1971

An Experimental Study of the Effectiveness of Two Instructional Devices: The Student Study Guide and the Project Model

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An Experimental Study of the Effectiveness of Two Instructional Devices: The Student Study Guide and the Project Model

(TITLE)

BY

Larry D. Johnson

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

Master of Science in Education

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY

CHARLESTON, ILLINOIS

1971

YEAR

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ACKNOWLEDGEMENTS

The writer wishes to express his gratitude to his advisor, Dr. R. B. Sonderman for his guidance and counsel during the study.

Appreciation is extended to Dr. Ming Land, Mr. James Tammen and Dr. Sonderman for their assistance in evaluating the student projects involved in the study.

The writer wishes to thank Dr. Wayne D. Coleman, who aided in the tabulation of statistics used in the study.

The writer is also grateful to the following persons from the Urbana Public Schools who made conducting the study possible: Mr. John Garth, Director of Vocational and Industrial Education, and Dr. Roger B. Marcum, Principal.

Chapter 1

INTRODUCTION

ORIENTATION TO THE PROBLEM

This study was undertaken because of the author's interest in the use of two instructional devices; the student study guide and the project model. In teaching industrial arts, the writer observed that the use of these aids appeared to aid in the retention of information and also improve the grasp of manipulative techniques and applications.

Ralph Gallington and J. W. Giachino (1961) stated about teaching devices in general:

> "Instructional aids are considered extremely valuable because they clarify verbal explanations, demonstrate principles which otherwise are often difficult to visualize, and add realism and interest to learning situations."[1]

If this statement were true and the author's observations were correct, then it is still not clear to what extent the two specific devices add to the student's learning, and if the benefits can be judged and shown accurately. Therefore, the primary interest of the author was to determine the merit of making the student study guide and the project model

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[1] J. W. Giachino and Ralph Gallington, Course Construction in Industrial Arts and Vocational Education (Chicago: American Technical Society, 1961), p. 161.

an integral part of the total teaching content.

STATEMENT OF THE PURPOSE AND HYPOTHESES

The purpose of this study was to investigate the effect of two instructional devices and to ascertain whether the teaching of industrial arts could be improved with their use. The study was designed to measure the effect of the student study guide and the project model on achievement of both informational content and manipulative techniques.

The following null hypotheses were assumed in investigating the problem:

1. There is no significant difference in informational content achievement at the .05 level in eighth grade industrial arts between those students taught with the student study guide and those taught by the traditional teacher presentation method.

2. There is no significant difference in the achievement of manipulative content at the .05 level in eighth grade industrial arts between those students taught with the project model and those taught by the traditional teacher presentation method.

DEFINITIONS OF TERMS

Instructional devices, synonymously known as teaching devices or instructional aids, are equipment employed by the instructor to aid in the presentation or management of instruction and to help facilitate student learning. Teaching aids should not be confused with methods or techniques of teaching.

Teaching methods are the manners in which specific instruction is presented. Examples of methods of teaching are the project method, demonstration method, testing method, problem solving method, assignment method, and the lecture or discussion method. Teaching of any one unit of instruction usually involves a combination of methods.

Technique of teaching is the manner of the teacher's performance, or procedures used by the instructor in presenting instruction through various teaching methods.

A student study guide or student syllabus functions as a presentation to the student of progressive selected and organised learning experiences. The syllabus is not used as a replacement for a textbook, but as a complementary aid to the prescribed reading.

A project model is a full siae mock-up of the project. For use in this study the model consisted of the properly formed parts ready for finishing and assembly.

The project method of instruction is one of the often used methods of teaching in industrial education. It refers to the use of a student project to provide learning experiences in the laboratory for the student.

The traditional teacher presentation method of teaching refers to presenting information mainly through the use of reading assignments, classroom discussion and lecture with the aid of a chalkboard. Presentation of manipulative content involves the above techniques and also demonstrations of procedure by the instructor.

Pre-test and post-test are terms used to identify the objective type of test which was taken by the study groups prior to and after the course instruction of the experiment. The pre-test was used as a measure of initial status or that knowledge which the student possessed prior to the experiment. The post-test was used in judging the informational content achievement of the subjects.

A project rating scale was used to evaluate the student projects completed in the study. The ratings were used as the measure of manipulative technique achievement by the subjects.

Significance. For this study, the acceptance of a hypothesis requires that the average difference be significant at the .05 level, meaning that the difference may be attributed to chance less than five per cent of the time.

STATEMENT OF LIMITATIONS

The subjects used in the present study were students enrolled at Urbana Junior High School in Urbana, Illinois. There were a total of fifty-five eighth grade boys in four sections of industrial arts. Four other sections of eighth grade industrial arts were offered by the school but because of differences in level of ability, scheduling difficulties or previous exposure to woodworking, these groups were not used in the study. The four intact sections, each comprising a scheduled class in industrial arts general shop, were randomly assigned to two test groups.

This included the assigning of all students who were members of a particular class into the same test group.

The results of students who had had previous instruction in industrial arts woodworking were deleted from the study because the experiment design required that all subjects be as naive to the course content as possible. A second requirement which placed a limit on the final number of subjects, was that all students had to be present at a pre-testing session, a post-testing session and must have completed the assigned individual project.

As stated previously, two study groups labeled A and B were selected for the experiment subjects. One group of students, A, was presented the informational content with the aid of the student syllabus; but the presentation of manipulative techniques was not aided by a project model. Study group B was taught minus the use of the student syllabus and with exposure to the project model. Table 1 shows the size of each group and the controlled instructional device tested on that group.

TABLE 1

SIZE AND CONTROLLED INSTRUCTIONAL DEVICES OF STUDY GROUPS

Group	Number of Subjects	Controlled Instructional Device	Controlled Area of Instruction
A	24	Student Study Guide	Informational Content
B	31	Project Model	Manipulative Content

The experiment was planned for a fourteen week course of instruction with subjects who met an average of two and one half class periods a week. Equivalent amounts of time were allowed for informational instruction and manipulative instruction. The writer believed that valid comparisons and conclusions could be made by comparing the achievements of the two study groups.

IMPORTANCE OF THE STUDY

Today's teaching is characterized by an increasing use of all types of instructional devices. Printed, visual, audio, audiovisual and real materials are being used by educators to provide effective learning experiences. These instructional devices add realism to strictly non-verbal, abstract presentations.

The sense of sight has been named the largest source of knowledge.[2] The addition of realism to seeing is brought into the classroom by the use of real objects. According to Giachino, one of the most valuable aids is a model.[3] Additional emphasis to the use of a project model was given by Brown: "The more closely a learning experience approximates the conditions under which a student is to perform as he later uses or demonstrates what he has learned, the more effective and permanent that learning will be."[4]

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[2] G. Harold Silvius and Estell H. Curry, Teaching Successfully The Industrial Arts and Vocational Subjects (Bloomington, Ill.: McKnight & McKnight, 1953), p. 71.

[3] J. W. Giachino and Ralph Gallington, p. 162.

[4] James W. Brown, Richard B. Lewis and Fred Harcleroad, A-V Instruction: Media and Methods (3rd ed.; St. Louis: McGraw-Hill Book Co., 1969), p. 361.

