| d 2. | |
| e 3. | |
| c 4. | |

| Number Missed | Score |
|---|---|
| 0 | 8 |
| 1 | 6 |
| 2 | 4 |
| 3 | 2 |
| 4 | 0 |

**Multiple Choice** — **Total Possible 8**

| | |
|---|---|
| d 1. | |
| c 2. | |
| a 3. | |
| d 4. | |

| Number Missed | Score |
|---|---|
| 0 | 8 |
| 1 | 6 |
| 2 | 4 |
| 3 | 2 |
| 4 | 0 |

**Completion** — **Total Possible 10**

| | |
|---|---|
| Sandpaper | 1. |
| four | 2. |
| glueing | 3. |
| coarse to fine | 4. |
| Rough to smooth | |

| Number Missed | Score |
|---|---|
| 0 | 10 |
| 1 | 8 |
| 2 | 6 |
| 3 | 4 |
| 4 | 2 |
| 5 | 0 |

# APPENDIX C.

# ABRASIVE PAPER

## Introduction

"Sandpaper" is a general term used when referring to coated abrasive material, cloth or paper. This is a misleading term. Sand grains are round and smooth whereas natural and manufactured abrasive grits are tiny sharp pieces of hard crushed rock or other material.

## Why do we sand?

Sanding is the process of smoothing a soft material with a harder material which grinds and wears away the softer material. When we sand, we erase all the machine and tool marks left by previous smoothing operations.

We sand in preparation for applying a protective finish to the wood.

## When do we sand?

Sanding should take place as the last operation before applying our first coat of finish to the wood. In some cases we sand before assembling and then smooth any rough areas after assembling.

Sandpaper is not meant to take the place of a plane, chisel, or scraper. Too often students start sanding before a surface has been thoroughly planed and scraped and then quit sanding before a properly smoothed surface is obtained.

Remember that after the finish is applied to the wood surface, any imperfections in the surface will be magnified by the finish.

## How to sand

1. When possible use a sanding block which has a felt or rubber cushion.

2. Tear full sheets into 4 equal parts, do this by folding the paper into quarters, creasing it on the smooth side with your finger and then unfolding it and tearing it against a straight edge along the folds.

3. Start with a coarse grit and work down to a fine grit. Do not jump more than 2 "aught numbers" at a time. Before changing paper make sure that you have removed all previous sanding marks.

4. Sand with the grain; cross grain scratches are hard to remove and tend to show up under the finish.

5. Sand end grain in one direction only. This will give a smoother surface than if you go in both directions.

6. Cut sanding blocks out of scrap materials to fit irregular surfaces.

7. When sanding small pieces, hold the sanding block in a vise and move the pieces over it.

## Terms and definitions

1. Abrasive - - - - - - - A material when rubbed against another material wears down or polishes the latter.

2. Coated abrasives - - Produced by glueing abrasive grit to a cloth or paper backing.

3. Sanding - - - - - - - The process of cutting the wood fibers with an abrasive; the purpose is to prepare the surface for finishing.

4. Quire - - - - - - - - 24 sheets of sandpaper.

5. Grit - - - - - - - - Natural or manufactured abrasive materials; also used as a grading designation for some abrasive paper.

I Flint

A. Material

Quartz, a natural abrasive material mined or quarried in many parts of the United States.

B. Color

Grayish white

C. Cost

Least expensive

D. Hardness (0 - 10 scale)

Number 6

E. Use

Paint removal

F. Grade

1. Rough 3 - 1 1/2
2. Finish 1/2 - 1/10

II Garnet

A. Material

A natural abrasive mined or quarried in the Adirondack Mountains in the United States.

B. Color

Reddish brown

C. Cost

More expensive than flint

D. Hardness (0 - 10 scale)

Number 7

E. Use

Hardwood, softwood, composition board, horn, cork, plastic.

