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Career Education: A Third Grade Mass Production Project

Jack Julian Hanson

CAREER EDUCATION: A THIRD GRADE MASS PRODUCTION PROJECT

An Abstract of a Thesis

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Specialist in Education

UNIVERSITY OF NORTHERN IOWA

by

Jack Julian Hanson

August 1973

This study was undertaken to determine if a mass production project could be used as an effective method to acquaint third grade students with the world of work through practical experience and provide information about specialization of labor and industrial organization.

The literature reviewed included three areas concerning career education at the elementary school level: general education, industrial education, and guidance. The writer, a former industrial arts teacher, developed the total teaching unit. The actual instruction was carried out with the support of the teachers and counselors of the participating classes.

The experimental group for the study included six third grade classes with a combined enrollment of 153 students. The control group consisted of two third grade classes with a total of fifty-seven students.

The classes of the experimental group took a pre-test, participated in the instructional unit including a mass production session where coaster sets were produced, and took a post-test. The classes of the control group took part only in the pre-test and the post-test to evaluate the effects of taking the same test twice in a span of fourteen days.

The hypothesis formulated for this investigation was: a mass production project can be used as an effective method to acquaint third grade students with the world of work through practical experience and provide information about specialization of labor and industrial organization.

The hypothesis was accepted. The post-test scores of the experimental group were higher than the pre-test scores and the difference was statistically significant. The control group did not make a significant gain in test scores as a result of participating in the pre-test post-test sequence.

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has been approved as meeting the thesis requirement for the Degree of Specialist in Education

Norman McCumsey

7/20/73
Date

Chairman, Thesis Committee

R. P. Brimm

7/20/73
Date

Member, Thesis Committee

Alvin E. Rudisill

7/20/73
Date

Member, Thesis Committee

Upon recommendation of the Thesis Committee, accepted by

Gordon J. Rhum

Dean of the Graduate College

July 25, 1973
Date

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CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

In recent years there has been an increased awareness of the importance of career education in the public schools. The career education movement across the nation has resulted in many proposals by curriculum planners to include career education in the elementary school programs. Recent literature in the fields of general education, industrial education and educational guidance and counseling bears this out.

The literature reviewed had suggestions for a variety of approaches that can be used when teaching career education at the elementary school level. Some authors expressed the opinion that elementary classroom teachers should include career education in their regular classroom work as an integral part of the curriculum. Others felt that the technical knowledge of industrial education teachers should be utilized at the elementary school level to increase career awareness. Another generally held viewpoint was that the dissemination of career information should be the responsibility of elementary school counselors.

A mass production unit taught by an industrial arts teacher with the support of elementary classroom teachers and elementary school counselors was the basis for this investigation.

I. THE PROBLEM

Statement of the Problem

It was the purpose of this study to ascertain if a mass production project could be used as the basis of an instructional unit that would introduce third grade students to the world of work through practical experience and provide meaningful information about specialization of labor and industrial organization.

Limitations of the Study

The evaluation of the study was based upon the statistical analysis of the gains third grade students made on a teacher constructed test as a result of participating in two formal classroom sessions, the performance of mass production, and culminating activities.

II. DEFINITIONS OF TERMS USED

Career Education

Hoyt's definition of career education is:

> The total effort of public education and the community aimed at helping all individuals to become familiar with the values of a work oriented society, to integrate these values into their personal value systems, and to implement these values into their lives in such a way that work becomes possible, meaningful, and satisfying to each individual.[1]

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[1]Kenneth B. Hoyt and others, *Career Education: What It Is and How to Do It* (Salt Lake City: Olympus Publishing Company, 1972), p. 1.

Industrial Arts for Elementary Students

In outlining the scope of industrial arts for elementary school students Scobey says:

> In the elementary school industrial arts is seldom a phase of vocational education; it does not attempt to develop skills needed in earning a livelihood or to train a pupil for a specific occupation. Occupational training, a facet of vocational education, is found in secondary schools. Industrial arts contributes to this function only as it provides general acquaintance with various industrial fields. The major emphasis for young children is not to teach a method of earning a living but to provide knowledge and skills necessary for a life in a technological society.[2]

Mass Production

The term mass production refers primarily to methods of organizing manufacturing processes to attain high output rates.[3]

The essential elements of mass production are (1) simplification of product; (2) standardization of parts; (3) use of production and machine tools; (4) careful arrangement of workers, machines, and materials in sequence,

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[2]Mary Margaret Scobey, Teaching Children About Technology (Bloomington, Illinois: McKnight and McKnight Publishing Company, 1968), p. 7.

[3]"Mass Production," Encyclopedia Britannica (1969 ed.), V. 14, pp. 1038-1039.

combined with the continuous motion of work; (5) high volume; (6) planning and coordination of all activities relative to production and distribution.[4]

Experimental Group

Those six third grade classes with a combined enrollment of 143 students who took part in the pre-tests, instructional sessions, mass production sessions, culminating activities and post-tests were known throughout the study as the experimental group.

Control Group

Those two third grade classes with a combined enrollment of fifty-seven students who took part in the pre-tests but did not participate in any instructional sessions during the study were known throughout the study as the control group.

III. IMPORTANCE OF THE STUDY

The tremendous expansion in the number and nature of jobs in recent decades has brought about new relationships between man and machine and society and citizen. One of the roles of education is to interpret this system of

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[4]Ford Motor Company, Manufacturing and Engineering Division, "Mass Production," The Encyclopedia Americana (1971 ed.), V. 18, p. 39.

manufacturing and production to all students so they can better understand the role of the worker in our society.[5]

A mass production project appeared to be an effective method to acquaint students with the world of work through practical experience, provide information about careers in industry and develop concepts about industrial organization and processes.