In recent years, research concerning the use of instructional devices has largely concentrated on audiovisual aids such as films and television. Although the Armed Forces and industry widely use models and mock-ups in training programs, they have done little research on their value.

The student study guide has been used by industrial educators as a printed instructional device. One important use of the study guide or syllabus is to correlate the various and diverse informational sources used by the student. According to Giachino, primarily the study guides' function is to assist students to study, to read, or to investigate various categories of information, problems or manipulative activities.[5] As with the project model, little research has been done on the use of the student study guide.

The present investigation has provided additional information on the classroom use of the project model and student study guide as compared to more traditional devices used by the teacher.

[5] Giachino and Gallington, p. 223.

Chapter 2

REVIEW OF LITERATURE

The review of the literature which pertains to the present study can be divided into two parts. The first is a review of literature pertaining to instructional devices; and second, a review of literature on two specific aids: models and the student study guide.

The term instructional devices covers a wide variety of aids used to complement the instructor's method of teaching. Printed, visual, audio, audiovisual and real materials are general divisions of instructional devices. Most recent research concerning these visual aids has dealt with audiovisual devices, particularly films and television. Research related to the use of student guides and the project models has been neglected, although they were among the earliest used forms of instructional devices used in industrial education.

According to Ericson and Seefeld instructional devices are "a physical means used by the teacher for the purpose of strengthening the instruction and making it effective.[1] Silvius and Curry described

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[1]Emmanuel E. Ericson and Kermit Seefeld, Teaching The Industrial Arts (Peoria, Illinois: Chas. A. Bennett Co., Inc., 1960), p. 148.

instructional devices as "devices which the educator uses often during demonstrations or discussions to teach better certain operations or related information".[2] These above definitions of instructional devices include printed matter such as text and reference books, visuals including slides and models, audio-visuals such as films, and equipment such as teaching machines.

One of the major assets of a visual such as a project model is the students' being able to see what he is constructing. The student has a more realistic concept of the project and the manipulative concepts involved in the project's completion than verbal explanation or discussion can give to him. Furthermore, the student may use the model as a guide when he is performing an operation.

During World War II Fryklund developed a manual for the teacher-training staff at the Armoured Force School in which he identified these values of instructional devices. "They: (1) broaden the sensory experience of the learner, (2) strengthen vital images, (3) give experiences not available in the shop or classroom, (4) add variety to student activities, (5) reinforce learning, (6) develop interest in some specific subject or activity, (7) develop an understanding of a subject in the shortest possible time, (8) assist the slower student in learning, (9) are an aid to other methods of instruction, and (10) show relationships between

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[2] G. Harold Silvius and Estell H. Curry, Teaching Successfully The Industrial Arts and Vocational Subjects (Bloomington: McKnight & McKnight, 1953), p. 73.

lessons, subject and other learning activities, and assist the student to use part experiences in new situations."[3] According to a more recent source, Rose, the values of instructional devices are that they: (1) appeal to the senses, (2) attract and hold attention, and (3) focus the student's attention on the essential elements to be learned at the proper time.[4] Giachino held that instructional devices are valuable because they: (1) clarify verbal explanations, (2) demonstrate principles which otherwise are often difficult to visualise and (3) add realism and interest to learning situations.[5]

Some of the greatest values of instructional devices is in their carrying information which cannot be given by means of a lecture, or in showing some process which is impossible to demonstrate otherwise in the classroom. Most aids which a teacher can use effectively may be constructed in school facilities. Also the device can remain before the student or may be referred to until the subject is mastered, long after spoken words are forgotten.

Rose also gave five factors which make a good instructional divice: (1) simplicity and unity, (2) colorfulness, (3) flexibility, (4)

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[3]Verne C. Fryklund, Teaching Techniques in the Armoured Force School (Fort Knox, Kentucky: Training Department, Armoured Force School, 1943), p. 35.

[4]Homer C. Rose, The Instructor and His Job (Chicago: American Technical Society, 1961), p. 134.

[5]J. W. Giachino and Ralph Gallington, Course Construction in Industrial Arts and Vocational Education (Chicago: American Technical Society, 1961), p. 161.

timeliness, and (5) visibility.[6] It would seem that here Ross was referring to visual aids and was excluding any printed instructional devices.

The Armed Forces was responsible for much of the research in the use of models and mock-ups. However, most of their research was found to be outdated or largely concerned with the preparation and presentation of the devices rather than comparative studies of their effectiveness. Industry recognised the value of models also and incorporated their use into training programs. Like the Armed Services, industry was mainly concerned with the preparation and presentation.

A study on the use of massed film series was made by Wendt and Butts. They tested a series of fifty-four world history films, and found that members of a one-semester class using those films did as well on a final achievement test as a control class using traditional class procedure, without films, for an entire year of study.[7]

Two studies were found which did involve models. Crowder made a study comparing the use of visual slides and assembly models with the use of traditional methods and devices. Crowder's findings showed that initial learning and retention was higher in both high and low intelligence groups.[8] In a study comparing the effectiveness of a

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[6]Rose, p. 136.

[7]Paul R. Wendt and Gordon K. Butts, "Audio-Visual Materials," Review of Educational Research, Vol. XXXII (April, 1962), pp. 141-155.

[8]Gene Arnold Crowder, "Visual Slides and Assembly Models Compared with Conventional Methods in Teaching Industrial Arts" (Unpublished Doctor's dissertation, Texas A & M University, 1968).

model to the use of the chalkboard in teaching atomic structure, Macri found the model called an Atomic Orbital Board superior.[9]

Brown gave several instances where a model was particularly advantageous to learning. They were when: (1) size rules out the use of the real object, (2) a representation of a real thing is so constructed as to highlight essential parts or functions and to eliminate unneeded details, (3) a working model shows the proper relationship between the parts of an object by spacing them out in a breadboard fashion, and (4) a cutaway model provides means of observing the inside of an object under study.[10]

The student study guide serves primarily as an aid to students in reading, studying or investigating various categories of information, problems and manipulative activities. According to Klehm, a course syllabus is a teaching device which presents to the learner selected, organized and progressive learning experiences.[11]

Ericson cited several ways in which student study guides could

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[9] Alfred R. Macri, "A Comparison of the Effectiveness of Two Teaching Methods on the Competence of College Students to Understand Atomic Structures in a One-Semester Course in General Physical Science" (Unpublished Doctor's dissertation, New York University, 1963).

[10] James W. Brown, Richard B. Lewis and Fred Harcleroad, _A-V Instruction: Media and Methods_ (3rd ed.; St. Louis: McGraw-Hill Book Co., 1969), pp. 365-366.

[11] _Guidelines for Industrial Arts Instruction_, Subject Field Series--Bulletin D-Six, Walter A. Klehm, chairman (Springfield, Ill.: Office of Superintendent of Public Instruction, 1964), p. 203.

be used. They were (1) to prepare for a demonstration, (2) to emphasize and follow up oral instruction, (3) to furnish a guide for manipulative processes and (4) to present related sources of information.[12] The course syllabus or student study guide is a device that can be used to present planned daily experiences which contribute to the achievement of course objectives. Moreover, the use of study guides helps the student gain a more comprehensive understanding of the work he is expected to do, because it places in his possession a constant reminder of the general scope of the course.