F. Grade

1. Rough

a. hardwood 2 1/2 - 1 1/2
b. softwood 1 1/2 - 1
c. composition board 1 1/2 - 1
d. horn 1 1/2
e. cork 3
f. plastic 50 - 80

2. Finish

a. hardwood 1/2 - 1/10
b. softwood 1/10
c. composition board 1/2
d. horn 1/2 - 1/10
e. cork 1
f. plastic 120 - 180

3. Fine

a. hardwood 2/0 - 3/0
b. softwood 2/0
c. composition board 1/10
d. horn 2/0 - 3/0
e. cork 1/ - 0
f. plastic 240

III Aluminum Oxide

A. Material

An artificially manufactured abrasive made from bauxite ore. A highly aluminous clay.

B. Color

Brown to tan in the finer grades

C. Cost

More expensive than either of the two natural materials

D. Hardness (0 - 10 scale)

Number 9

E. Use

Hardwood, aluminum, bakelite, copper, cork, fiber, ivory, plastic, steel.

F. Grade

1. Rough

a. hardwood 2 1/2 - 1 1/2
b. aluminum 40
c. bakelite 36 - 40
d. copper 40 - 50
e. cork 3
f. fiber 36
g. ivory 60 - 80
h. plastic 50 - 80
i. steel 24 - 30

2. Finish

a. hardwood 1/2 - 1/10
b. aluminum 60 - 80
c. bakelite 60 - 8-
d. copper 80 - 100
e. cork 1
f. fiber 60 - 80
g. ivory 100 - 120
h. plastic 120 - 180
i. steel 60 - 80

3. Fine

a. hardwood 2/0 - 3/0
b. aluminum 100
c. bakelite 100
d. copper 100 - 120
e. cork 1 - 0
f. fiber 100
g. ivory 120 - 260
h. plastic 240
i. steel 100

IV Silicon Carbide

A. Material

An artificially manufactured abrasive made by fusing silica sand and coke.

B. Color

Gray, green, or black

C. Cost

Most expensive

D. Hardness (0 - 10 scale)

Number 10

E. Use

Cast brass, glass, cast iron

F. Grade

1. Rough

a. cast brass 36 - 40
b. glass 50 - 60
c. cast iron 24 - 30

2. Finish

a. cast brass 60 - 80
b. glass 100 - 120
c. cast iron 60 - 80

3. Fine

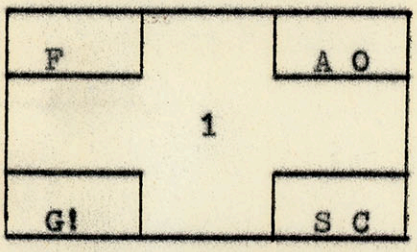
a. cast brass 80 - 120
b. glass 120 - 230
c. cast iron 100

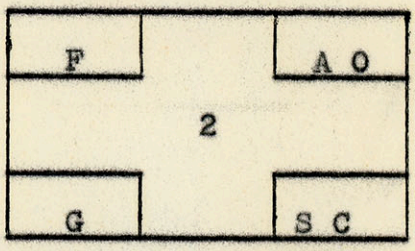
# APPENDIX D.

ABRASIVE WEAR TEST
(Bench One and Two)

A. Experimental procedure

1. Each boy take the assigned abrasive cloth or paper and corresponding block of wood or plastic.




2. Flint and garnet use wood block samples. Aluminum oxide and silicon carbide use plastic block samples.

3. Sand contionuously for five minutes. Check time by the clock.

B. Record results

1. Compare the used paper with samples of new paper and estimate the wear which has occurred and record results.

| Bench One | | | | Bench Two | | | |
|---|---|---|---|---|---|---|---|
| Type of Paper | Sharp | Medium | Dull | Type of Paper | Sharp | Medium | Dull |
| Flint | | | | Flint | | | |
| Garnet | | | | Garnet | | | |
| Aluminum oxide | | | | Aluminum oxide | | | |
| Silicon carbide | | | | Silicon carbide | | | |