IV. POPULATION FOR THE STUDY

The third grade mass production project was carried out as a part of the "Cultural Explorations Program" of the Waterloo, Iowa, Community Schools. The activities for the "Cultural Explorations Program" took place at the Waterloo Recreation Center.

Participation in the activities of the "Cultural Explorations Program" was optional with the classroom teachers choosing the activities they felt would be the most beneficial to their classes. One guideline for participation in the activities was that classes were paired so that one East Waterloo class participated with one West Waterloo class in any given activity.

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[5]Lee E. Isaacson, Career Information in Counselling and Teaching (Boston: Allyn Bacon, Inc., 1972), pp. 4-5.

Selection of the Experimental Group

At the beginning of each school year all classroom teachers were given a list of the activities that would be included in the "Cultural Explorations Program" and were asked to list their first, second, third, and fourth choices from the activities listed. The schedule of activities open to third grade classes for the 1972-73 school year included fourteen choices other than the mass production project.

Since participation in this project was voluntary only two criteria were established for the selection of the six participating classes:

1. Interest shown by the individual teachers must be high as indicated by the rankings of those choices available.
2. The final selection of classes would need to include three classes from East Waterloo Schools and three classes from West Waterloo Schools.

When choosing from the fifteen choices available thirty-nine of a possible sixty-five teachers indicated an interest in the mass production project. Four East Waterloo teachers listed it as their first or second choice while four West Waterloo teachers listed it as their first choice.

The four East Waterloo classes were reduced to three when it was learned that one of the four was actually a second/third grade combination class.

The four West Waterloo classes under consideration included two classes from one school. One class had the average and above average third grade students while the other had the low achievers. The two teachers and the principal of the school felt that the class containing the low achievers might benefit the most from the project and withdrew the request for the class with the above average achievers which brought the number of West Waterloo classes to three.

The general make up of the classes in the experimental group was:

Two classes from upper middle class socio-economic backgrounds

Two classes from middle class socio-economic backgrounds

One class from lower middle class socio-economic backgrounds

One class from low socio-economic backgrounds

Selection of the Control Group

The purpose for using a control group in this study was to check the possibility of students showing significant gains on the pre-test post-test sequence as a result of becoming familiar with the test.

The three third grade teachers from this writer's school volunteered the services of their students for the study. Two of the three classes were chosen through mutual agreement of the three teachers. The fifty-seven students were representative of our third grade students as each classroom had an even distribution of low, average, and high achievers.

The students of the control group were from predominantly middle to lower middle class socio-economic backgrounds.

CHAPTER II

REVIEW OF THE LITERATURE

Studies in masters theses and doctoral dissertations have not yet extensively investigated the role of career education in elementary schools. No studies located bear direct relationships to all of the concerns of this investigation. However, the recent career education movement across the nation has resulted in new k-12 career education programs being developed and writers from within the various disciplines have been proposing methods for integrating career education into the elementary school curriculum. The review has therefore been organized to provide a background of information pertinent to the roles played by the various disciplines.

I. GENERAL EDUCATION

The classroom teacher should be the primary source of career information and career orientation in the elementary school. Isaacson, an advocate of career education as an integral part of the curriculum, asserts what seems to be a common attitude toward career education in the elementary school:

> With the increased emphasis upon education in recent years and the trend toward acquisition of more education one might assume that there is less need today for career information at the elementary

> level than was true in former years. In actuality, it is more important today than ever before that attention be given to proper use of career information throughout the elementary grades.[1]

Isaacson's philosophical position is that a youngster entering the elementary school is starting on a path that will ultimately determine his participation in the world of work and that his elementary school experiences will influence his course. With the classroom teacher laying the foundation for the educational and occupational development of all of tomorrow's workers the elementary teacher should participate in the vocational choice process by:

1. Providing a broad basic knowledge of the world of work.
2. Developing a healthy attitude toward all forms of work.
3. Developing some understanding of the individual's role in vocational choice and how the process of choice proceeds.
4. Developing the child's self concept.
5. Helping parents to see and accept their role in the development of the youngster.[2]

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[1]Lee E. Isaacson, Career Information in Counselling and Teaching (Boston: Allyn and Bacon, Inc., 1972), pp. 478-479.

[2]Ibid., pp. 478-483.

The classroom teacher should direct her emphasis toward stimulating the youngster's curiosity about jobs and help the developing mind grasp relationships between jobs and between jobs and people. It is not necessary for the elementary teacher to feel that all of the task must be accomplished before the child moves on to another level. When summarizing the role of the classroom teacher Isaacson says:

> In summarizing the broad general goals of career related activities in the elementary classroom, it is important to emphasize that the basic purpose is not to help the child find an occupation. Instead, the basic purpose is to prepare the child for his involvement in a process extending over many years that will, in time, lead him into occupational activities which he will find worthwhile and satisfying. While this goal is slightly apart from the basic objective of the elementary school, it is essentially so pervasive in the total fabric of our society that it cannot be ignored. In fact, attention to activities in this area should increase the effectiveness with which the elementary school pursues its basic goals of general education.[3]

In explaining Seattle's career education program, Hendrick[4] describes the classes in the early grades as being organized to acquaint the younger children with various kinds of workers and the roles they play in the life of the community. Along with the awareness the elementary classes prepare the pupils for the higher level

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[3] Ibid., pp. 484-485.