Giachino classified the purpose of a student study guide as being either informational, investigatory or manipulative.[13] Informational units are designed to help the learner seek certain kinds of information which are essential to the basic comprehension of the course. Investigatory units are designed to help a student perform an experiment or undertake a simple research problem. Manipulative units are prepared to help a pupil study the necessary operations to be performed. Oftentimes, it is convenient to combine these types of units together and possibly have a unit that deals with both informational and manipulative activities.

Giachino separated the construction of a typical student study guide into four divisions. (1) The purpose of each assignment should

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[12] Ericson and Seefeld, p. 153.

[13] Giachino and Gallington, p. 223.

be stated in terms of what the student is expected to learn. (2) A series of pertinent questions can be listed to guide the student's learning. (3) The reference section should present the available sources where the student may find the information needed to answer the listed questions. (4) Where possible, practical application of the material read should be required of the learner.[14]

Although authorities have long advocated the use of instructional devices in aiding the learning process, little research has been completed on their use. This study was made to determine the relative merit of the project model and the student study guide.

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[14]Giachino and Gallington, p. 224.

Chapter 3

THE EXPERIMENT DESIGN

THE TWO METHODS

There were two independent variables in the experiment: the student study guide and the project model. The student study guide was used in the presentation of information while the project model aided in the learning of manipulative techniques. The two instructional devices were applied to separate learning areas during the study and therefore evaluation of their effectiveness remained separate. Both study groups had the identical reading assignments, were exposed to like demonstrations, and were taught following the same course outline and by the same instructor.

The use of the two instructional devices was contrasted to traditional instructional techniques. The traditional techniques of instruction were without the aid of the project model or the student study guide.

DESIGN AND USE OF INSTRUCTIONAL DEVICES

The student study guide was primarily designed and employed according to guidelines given by Giachino and Gallington.[1] The study

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[1] J. W. Giachino and Ralph Gallington, Course Construction in Industrial Arts and Vocational Education (Chicago: American Technical Society, 1961), pp. 223-229.

guide was mainly used in the conveying of information to the student; therefore it was informational in character. The construction of the study guide was divided into four parts: (1) a brief introduction to each unit which stated the purpose, (2) a reference section which listed the sources of information which were available to the student, (3) a study and discussion outline of the material and (4) a series of questions designed to guide the student's learning.

Construction and use of the project model was influenced largely by Silvius and Curry.[2] The project model was the completed parts of the project ready for assembly. The model was constructed full-sise and of identical material used by the students. Measurements of parts were identified clearly in color. The project model was presented to the test group during the planning of the project and was readily accessible to the students during their work. The instructor used the project model as an aid to manipulative instruction when it complemented the clarity and realism of a presentation.

COMPOSITION OF GROUPS

All students were eighth grade boys at Urbana Jr. High School, Urbana, Illinois. Students were placed in the four sections of industrial arts by the registration process. All were naive to industrial arts woodworking and had previously received twelve weeks of instruction in

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[2] G. Harold Silvius and Estell H. Curry, Teaching Successfully The Industrial Arts and Vocational Subjects (Bloomington, Illinois: McKnight & McKnight, 1953), pp. 73-80.

sketching and drawing. The four sections were combined to form two study groups. The study guide group (A) consisted of twenty-four students and the project model group (B) contained thrity-one students. Group A had originally contained two additional subjects and group B had contained one additional subject. A member of the study guide group moved from the district midway through the experiment and the remaining two students did not complete the experiment project in time for their scores to be included in the study.

The experiment groups were given a pre-test, identical to the post-test of information content achievement, as a measure of initial status. The pre-test scores were used primarily as a check on the equality of the experiment groups, and were used to compute the variance in achievement of the groups. The arithmatic mean of the scores of the two groups were 12.75 for the study guide group and 12.16 for the project model group. The two groups were considered equal for the purpose of the experiment.

THE LEARNING TASK

The learning task in the study was both informational and manipulative in character. Woodworking was selected as the area of learning because of the teaching schedule of the writer.

The informational content followed a course outline developed by the writer and approved by the industrial education department of Urbana Community Unit Schools. The course outline lists the topics below:

I. Wood, lumber and forest products

A. Lumber
1. Wood structure and growth
2. Classification of lumber
3. Methods of cutting lumber
4. Methods of drying
5. Moisture content and shrinkage
6. Grades and sizes of lumber

B. The lumbering industry

II. Planning

A. Method of planning
1. Selection
2. Drawing
3. Bill of materials
4. Plan of procedures
5. Necessary tools

B. Measuring and designating size of lumber

III. Layout and roughing-out stock

A. Measurement

B. Layout tools and their use

C. Aids to layout

D. Roughing-out stock
1. Straight cutting with hand saws
2. Cutting curves

E. Introduction to power tools used in roughing-out
1. Portable tools
2. Stationary power tools

IV. Planing and shaping wood to finished size

A. Planes
1. Identification
2. Use of planes

B. Carving and shaping
   1. Use of spokeshave
   2. Files
   3. Surform files

C. Chamfers, bevels and tapers

V. Wood joints and fastening

A. Joining of wood
   1. Common joining
   2. Tools used in cutting joints
   3. Reinforcement devices

VI. Drilling and boring holes

A. Drilling tools

B. Boring tools

C. Power tools

D. Special drilling operations

VII. Adhesives and holding devices

A. Adhesives
   1. White glues
   2. Urea resin
   3. Resocinal resin

VIII. Preparing for a finish and finishing

A. Abrasives and smoothing
   1. Kinds of abrasives
   2. Grades of abrasives
   3. Smoothing of wood

B. Finishing
   1. Purposes of finish
   2. Selection and care of brushes
   3. Wood grain and use of filler
   4. Staining
   5. Application of finishes, and finishing materials

The informational content was presented using a variety of methods excluding the experiment variable; the student study guide. The groups were conditioned equally in regard to use of textbooks, teacher presentations, teacher-student discussions, films and filmstrip presentations.

For purposes of evaluating student achievement in manipulative activities, the individual project method was used in the experiment. The project to be completed was selected from suggestions and ideas of students and instructor. The final selection of the project was determined by votes made by members of the two test groups.

The construction of the individual project involved the following applications:

A. Completion of a plan sheet
B. Layout of dimensions of parts
C. Rough cutting parts to size
D. Shaping parts to finished size
E. Layout and cutting of joints
F. Layout and drilling of holes
G. Smoothing of parts
H. Assembly
I. Application of a finish

Manipulative techniques were also presented as similar as possible in the three groups. Demonstrations of techniques were given as needed by each group and the variance of presentation was held as low as possible. However, as noted, group A completed their work without the aid of a process model of the project.

DESIGN OF INSTRUMENTS

Because of the two independent variables being tested in this experiment, there was a necessity for two separate instruments for measuring achievements. A test for achievement in the informational content of the experiment was needed. Also a test for achievement in manipulative activities was necessary.