C. Conclusion

1. Which abrasive would you recommend for use in the shop for sanding wood? (circle one) Flint Garnet

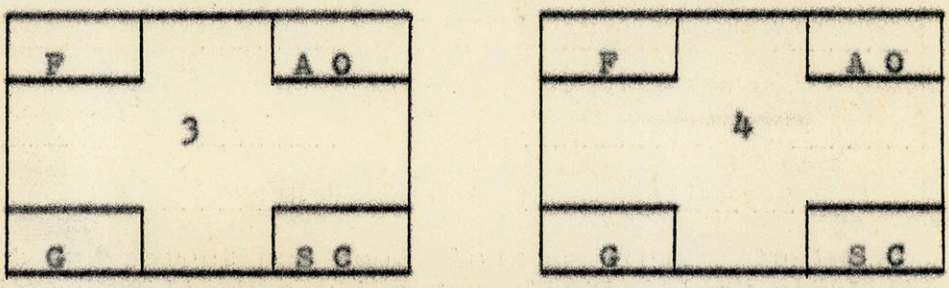
2. Which paper would you recommend for use on plastic? (circle one) Silicon carbide Aluminum oxide

# ABRASIVE CUTTING TEST

## (Bench Three and Four)

A. Experimental procedure.

1. Each boy take the assigned abrasive cloth or paper and corresponding block of wood or plastic.




2. Flint and Garnet use wood block samples. Aluminum oxide and Silicon Carbide use plastic wood samples.

3. Weigh each sample before starting. Record weight.

4. Sand briskly for five minutes. Check time by the clock.

5. Weigh each sample at the end of sanding time.

B. Record results.

| Bench Three | | | Bench Four | | |
|---|---|---|---|---|---|
| Type of Paper | Weight | | Type of Paper | Weight | |
| | Before | After | | Before | After |
| Flint | | | Flint | | |
| Garnet | | | Garnet | | |
| Aluminum Oxide | | | Aluminum Oxide | | |
| Silicon Carbide | | | Silicon Carbide | | |

C. Conclusions

1. Which abrasive would you recommend for use in the shop on wood? (circle one) Flint Garnet

2. Which abrasive would you recommend for use on plastic? (circle one) Flint Garnet

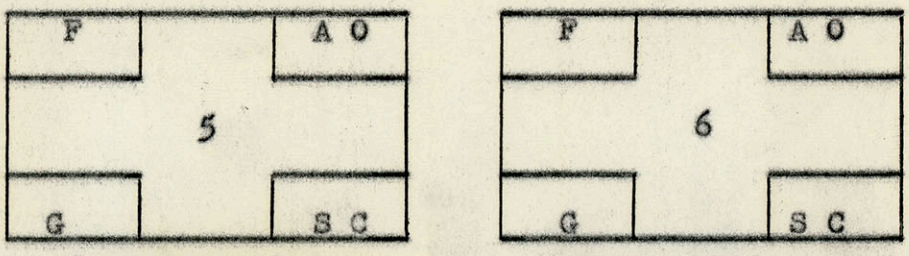
3. Which abrasive would you recommend for use on plastic? Silicon Carbide Aluminum Oxide.

# MOISTURE RESISTANCE TEST

(Bench Five and Six)

A. Experimental procedure

1. Each boy, take the assigned sample of abrasive cloth or paper.




(Water Test) (Rubbing Oil Test )

2. Dip samples into the pans provided for five minutes. Check time by the clock.

3. Rub each sample on the wood block provided.

B. Record results

| Bench Five-Water Test | | | | Bench Six-Rubbing Oil Test | | | |
|---|---|---|---|---|---|---|---|
| Type of Paper | Resistance Total | Some | None | Type of Paper | Resistance Total | Some | None |
| Flint | | | | Flint | | | |
| Garnet | | | | Garnet | | | |
| Aluminum Oxide | | | | Aluminum Oxide | | | |
| Silicon Carbide | | | | Silicon Carbide | | | |

C. Conclusions

1. Which abrasive paper or cloth would you recommend for use with water? A_____ B_____ C_____

2. Which abrasive paper or cloth would you recommend for use with rubbing oil? A_____ B_____ C_____

3. Which abrasive paper or cloth is strictly for dry sanding? A_____ B_____ C_____

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