[4] Vivian Hendrick, "Seattle's Concentration on Careers," The Education Digest, (November, 1971), pp. 34-37.

of manual skills expected of them at the junior high school level. The elementary classes include such practical experiences as baking corn bread to better understand the processing of corn, marketing, cost of ingredients, and comparative prices.

Children in one classroom get to work in the "clock shop" disassembling second hand clocks to investigate their inner workings. Another classroom has a "sewing center" to help children expand their knowledge of fabrics and fractions. A "typing center" is used in another classroom to add practical experience to the study of business occupations. The elementary teachers help their students see practical applications to their day-to-day classroom work and career awareness comes at a time when interests are fluid and can be tested without obligation to make a final career commitment.

Laramore[5] describes the role of the Sonoma County, California, teachers as creative members of curriculum developing teams. Each school in the county is expected to develop its own career education packages. Involvement of teachers in the development of career education packages helps insure implementation in the classrooms. The

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[5]Darryl Laramore, "Career Education Filters Down," American Vocational Journal, (September, 1972), pp. 45-47.

curriculum development teams include counselors, administrators, and career education specialists besides the classroom teachers. The team members learn to draw on one another's creativity in developing career education packages.

Teachers use student interest in specific areas of leisure time activities as the starting point for developing a career education package. The career education specialist is available to help plan a series of activities related to the chosen interest area. The activities generally include interviews employed in related occupations and field trips. The classroom teacher relates her spelling, reading, math, and social studies classes to the interest area.

A challenge to so called general education at the elementary school level is made by Hoyt[6] who claims that elementary school education has not been general at all but has unstated assumptions about the desirability of white collar jobs and so emphasizes skills, knowledge, and attitudes associated with the pursuit of further education ending in white collar jobs. The aim of general education should not be to impose any particular set of work values on any individual, but to see that each individual is exposed to a variety of forms of work so that he can develop an appreciation for those forms of work that exist. At the

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[6]Kenneth B. Hoyt and others, Career Education: What It Is and How to Do It (Salt Lake City: Olympus Publishing Company, 1972), pp. 72-73.

elementary school level an element of awareness of work values should be developed so individuals can integrate work values into their own personal value systems. Two assumptions about career education in the elementary school that Hoyt admits to being controversial although not necessarily undesirable are:

1. The work ethic should be taught to and accepted by all students.
2. All students should make a tentative career choice by the end of kindergarten and should modify or reaffirm this choice periodically throughout the school years.[7]

II. INDUSTRIAL EDUCATION

As students go through the transition from formal education to entry in the work force they generally have knowledge gaps or "blind spots" about such realities as the work place, the importance that their choice or work will have on their lives, and how to cope with their frustrations as workers in today's demanding economy.[8]

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[7] Ibid., p. 74.

[8] Robert L. Darcy, "A Classroom Introduction to the World of Work," Occupational Outlook Quarterly (Vol. 5, No. 4, Winter, 1971), p. 23.

Formal classroom training generally fails to help youngsters bridge the psychological gap from school to employment. Our schools need to develop courses that can help young people develop practical, meaningful, and realistic insights into the nature of work in today's world. To accomplish this goal, Darcy feels that schools need to offer courses of instruction which might be called "world of work" education.

> Broadly speaking such instruction would seek to help students understand the role of work in the economic process as well as in the life of the individual. The program would include exploration of both the economic and noneconomic effects of employment on the worker, as well as information about the various activities in preparation for work.[9]

The entire job of preparing young people for satisfying participation in the labor force would not fall on the "world of work" courses. Other school activities such as guidance and counseling and vocational courses and skill training would continue their important roles.

In a "world of work" course or program students should learn that our economy operates through decisions concerning production and distribution of goods and services. Students should also learn that production is increased by specialization and division of labor, and

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[9] Ibid.

that workers receive wages as payment for contributing to the production process.[10]

A strong case for reordering educational priorities is built by Dobrovolny[11] who feels that thoughtful members of America's educational community have recognized the need to outgrow fixations on academic education and begin preparing students for the technical and skilled occupations that are going begging for lack of prepared workers. This reordering of education priorities should include a more pragmatic preparation of people for the world of work as it exists in this country.

Dobrovolny[12] proposes that all elements of the educational system be redesigned with an attempt made to immediately establish a well articulated total system of career education in which a harmonious, comprehensive relationship would exist between academic education and vocational technical education. Career education, using this blueprint, would be a continuum of information on careers from kindergarten through high school and on into post high school technical education and baccalaureate programs.

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[10] Ibid., p. 24.

[11] Jerry S. Dobrovolny, "Let's Get on With Career Education," Industrial Arts and Vocational Education, (April, 1972), p. 74.

[12] Ibid.

To achieve the stated goals the generalists in education, those who teach academic subjects, would themselves have to be reoriented by acquiring some real world of work experiences so that their teaching would become more relevant.

A somewhat similar view about orienting the curriculum to the eventual entry of students into the world of work was expressed by Jerry C. Olson, assistant superintendent of the Pittsburgh, Pennsylvania, Public Schools, when telling about the shot-in-the-arm needed to revitalize a reeling public school system.