The test used in measuring achievement of the informational content of the fourteen week course was designed in accordance with guidelines given by Micheels and Karnes.[3] The achievement test was composed of twenty-five identification items, fifteen sentence-completion items and ten multiple choice items.

A quality rating scale was used in the evaluation of the manipulative achievements of the experiment subjects. The scale was designed in accordance to guidelines suggested by Newkirk and Greene.[4] The items rated by the scale were changes made in the material by the use of tools, fasteners and finishes. In other words, the results of techniques of procedures performed on the material were evaluated. According to Newkirk and Greene, "improvement in the reliability of rating shop projects indicate the desirability of combining the judgments on the different parts of the projects into a complete rating, and having the

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[3]William J. Micheels and M. Ray Karnes, Measuring Educational Achievement (New York: McGraw-Hill Book Co., 1950), pp. 180-193, 256-265.

[4]Louis V. Newkirk and Harry A. Greene, Tests and Measurements in Industrial Education (New York: John Wiley & Sons, Inc., 1935), pp. 151-170.

projects rated by three or more judges."[5]

The reliability of the pooled judgments of expert judges and the reliability of ratings on quality scales have been determined to be high, especially when the ratings of two or more judges are averaged.[6] For these reasons, the rating scale was judged as a reliable instrument in rating student projects and the corresponding manipulative achievement.

METHOD OF COLLECTING EXPERIMENT DATA

The fifty item achievement test was given as a pre-test on the first day of the experiment as a measure of the initial status of the experiment subjects. At the end of the fourteen week experiment period, the achievement test was again given. This time the scores were used as a post-test of achievement in informational content. The post-test scores were used in the computation of the value of the student study guide as an instructional aid in the classroom. In order to assure that the pre-test did not affect the other, only the scores earned were made known to the students.

The seven item rating scale was used at the end of the experiment to evaluate the students' achievement in manipulative activity. Three judges rated the projects on the scale. They rated the quality of each item on a scale of one to ten. The rating was done independently by each judge. The anonymity of the students or the control groups was

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[5]Newkirk and Greene, p. 151.

[6]Newkirk and Greene, pp. 168-169.

insured by identifying the projects randomly by letter.

STATISTICAL TREATMENT OF EXPERIMENTAL DATA

Coefficient of Reliability

The term reliability means the consistency with which a set of test scores measure whatever they do measure.[7] Only one form of the test for measuring informational content achievement was designed for the study, and the available time made it impractical to give the test to groups other than those in the experiment. Consequently, the coefficient of reliability of the test was computed by using the post-test scores of the experiment subjects.

A split-half reliability coefficient, using the Stanley modified formula as explained by Ebel, was computed from the post-test scores. The test was divided into odd-numbered items and even numbered items and scored. The coefficient of correlation between the two subtests was obtained by applying Stanley's modified formula:[8]

$$r = 1 - \frac{D_d2}{D_s2}$$

D_d2 represents the squared difference between the sum of difference scores on the 27 per cent of papers having largest half test dif-

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[7]Robert L. Ebel, Measuring Educational Achievement (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1965), p. 310.

[8]Ebel, pp. 315-316.

ference scores and the sum of difference scores on the 27 per cent of papers having smallest half test difference scores. D_s2 represents the squared difference between the sums of total scores on the 27 per cent of papers having largest total scores and the sum of total scores on the 27 per cent of papers having smallest total scores

The coefficient of correlation derived by the Stanley modified formula is a coefficient of reliability which has been obtained from half-length tests. To obtain an estimate of the reliability of the total test it is necessary to correct the half test correlation by using the Spearman-Brown formula:[9]

$$r_n = \frac{nr_s}{(n-1)r_s+1}$$

r_n = reliability of total test n times as long as a shorter test.

nr_s = n times the reliability of the shorter test.

$(n-1)\ r_s\ 1$ = (n-1) times the reliability of the shorter test, plus one.

The Kuder-Richardson formula 20 reliability was obtained from the formula[10]

$$r = \frac{k}{k-1}\left(1 - \frac{n\sum Q^2 - \sum T^2}{n\sum X^2 - (\sum X)^2}\right)$$

in which:

k is the number of items

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[9]Ebel, pp. 327-328.

[10]Ebel, pp. 328-239.

n is the number of students

Q^2 is the sum of the squares of the k times n individual question scores.

T^2 is the sum of the squares of the k question total scores

X^2 is the sum of the squares of the n student total scores

X is the sum of the n student total scores.

<u>Analysis of Variance</u>

To make an adequate and reliable comparison of the two methods of teaching informational content and the two methods of presenting manipulative information, the statistical procedure of analysis of variance was selected. The statistical procedures were selected on the basis that they best utilized the available data in testing the experimental hypotheses. Because there were two experiment groups, the t distribution was used to test the significance at the five per cent level. The .05 level was selected in order that obtaining a significant difference would not be extremely difficult, yet not allow random differences to be considered true differences.

There were two experimental groups; one of which was subjected to the student study guide in the informational content of the learning task, and the other to the project model in the manipulative content. Both groups were measured prior to instruction by a pre-test, and immediately following the instruction by a post-test. The resultant data was adequate for the analysis of variance concerning the informational content control. Also the manipulative achievement of the two groups was measured by a quality rating scale.

In testing the experiment hypotheses proposed in this study, the procedure of analysis of variance provided a test for the following questions.

1. Was the mean difference in outcome between the two groups on the pre-test and post-test large enough to be significant in measuring informational content achievement?

2. Was the mean difference in outcome between the two groups on the pre-test and quality rating scale large enough to be significant in measuring manipulative content achievement?

Six means were used in the computation of analysis of variance; one for each group on the pre-test, one for each group on the post-test and one for each group on the quality rating scale. By using a combination of subscripts: 1, 2 and 3 respectively for pre-test, post-test and rating scale; and A and B to represent the student study guide group and the project model group respectively, the means were designated as $\overline{M}_{A1}$ $\overline{M}_{B1}$, $\overline{M}_{A2}$, $\overline{M}_{B2}$, $\overline{M}_{A3}$, and $\overline{M}_{B3}$. The possible differences which were applicable to the experiment were identified as follows:[11]

$D_1 = \overline{M}_{A2} - \overline{M}_{A1}$, the change shown by the student study guide group in informational content achievement.

$D_2 = \overline{M}_{B2} - \overline{M}_{B1}$, the change shown by the project model group in informational content achievement.

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[11]Quinn McNemar, Psychological Statistics (4th ed.; New York: John Wiley & Sons, Inc., 1969, pp. 85-87.

$D_3 = \overline{M}_{A3} - \overline{M}_{A1}$, the change shown by the student study guide group in manipulative content achievement.

$D_4 = \overline{M}_{B3} - \overline{M}_{B1}$, the change shown by the project model group in manipulative content achievement.

$D_5 = \overline{M}_{A1} - \overline{M}_{B1}$, the pre-test difference between groups.

$D_6 = \overline{M}_{A2} - \overline{M}_{B2}$, the post-test difference between groups.

$D_7 = \overline{M}_{B3} - \overline{M}_{A3}$, the quality rating scale difference between groups.

It could be assumed that if there was a significant difference between D_5 and D_6 that the intervening experiment had had an effect on informational achievement; however, this comparison would have failed to test the net change. Likewise, a comparison of D_5 and D_7 would have failed to gauge the net shift of manipulative content achievement. The significance of the difference between D_1 and D_2 was tested in order to ascertain the net shift attributed to the student study guide. Also the difference between D_4 and D_3 was computed in order to properly gauge the net change attributed to the project model.

For the small sample situation, $t = D/s_{DD}$, where s_{D_D} is the best estimates of the variance of the standard error of difference. The best possible estimates of the variances of the two groups were needed to compute standard error. For computation of standard error, it must be assumed that the two groups have the same variance, s^2_D. In the instance of finding the significance of difference between D_1 and D_2, the following formula was applied:

$$t = \frac{D}{s_{D_D}} = \frac{M_{D_1} - M_{D_2}}{\sqrt{\frac{S^2_D}{N_A} + \frac{s^2_D}{N_B}}} \quad , \quad (1)$$

where

M_{D_1} = the mean of the differences between the pre-test and the post-test scores of the student study guide group.

M_{D_2} = the mean of the differences between the pre-test and the post-test scores of the project model group.

N_1 = the number of subjects in the student study guide group.

N_2 = the number of subjects in the project model group.

An estimate of the variance common to the two groups, s^2_D, was derived by computing the sum of the scores and the mean of the difference separately for the two groups, then combining these sums, and dividing by the number of degrees of freedom.

$$s^2_D = \frac{\sum(D_a - M_{D_1})^2 + \sum(D_b - M_{D_2})^2}{N_1 + N_2 - 2} \quad , \quad (2)$$

where $D_a = X_{A2} - X_{A1}$ and $D_b = X_{B2} - X_{B1}$ for all students in each group with X as the test score denoted by the subscripts.

In equations (1) and (2), the mean of the differences is equal to the difference between means; therefore, $M_{D1} = \overline{M}_{A2} - \overline{M}_{A1}$ and $M_{D2} = \overline{M}_{B2} - \overline{M}_{B1}$.[12]

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[12]McNemar, pp. 90-93.

Using these formulas, the value of the t ratio was determined with which to test the significance of the differences between changes shown by the two groups on the pre-test and post-test. This method was also used to compute the significance of difference between the changes shown by the two groups on the pre-test and the quality rating scale.

Chapter 4

PRESENTATION AND TREATMENT OF EXPERIMENT DATA

COEFFICIENT OF RELIABILITY

The reliability of the testing instrument used in this study for measuring informational content achievement was determined by calculating the coefficient of reliability for the test. Two methods were used in determining the coefficient of reliability.

Stanley's modified formula required dividing the test into a subtest of odd items and a subtest of even items. The coefficient of correlation indicating the relationship between the scores on the two subtests was .87. This coefficient of correlation was an approximation of the coefficient of reliability of a test one-half the length of the experiment instrument. To provide an estimate of the coefficient of reliability of the full length test, the Spearman-Brown modified formula was applied. The Spearman-Brown modified formula yielded an estimated coefficient of reliability of .92. The coefficient of correlation computed by Stanley's modified formula was lower than the coefficient of reliability, because the reliability of a test is increased by increasing its length.

The Kuder-Richardson formula of obtaining a coefficient of reliability required an item analysis of the testing instrument. This method indicated a coefficient of reliability of .75. The Kuder-Richardson method usually provides a coefficient of reliability that is slightly lower than the split-half method. The difference in the coefficients of reliability yielded by the two methods also indicates that the difficulty of the items in the test was not consistent.[1]

The reliability of the informational content achievement test used in this study was estimated by calculating the coefficient of reliability by two methods. The Spearman-Brown modified formula provided a coefficient of reliability of .92. The Kuder-Richardson formula provided a coefficient of reliability of .75. Of these two coefficients, that yielded by the Kuder-Richardson formula would usually be more accurate due to the use of all the student scores in the computation. Perfect reliability, never obtained in actual practice, would be represented by a coefficient of 1.00. However, a test with a reliability coefficient of .50 or higher is considered useful for research where group performance is being measured.[2] For these reasons, the test instrument used in measuring informational content achievement in this study was judged sufficiently reliable.

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[1]Quinn McNemar, Psychological Statistics (4th ed.; New York: John Wiley and Sons, Inc., 1969), p. 170.

[2]H. H. Remmers, N. L. Gage and J. Francis Rummel, A Practical Introduction to Measurement and Education (New York: Harper and Brothers, 1960), p. 124.

ANALYSIS OF VARIANCE

In order to make an adequate and reliable comparison of the effects of the two instructional devices and the effects of the traditional method of teaching, the statistical procedure of analysis of variance was selected for the treatment of the experiment data. An analysis of variance was used in testing the following hypotheses. The experimental hypotheses were tested at the .05 level of significance. The selection of the .05 level of significance was discussed in Chapter 3 of this paper. For either hypothesis to have been significant at the .05 level, the t ratio would had to have been greater than 2.0525.[3]

<u>Test of Hypothesis 1</u>

Hypothesis 1: There is no significant difference in informational content achievement at the .05 level in eighth grade industrial arts between those students taught with the student study guide and those taught by traditional teacher presentation method.

An analysis of variance was used in comparing the changes in test scores from the pre-test to the post-test shown by the student syllabus group and the project model group. The t distribution was used to test the significance of the difference between the changes of these two groups. The mean scores of the student study guide group were 12.75 on the pre-test and 33.67 on the post-test. The mean scores of the project model group were 12.16 on the pre-test and 26.61 on the

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[3]George A. Ferguson, <u>Statistical Analysis in Psychology and Education</u> (2nd ed.; New York: McGraw-Hill Book Co., 1966), p. 406.

post-test. The difference of the mean pre-test scores for the two groups was .59. The increase in the mean score from the pre-test to the post-test indicates that information content learning did take place. The mean of the change in scores from the pre-test to the post-test was found to be 14.45 for the project model group and 20.92 for the student study guide group. The difference of these two means was found to have a t ratio of .85. This difference wae not significant at the .05 level of significance. Table 2 shows the mean score of each group on the pre-test and on the post-test and the mean change in score from the pre-test to the post-test for each group.

TABLE 2

MEAN SCORES AND CHANGE OF EACH GROUP ON PRE-TEST AND POST-TEST

Group	Mean Score on Pre-test	Mean Score on Post-test	Mean Change
Student Study Guide (A)	12.75	33.67	20.92
Project Model (B)	12.16	26.61	14.45

On the basis of the analysis of variance the null hypothesis was accepted.

Test of Hypothesis 2

Hypothesis 2: There is no significant difference in the achievement of manipulative content at the .05 level in eighth grade industrial arts between those students taught with the project model and those taught by the traditional teacher presentation method.

An analysis of variance was used in comparing the changes in scores from the pre-test to the quality rating scale shown by the project model group and the student study guide group. The t distribution was used to test the significance of the differences between the changes of these two groups. The mean scores of the project model group were 12.16 on the pre-test and 37.82 on the quality rating scale. The mean scores of the student study guide group were 12.75 on the pre-test and 34.15 on the quality rating scale. The mean of the change in scores from the pre-test to the quality rating scale was found to be 25.66 for the project model group and 21.40 for the student study guide group. The difference of these two means was found to have a t ratio of .04. This difference was not significant at the .05 level of significance. Table 3 shows the mean score of each group on the pre-test and on the quality rating scale and the mean change in score from the pre-test to the quality rating scale for each group.