> One approach to structuring career education is to start at the job output level and work backward through post high school, high school, through junior high and into the elementary school. This can, and has been done by job analysis, determining commonalities and spin off points, and clustering, to produce an educational continuum beginning in the elementary schools and continuing through high school and into all walks of the working society.
>
> Concern must be shown for integration of resources, human relationships, structure and self maintenance. Objectives need to be clearly stated, and a vital step is to decide whether the student or teacher has the decision making power relating to each objective.[13]

The major impetus for the present career education movement has come from Dr. Sidney P. Marland, U. S. Commissioner of Education, who has directed that substantial

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[13] "Researchers Discuss Career Education, Performance Goals," American Vocational Education, (February, 1972), p. 25.

amounts of federal funds be made available to school districts to help in the establishment of career education programs. He has outlined his broad, basic philosophy on career education:

> I said in Houston that career training at the secondary level must be accorded the same prestige, the same careful preparation, the same sober planning, the same recognition as the college preparatory curriculum. I still hold this to be an essential and an extremely important component of career education. But I do not speak of career education solely in the sense of job training, as important as that is.
>
> I prefer instead to use career in a much broader connotation--as a stream of continued growth and progress. Career in that sense strongly implies that education can be made to serve all the needs of an American-teaching, to begin with, the skills and refinements of the workaday world, for if we cannot at the minimum prepare a man or a woman to earn a living, our efforts are without worth.[14]

Elementary school students in a number of New York City schools now have the opportunity to get first hand experiences in the world of work under the direction of industrial arts teachers. This was accomplished as the result of an innovative program that allows one industrial arts teacher to serve many elementary buildings during a school year.

The "Elementary Industrial Arts Consultant Program", which is a division of the industrial arts department of

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[14]Sidney P. Marland, "Career Education 300 Days Later," American Vocational Journal, (February, 1972), pp. 14-15.

the New York City Board of Education, has developed and put into use trailers equipped to teach shop courses that are moved between elementary schools in New York City. In explaining the purpose of the mobile classrooms Herb Siegel, Director of Industrial Arts, states:

> Hopefully there will be kids whose elementary industrial arts experience serves to acquaint them with the world of work around them; give them occupational orientation, information, and pride of accomplishment and not the least important, hands on experience and an appreciation of tools.[15]

Industrial arts courses should be planned and correlated with academic subjects to provide the practical aspects deemed necessary for career orientation. Career orientation and exploration in an industrial arts program should include laboratory instruction to:

> (1) give students "hands on" experiences typical to those found in the "world of work", (2) acquaint them with a broad range of occupations, (3) make them aware of requisites for careers, (4) guide them in exploring and selecting a career, and (5) develop respect for the dignity of labor.[16]

The elementary school industrial arts program in New York City is organized to:

> Provide an enjoyable experience for boys and girls in which they learn manipulative skills correlated with the academic disciplines and an awareness of the

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[15]Herb Siegel and Henry Kane, "Curbside Shops for New York City," Industrial Arts and Vocational Education, (March, 1971), pp. 37-38.

[16]Herb Siegel and others, "Career Education Through Industrial Arts," Journal of Industrial Arts, (April, 1972), p. 225.

world of work. This is achieved by providing tangible first hand experiences with tools, materials, processes, and occupations of industry while producing projects directly related to units of study in the curriculum.[17]

The career education movement has resulted in industrial education teachers being called on to perform in expanded conceptual areas requiring insights into marketing, development, packaging and shipping, and many other technologies. Cochran[18] has proposed a curricular framework wherein the industrial education teacher could play an integral part of the rapidly expanding k-12 programs. At the elementary level an introductory overview of the world of work would provide a focus on modern industry and related occupations. Industrial oriented units would be added to portray the role the world of work plays in society by satisfying man's industrial needs and wants.

A study of modern industry through a coordination of effort could provide experiences ranging from the most elementary to the formation of mock companies whose operation would call for the development of concepts, knowledge, and common skills.[19]

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[17]Ibid.

[18]Leslie H. Cochran, "Proposed: A New Curriculum Framework for Industrial Education," School Shop, (January, 1971), pp. 13-14.

[19]Ibid.

III. COUNSELING AND GUIDANCE

The counseling service of a school generally provides a one-to-one relationship between the counselor and the student. The counseling service is a part of a school's guidance program. In many larger schools the guidance program is a part of the total student personnel program.[20]

The guidance counselor assists with those aspects of the student personnel program designed to assist the individual in acquiring the attitudes, information, and understanding needed to make wise choices and adjustments. With a major emphasis upon decision making, counseling services are needed at all stages involving decision making.

One guidance service is the individual inventory service used to assist the student in developing self understanding and self acceptance. This service often employs the use of test results, sociometric results, rating scales, interviews, observations, and data available in the student's cumulative record to help the student acquire and organize useful information about himself.

Another guidance service is information service which offers information about the student's present

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[20] Lee E. Isaacson, Career Information in Counselling and Teaching (Boston: Allyn and Bacon, Inc., 1972), pp. 9-10.

environment and information related to educational, occupational, and social factors. This service offers information about the world of work and the procedures for acquiring training and skills needed for future career choices as well as the kind of life and opportunities provided by various types of work.[21]

A counselor assisting an individual in vocational guidance would use three types of information:

> "Occupational information" is used ordinarily to refer to material directly concerned with duties, requirements for entrance, conditions of work, rewards, patterns of advancement, present and expected worker supply and demand, and sources of additional information about positions, jobs and occupations.
>
> "Educational information" refers to materials about all types of existing and potential educational and training opportunities, including nature and purpose of the program, requirements for admission and retention, costs, special features, facilities and staff, and similar items.
>
> "Social information" refers to materials which help the individual to understand the human and physical environment which surrounds him and the ways in which he and others relate to one another and to the existing and anticipated environment.[22]

Elementary school counselors have helped develop and put into use the materials and methods involved in the individual inventory service. However, there is a real lack of vocational guidance materials for elementary school

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[21]*Ibid.*

[22]*Ibid.*, pp. 15-16.

children.[23] Arthur M. Carter, in an attempt to help fill this void, developed a simulation board game called Occunations. The word "occunations" is a combination derived from two words--occupations and nations. The combination, occunations, means occupations of the nations.