TABLE 3

MEAN SCORES AND CHANGE OF EACH GROUP ON PRE-TEST AND QUALITY RATING SCALE

Group	Mean Score on Pre-test	Mean Score on Quality Rating Scale	Mean Change
Project Model (B)	12.16	37.82	25.66
Student Study Guide (A)	12.75	34.15	21.40

On the basis of the analysis of variance the null hypothesis was accepted.

Summary

An analysis of variance indicated that the null hypotheses in this experiment should be accepted. Both hypotheses were tested at the .05 level of significance, and neither hypothesis was shown to be significant. This would indicate that the student study guide and traditional teaching techniques are equally effective in producing informational content achievement in eighth grade industrial arts. Furthermore, it was indicated that the project model and traditional teaching techniques are equally effective in producing manipulative content achievement in eighth grade industrial arts.

Chapter 5

SUMMATION

SUMMARY

This study was conducted to determine the relative effectiveness of two instructional devices, the student study guide and the project model, as compared to the effect of traditional techniques of teaching eighth grade industrial arts. The experiment research compared the use of traditional techniques of teaching and attempted to determine the relative effectiveness of each on informational content achievement. The study also compared the use of the project model and the use of traditional techniques of teaching and attempted to ascertain the relative effectiveness of each on manipulative content achievement.

The experiment involved fifty-five junior high school boys enrolled in four classes of eighth grade industrial arts at Urbana Junior High School, Urbana, Illinois, during the 1970-1971 school year. The two experiment groups formed from the four sections were considered equal on the basis of their average scores on the pre-test of achievement.

The pre-test was given on the first day of the experiment, prior to any instruction, and was again given immediately following a fourteen week period of instruction as a test of informational content achievement. The reliability of the post-test scores was computed by two methods, the Kuder-Richardson formula and the Spearman-Brown modified formula, and on the basis of the coefficients of reliability derived, the measuring instrument was judged as sufficiently reliable for the study.

Identically planned individual projects were completed by the experiment subjects during the fourteen weeks and these were appraised separately by three impartial evaluators on a quality rating scale. The resultant scores on the quality rating scale were averaged to give reliable statistics for the experiment.

An analysis of variance was used to ascertain the significance of differences in achievement of informational content and achievement of manipulative content between the two study groups. The t distribution was used to test the significance of the differences at the .05 level. Results indicated no significant difference in informational content achievement between that group aided by the student study guide and the group instructed by traditional techniques. The findings also indicated there was no significant difference in manipulative content achievement between the group aided by project model and the group instructed by traditional techniques.

On the basis of these findings, it was concluded that the use of traditional techniques and the use of the student study guide are equally effective on achievement in the teaching of informational content of eighth grade industrial arts. From the findings, it was also concluded that the use of traditional techniques and the use of a project model are equally effective on achievement in the teaching of manipulative content of eighth grade industrial arts.

CONCLUSIONS

All conclusions were based on the population, treatment, tests, and conditions used in the experiment.

1. Instruction in eighth grade industrial arts which uses traditional techniques appears to be just as effective in producing informational content achievement as instruction which uses the student study guide as the major instructional device.

2. Instruction in eighth grade industrial arts which uses traditional techniques appears to be just as effective in producing manipulative content achievement as instruction which uses a project model as the major instructional device.

IMPLICATIONS

The results of the study indicate that the use of the student study guide in the teaching of eighth grade industrial arts has no advantage over the traditional techniques of teaching in the achievement of informational content. Results of the study also indicate that the use of the project model in teaching eighth grade industrial arts has no advantage over traditional techniques in terms of manipulative content achievement. However, on the basis of observations made by the writer during the experiment, it is his opinion that the use of the student study guide is beneficial to the instruction of eighth grade industrial arts. It is his belief that two major assets of the student study guide and the project model are the improvement of classroom management of instruction, and that a definite concept is gained by the student of what he is expected to study.

Since there appears to be no difference in achievement produced by the two instructional devices and traditional techniques, the choice of whether to use the student study guide and the project model as instructional devices may be a practical one of time, money or effort. It should be stated that because only achievement was considered in the study, other areas such as improvement of classroom management and student interest should not be ignored when choosing instructional devices and techniques.

SUGGESTIONS FOR ADDITIONAL RESEARCH

The present study has been of narrow scope. This was necessary in order to reach valid conclusions from the experiment data in the time available. The following suggestions are for additional research in areas related to this study.

1. The use of the student study guide and/or models could be evaluated as to their effect on time necessary for achievement as compared to traditional instruction techniques.

2. The use of a panel showing the steps in completing a project could be evaluated in terms of achievement and time necessary for completion of the procedures.

3. The review of literature and research for this study has shown a need for research into the principles and uses of both the student study guide and project models.

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SELECTED BIBLIOGRAPHY

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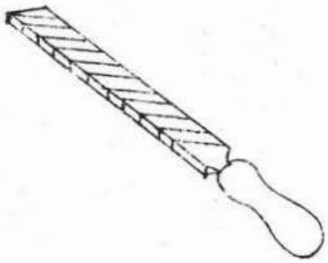
APPENDICES

APPENDIX A

Informational Content Achievement Test

TEST

DIRECTIONS: Shown below are several handtools used in woodworking. You are to write the proper name of the tool in the blank provided.



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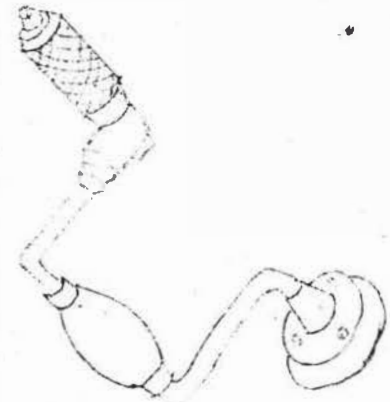

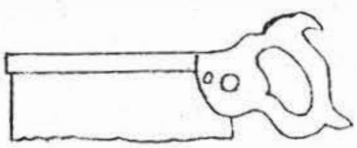

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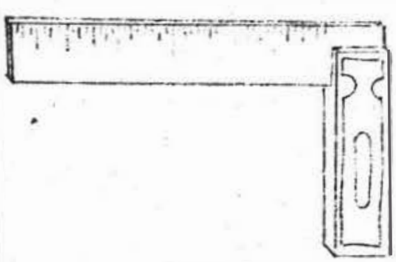

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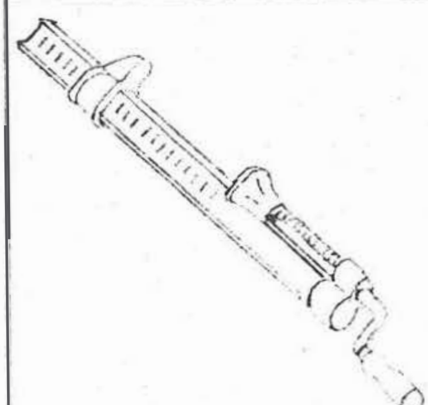