Children can play the game as individuals with two, three, or four players or can play as members of teams with two, three, or four teams participating. The game board shows thirteen occupation centers and has a spin wheel, play money, and a deck of chance cards. Each occupation center on the game board has a number of occupations listed with the average salary given for each occupation. The objective of the game is to see which player or team can hire the personnel needed to build enough rockets to defeat the other players or teams.

Detroit sixth grade students participated in an experiment to test the effects of occunations on vocational aspiration, vocational maturity, and vocational vocabulary of selected sixth grade youngsters. While there were no significant gains made in vocational maturity or aspirations the participants did show a significant increase in vocabulary words.[24]

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[23] George E. Leonard, "Career Guidance in the Elementary School," Elementary School Guidance and Counseling (Vol. 7, No. 1, Fall, 1972), p. 53.

[24] Ibid., pp. 53-54.

An elementary child's total educational program should include vertically articulated vocational guidance services.[25] Elementary school counselors can capitalize on the inherent eagerness and curiosity of youth by developing sequential vocational experiences that will lead to vocationally mature young adults.

Vocational guidance programs in the elementary grades should provide experiences by which youngsters can:

1. Expand their knowledge concerning the magnitude of the occupational world. . .
2. Appreciate the various broadly defined dimensions of work. . .
3. Systematically diminish their distortion about various occupations. . .
4. At the generalization level, understand those factors present in our society which cause change, and in turn directly affect work and workers. . .
5. Identify, understand, and interpret the significance of interests, capacities, and values as dominant factors in the career process. . .
6. Establish meaningful relationships between education and future occupational endeavors. . .
7. Acquire more effective decision making skills. . .[26]

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[25]Edward D. Smith, "Vocational Aspects of Elementary School Guidance Programs: Objectives and Activities," Vocational Guidance Quarterly (June, 1970), p. 273.

[26]Ibid., pp. 273-274.

It is necessary to understand that the seven areas are not separate entities capable of being managed at specific levels of the elementary school experience. The main goal of the well articulated elementary school guidance program is the development of more vocationally mature pre-adolescents who can better profit from their secondary school experiences and ultimately in a successful manner with adult decisions.[27]

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[27] Ibid., pp. 278.

CHAPTER III

PROCEDURE FOR THE STUDY

The third grade mass production unit used for this study was first used during the fall of 1971. The construction project, a coaster set, was designed, production tools were developed, instructional materials were worked out and two test forms were constructed and used at that time. The organization for this study has come about as an outgrowth of the 1971 study with a number of revisions.

I. THE COASTER SET

One of the most difficult problems in planning a mass production unit is the decision of what product should be produced. The product may be completely new or a modification of something already in use.[1] A review of projects shown in textbooks did not yield a third grade level project that appeared satisfactory for the teaching unit.

A search of commercial products led to the choice of the coaster set for the construction project. The coaster set designed for this study differs from the commercial product to the extent that it is made basically

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[1]Robert W. Haws and Carl J. Schaefer, Manufacturing In the School Shop, (Chicago: American Technical Society, 1972), pp. 22-28.

of wood with hardboard coasters while the commercial product had aluminum legs, wooden base, and ceramic coasters.

Figure 1, page 28, shows a working drawing of the coaster holder.

II. INSTRUCTIONAL MATERIALS

The Flow Chart

When planning for production it is necessary to (1) list the processes and operations in the order that they happen, (2) select and lay out the work stations needed, and (3) organize for the efficient flow of materials from one work station to the next.[2]

This organization for production is shown on a flow chart. The flow chart helps in scheduling parts so that they are at the right spot at the right time and aids in placing machines so that the handling of materials or components is kept to a minimum.[3]

The flow chart for the production of the coaster sets (Appendix A, page 80) shows the arrangement of machines and a description of the operations to be performed to efficiently move materials through the production and assembly stages.

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[2]Donald G. Lux and Willis B. Ray, The World of Manufacturing: Industrial Arts Curriculum Project, (Bloomington, Illinois: McKnight and McKnight Publishing Company, 1971), p. 124.

[3]Ibid.