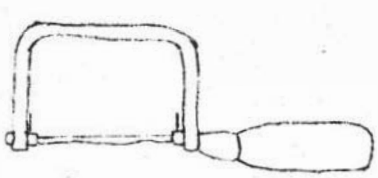

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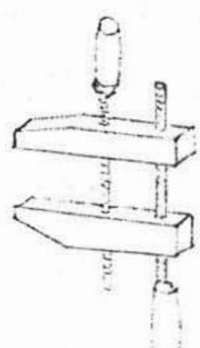

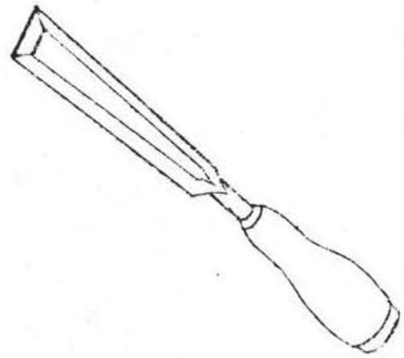

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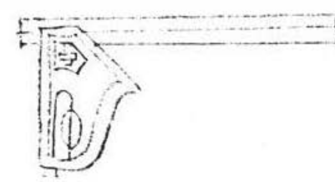

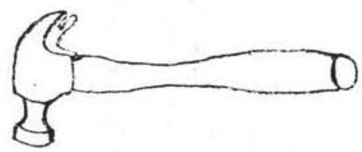

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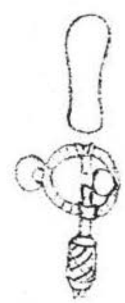

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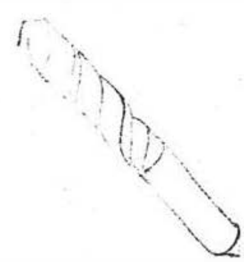

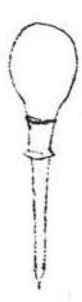

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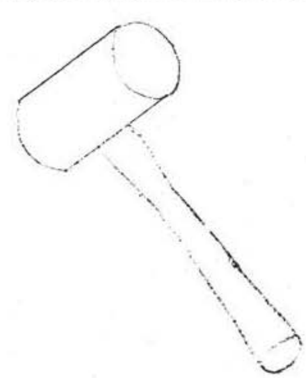

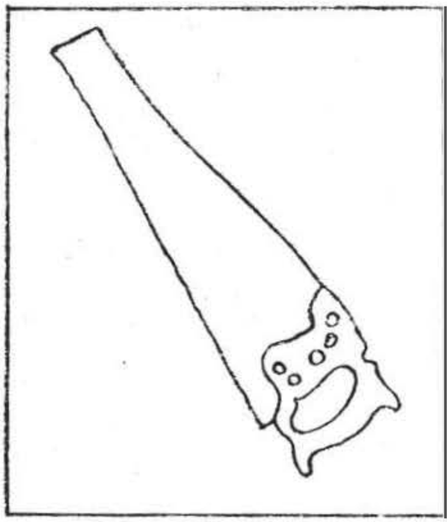

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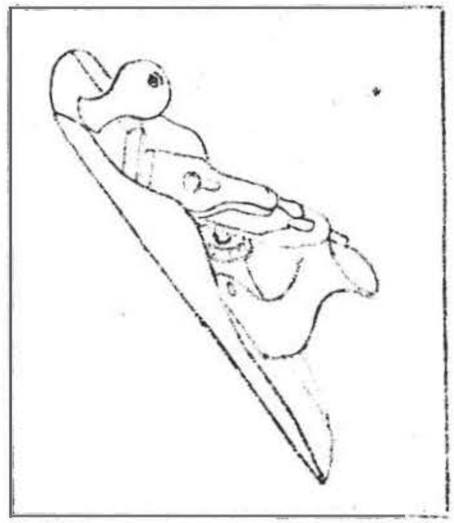
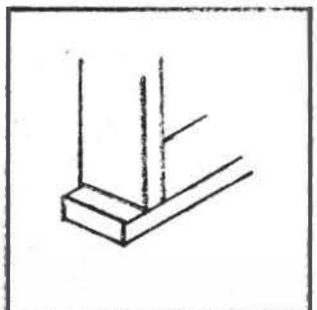


DIRECTIONS: Identify the following wood joints by writing the proper names in the appropriate blank.



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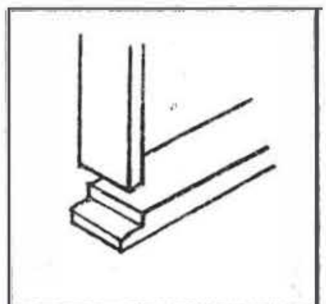

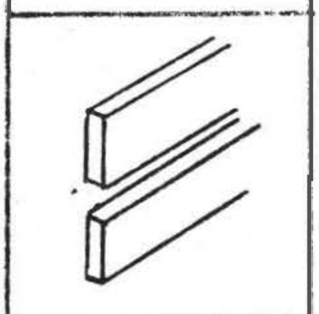

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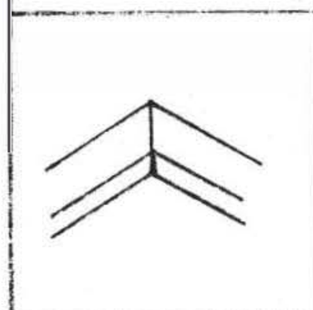

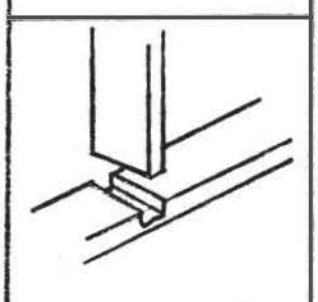

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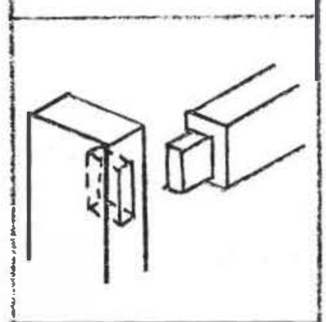

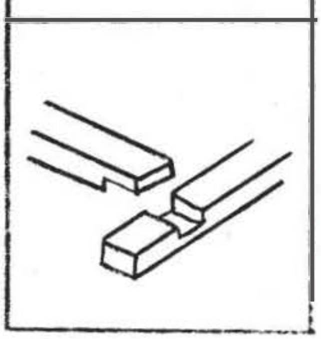

25 ______________________

DIRECTIONS: In the following sentences certain key words are omitted. The omissions are indicated by small blank spaces. Write the word or words that complete the meaning of the sentences in the blank spaces to the left.

_______________ 26 Veneer is cut by either the _____ or the _____

_______________ 27 method.

_______________ 28 Lumber is dried either by _____ or _____

_______________ 29 drying.

_______________ 30 There are two general types of wood: _____

_______________ 31 and _____.

_______________ 32 Lumber is cut from the log by two methods: _____

_______________ 33 sawing and _____ sawing.

_______________ 34 The size of nails is designated by the word _____.

_______________ 35 Wood is also classified as to whether it has _____

_______________ 36 or _____ grain.

_______________ 37 When putting screws in hardwood it is always best to drill a pilot hole and a _____ hole.

_______________ 38 Abrasives that are mined or quarried are called _____ abrasives.

_______________ 39 There are _____ board feet in a piece of lumber that is 1 inch X 12 inches X 5 feet.

_______________ 40 Smoothing of wood should be done in the same direction as the _____.

DIRECTIONS: Each of the questions or incomplete statements listed below is followed by several possible answers. Choose the answer that <u>best</u> answers the question or completes the statement. Place the identifying letter of that answer (A, B, C, or D) in the numbered blank space at the left of the item.

_____ 1. The ripsaw is for cutting

A. across grain
B. wood joints
C. with the grain
D. curved designs

_____ 2. A pattern of wood, metal, plastic or masonite is a

A. layout
B. pattern
C. design
D. template

_____ 3. Sanding of end grain should be done

A. across the edges
B. in one direction only
C. with the grain
D. across grain

_____ 4. Mineral spirits is an oil product used in place of

A. turpentine
B. lacquer
C. alcohol
D. linseed oil

_____ 5. To bore a 3/8 inch diameter hole, you would use a number __?__ auger bit.

A. 3
B. 8
C. 3/8
D. 6

_____ 6. Plywood is constructed of a (an) _?_ number of layers.

A. odd
B. even
C. odd or even
D. seven

_____ 7. Measurements of a piece of wood are listed

A. thickness x width x length
B. thickness x length x width
C. width x length x thickness
D. length x thickness x width

_____ 8. A tool used for checking squareness of a board is

A. ruler
B. try square
C. level
D. dividers

_____ 9. The split or space made by a saw is called the

A. vee
B. line
C. korf
D. cut

_____ 10. The final step to cleaning a brush is to clean in

A. correct thinner
B. turpentine
C. soap and water
D. oil

1. file
2. brace
3. backsaw
4. auger bit
5. try square
6. bar clamp
7. coping saw
8. handscrews
9. chisel
10. combination square
11. claw hammer
12. screw driver
13. hand drill
14. drill (bit)
15. scratch awl
16. mallet
17. handsaw
18. plane
19. butt
20. rabbett
21. edge
22. miter
23. dado
24. mortise and tenon
25. lap
26. rotary
27. slicing
28. air
29. kiln
30. hardwood
31. softwood
32. straight
33. quarter
34. penny
35. open
36. closed
37. shank
38. natural
39. five (5)
40. grain
41. C
42. D
43. B
44. A
45. D
46. A
47. A
48. B
49. C
50. C

APPENDIX B

Individual Project Evaluation Team

INDIVIDUAL PROJECT EVALUATION TEAM

Dr. Ming H. Land, Assistant Professor of Industrial Arts and Technology, Eastern Illinois University, Charleston, Illinois.

Dr. Robert B. Sonderman, Head of the Department of Industrial Arts Education, Eastern Illinois University, Charleston, Illinois.

Mr. James Tammen, Graduate Assistant, Department of Industrial Arts Education, Eastern Illinois University, Charleston, Illinois.

APPENDIX C

Quality Rating Scale

QUALITY RATING SCALE

Rating Scale for Project No. _____

PHYSICAL MEASUREMENT

A. Dimensions	1	2	3	4	5	6	7	8	9	10
B. Squareness	1	2	3	4	5	6	7	8	9	10

INSPECTION

C. Drilling	1	2	3	4	5	6	7	8	9	10
D. Joints	1	2	3	4	5	6	7	8	9	10
E. Smoothing	1	2	3	4	5	6	7	8	9	10
F. Finish	1	2	3	4	5	6	7	8	9	10
G. Finesse	1	2	3	4	5	6	7	8	9	10

TOTAL _____

APPENDIX D

Complete Record of Scores for Subjects

Table 4

Scores for Each Student in Student Study Guide Group

Student	Pre-test (X_{A1})	Post-test (X_{A2})	Rating Scale $\overline{M}(X_{A3})$
1	26	47	47
2	21	30	26.67
3	21	35	29.33
4	18	40	48.33
5	18	42	53
6	17	27	25
7	15	40	40.33
8	13	31	44
9	13	37	35.33
10	13	41	26.33
11	12	34	22
12	12	30	29
13	11	31	38
14	11	30	25
15	11	27	42.67
16	10	32	36.67
17	9	29	25.33
18	9	36	26.67
19	9	31	23.33
20	9	39	30.67
21	9	37	33.33
22	7	29	34
23	6	21	31
24	5	32	36.67

Table 5

Scores for Each Student in Project Model Group

Student	Pre-test (X_{A1})	Post-test (X_{A2})	Rating Scale $\overline{M}(X_{A3})$
25	20	39	33.33
26	17	30	36.67
27	16	32	39.67
28	16	32	40.33
29	16	27	42.33
30	16	32	36.67
31	16	33	39.33
32	16	28	29.67
33	15	39	49.67
34	15	40	61.67
35	14	23	34.33
36	14	31	36
37	13	29	39.67
38	13	22	40.33
39	12	22	39.
40	12	20	33.33
41	12	23	41.33
42	11	23	53.33
43	11	19	46.67
44	11	22	34.33
45	11	27	31
46	10	21	34.67
47	10	24	25.33
48	10	26	38.33
49	9	22	32.67
50	9	22	32.67
51	7	35	29
52	7	24	37.67
53	6	17	27
54	6	26	40
55	6	15	36.67

APPENDIX E

Unit from Student Study Guide

Unit No. 1

WOOD, LUMBER AND FOREST PRODUCTS

It seems right that in briefly examining the field of woodworking, at some point we should examine the growth and production of lumber. The information we cover in this unit will be presented both by discussion and by reading the text.

References:

Read the pages listed below in the textbook assigned.

1. General Shop, Groneman & Ferier, (grey & blue), pages 65 to 78.
2. General Shop, Groneman & Ferier, (red), pages 46 to 58.

Discussion Outline:

A. Lumber

1. Wood structure and growth

2. Classification of lumber
    a. hardwood
    b. softwood
    c. plywood

3. Methods of cutting lumber
    a. plain sawing
    b. quarter-sawing
    c. cutting of veneer

4. Methods of drying
   a. air
   b. kiln

5. Moisture content and shrinkage

6. Grades and sizes of lumber

B. The lumbering industry

1. Cutting and transportation

2. Lumber products

3. Conservation

4. Occupations

Study Questions:

Answer the questions below on an 8 1/2 x 11 sheet of lined paper and hand in. Use both the information from the textbook and the class discussions.

1. How can you find the age of a tree?

2. Which of the two methods of drying lumber is best?

3. What is the most common method of cutting veneer?
   What is the core of plywood?
   What are the faces?

4. Explain the meaning of the following abbreviations or terms.

   A. K D

   B. S 2 S

   C. heartwood

   D. cambium

APPENDIX F

Drawing of Individual Project

INDIVIDUAL PROJECT

Scale 1/4" = 1"