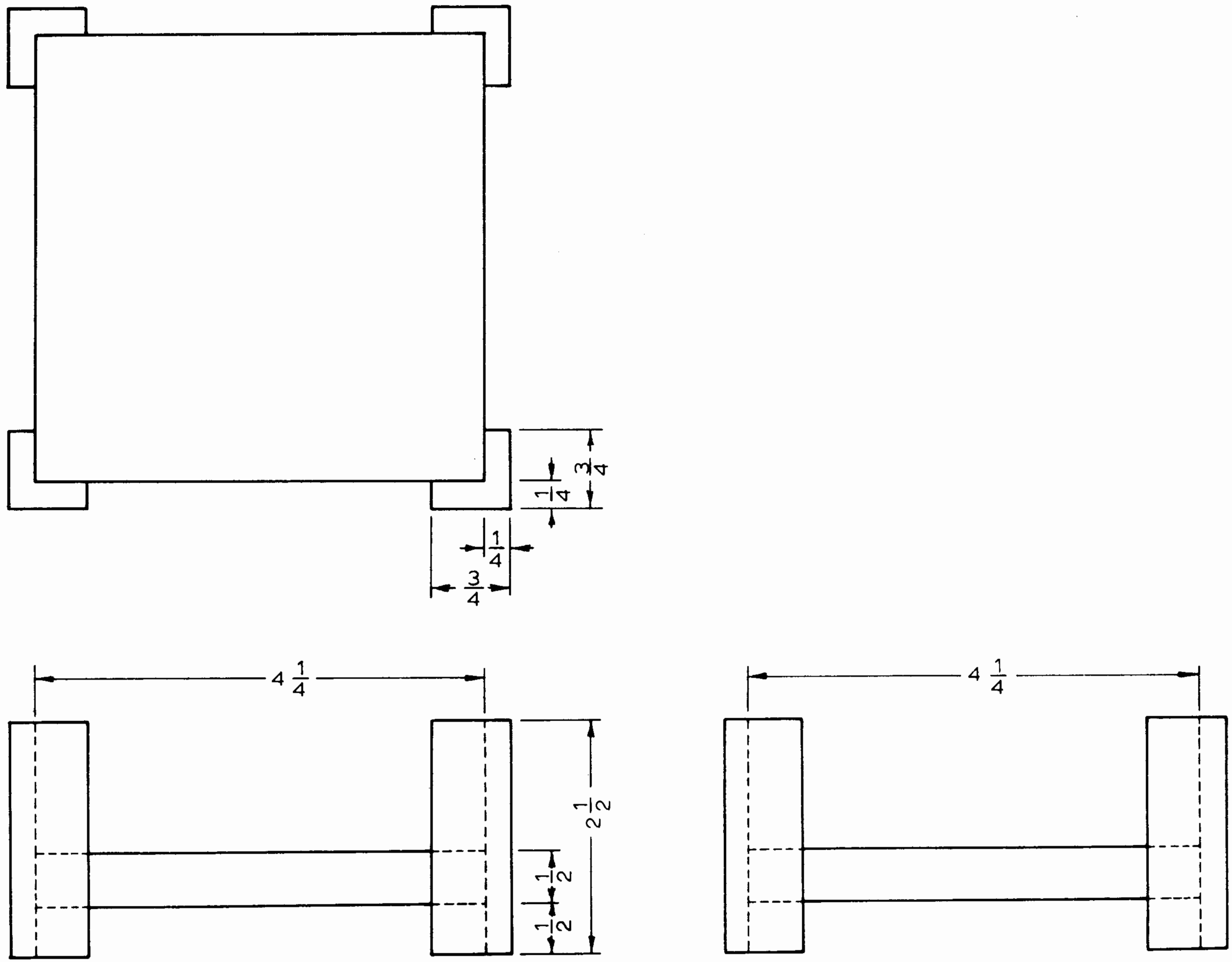

Figure 1. A Coaster Holder.

The Job Assignment Sheets

The planning of a line production project for a teaching unit should include the assignment of students to the wide range of jobs needed in manufacturing to help foster better understanding of all facets of organizing and operating a manufacturing business.[4] The production and assembly lines for the coaster set unit included the potential for thirty-three job assignments. The job assignments were listed in a sequential order that would move materials through the steps of production and assembly in an orderly, efficient manner. Each job assignment included the job title for the worker or workers and a brief description of the operation to be performed.

The job assignment sheets (Appendix B, page 82) were meant to be used in conjunction with the flow chart to give a complete plan of operation for each class of third grade students.

The Vocabulary List

Of major importance in this study was the instruction of students in the area of industrial organization and specialization of labor. The instruction included the use of vocabulary words common to industry and the evaluation

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[4]Robert W. Haws and Carl J. Schaefer, Manufacturing in the School Shop, (Chicago: American Technical Society, 1972), pp. iv-v.

of the progress students made relied upon a test that used vocabulary words typical of industrial organizations.

Twenty-one vocabulary words from Scobey[5] were chosen to be the words on the vocabulary list that was duplicated and distributed to all teachers and students in the experimental group.

The vocabulary list included many words that third grade students do not encounter in regular classroom instruction. Tables I and Ia show the grade level that Dale[6] gives where 67 per cent or more of the students know the meaning of the word. In some cases a similar word was given at a grade level rather than the exact word from the vocabulary list and is shown with the per cent of students who knew the meaning of the word.

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[5]Mary Margaret Scobey, Teaching Children About Technology (Bloomington, Illinois: McKnight and McKnight Publishing Company, 1968), pp. 74-75.

[6]Edgar Dale and Gerhard Eicholz, Children's Knowledge of Words, An Interim Report Prepared by the Bureau of Educational Research and Service (Columbus: The Ohio State University, 1954-1960).

TABLE I

CHILDREN'S KNOWLEDGE OF VOCABULARY WORDS AT SPECIFIED GRADE LEVELS

Word	Percentage of Children Familiar with the Word 4th Grade	 6th Grade
assembler		assemble 76%
assembly stage		assembly 67
design	86%	
efficiency		
engineer		engineering 73
flow chart		
foreman		80
inspector	inspection 77	76
interchangeable parts		particle 67
jig		
mass production		mass 73 production 71
mechanization		mechanical 83
pilot model		model 81
planning stage		
product		86
production stage		production 75
production worker	workmen 93	production 75 workmen 96
quality control		quality 78 control 69
supervisor		
specialization	special 80	specialize 75 specially 84 specialty 84
time study		

NOTE: Percentages were obtained from Dale and Eicholz' _Children's Knowledge of Words_ but when the project vocabulary word was not listed in that report a related word and its percentage is noted.

TABLE Ia

Word	Percentage of Children Familiar with the Word	
	8th Grade	10th Grade
assembler		
assembly stage		
design	designer 97%	designer 92%
efficiency	efficient 79	
	efficiency 75	
engineer		
flow chart		
foreman		
inspector		
interchangeable parts	interchange 76	interchangeable 82
jig		
mass production	massive 86	massive 88
		productivity 81
mechanization	mechanism 77	
pilot model		
planning stage		
product		
production stage	produce 96	
production worker	produce 96	
quality control		
supervisor	supervise 68	
	supervision 78	
specialization	specially 88	
time study	studied 86	

III. PRODUCTION EQUIPMENT

The manufacturing of quantities of identical products is based upon producing standardized parts that can be assembled with economy of time and effort.[7] Standardized parts are produced through the use of specialized tools and machines. The specialized tools and machines developed for the production of the parts for the coaster sets included jigs and fixtures to be used with power sabre saws, drill presses, and mitre boxes.

A Sabre Saw Jig - Figure 2, Page 34

The legs for the coaster set were cut from 3/4" x 3/4" x 6' pine corner stock. The pine stock was cut to 5" lengths in a jig designed to hold the stock material in position while sawing with a sabre saw. The stock material was fed from the rear of the jig and held in position by hand while making the cut with the sabre saw. Figure 2 shows the working drawing of the sabre saw jig for cutting 5" leg pieces from the corner stock.

A Fixture for Drilling on the Drill Press - Figure 3, Page 35

A fixture to hold the 5" leg pieces for drilling and countersinking in the drill press was planned and constructed. Figure 3, page 35, shows the working drawing of

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[7] Scobey, loc. cit.

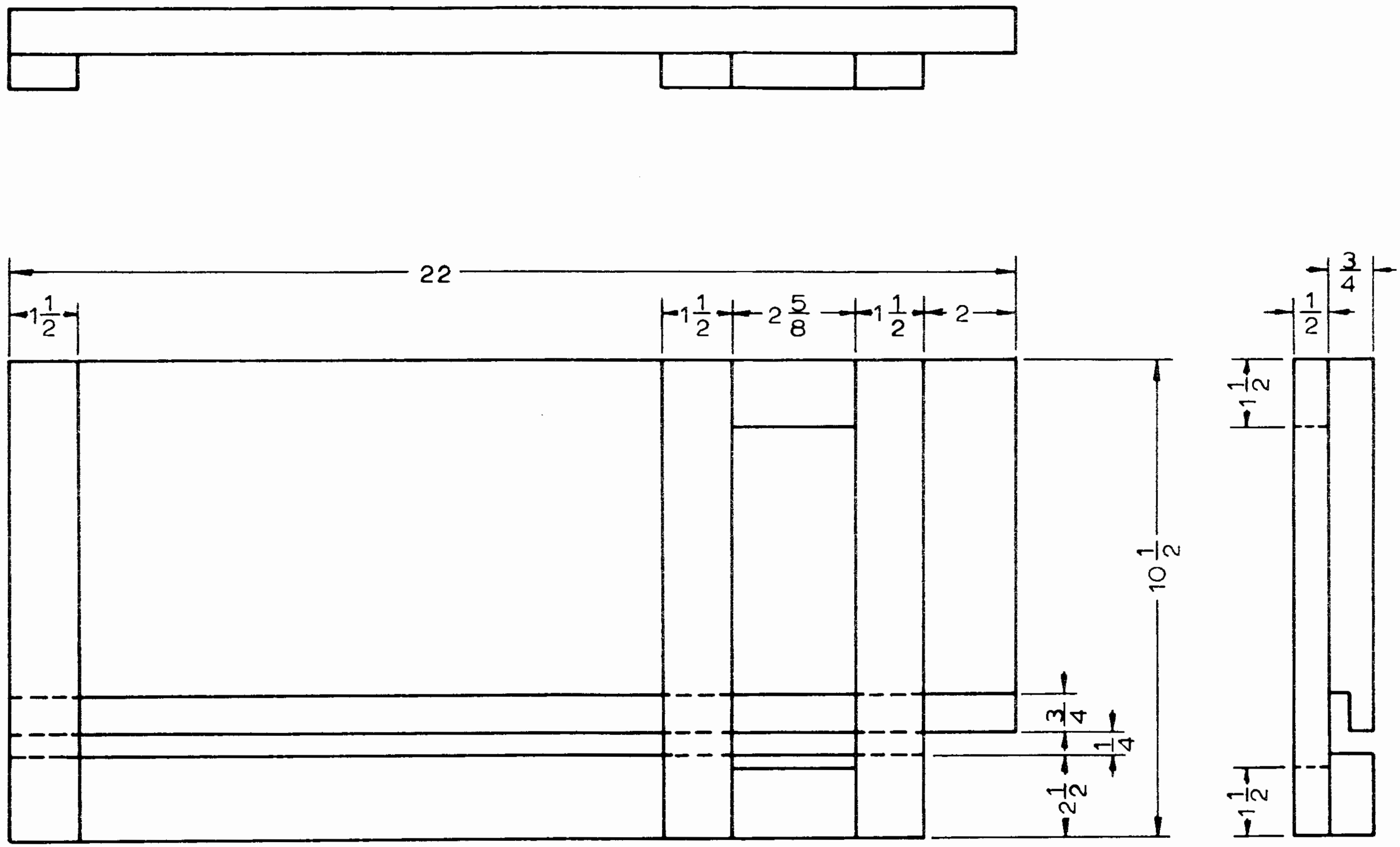

Figure 2. A Sabre Saw Jig.

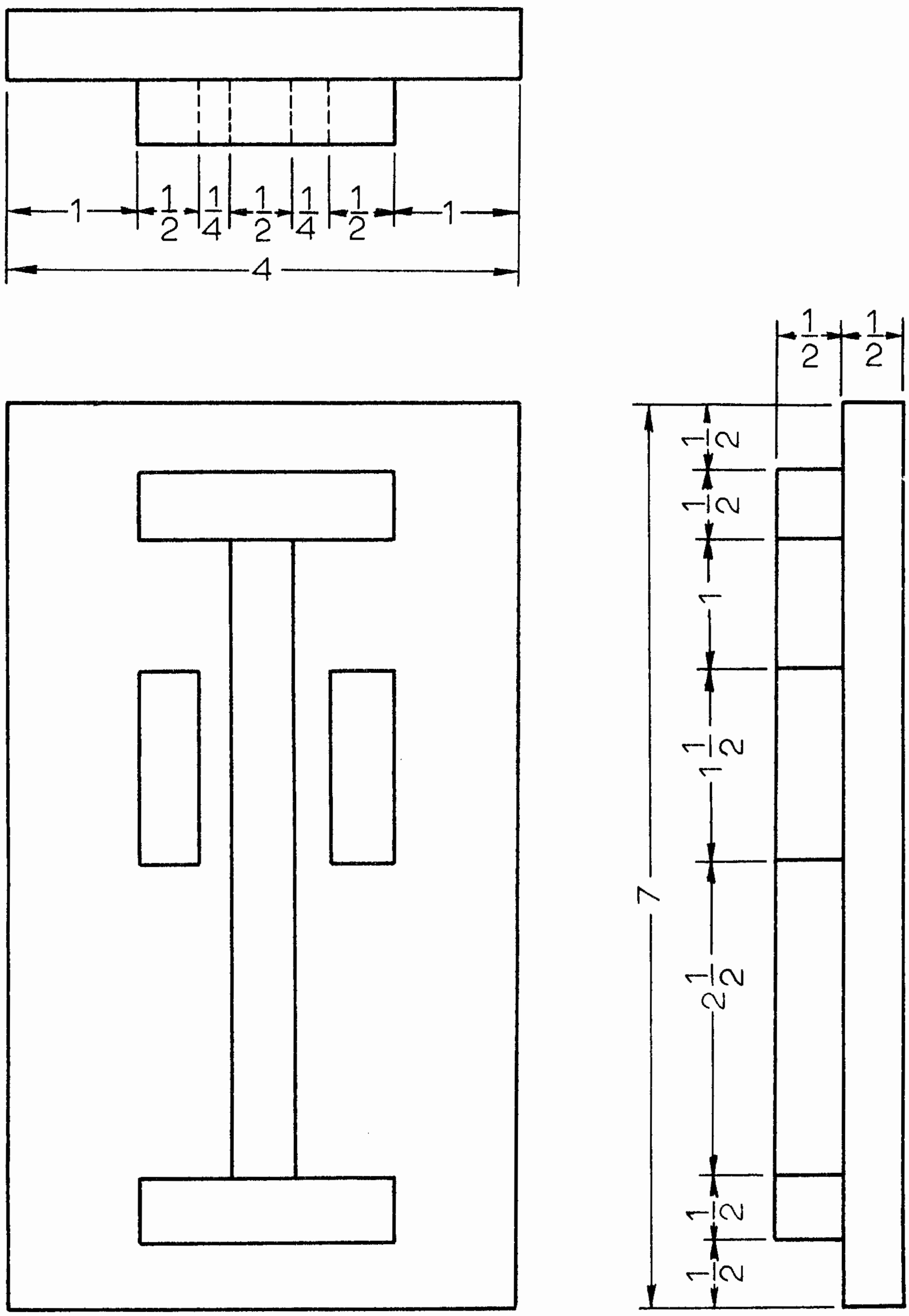

Figure 3. A Drill Press Fixture.

the drill press fixture. The drill press fixture was constructed to allow each leg piece to be rotated through four positions to facilitate the accurate drilling and countersinking of four screw holes for the assembly process.

Fixtures for a Mitre Box

Two wooden stops were clamped to the frame of a mitre box to hold the drilled and countersunk leg pieces in the correct position to saw two 2 1/2" legs from each 5" leg piece.

A Sabre Saw Jig - Figure 4, Page 37

A jig to saw 1/2" x 4 1/4" x 6' pine stock to 1/2" x 4 1/4" x 4 1/4" base pieces with a sabre saw was designed and constructed. The jig was designed to have the stock material fed through the jig from the rear and clamped securely in place with a "c" clamp for each slit with the sabre saw. Figure 4, page 37, shows the working drawing of the sabre saw jig for cutting the base pieces to 4 1/4" x 4 1/4".

An Assembly Jig - Figure 5, Page 39

A jig was planned and constructed to hold a base piece while attaching the leg pieces with screws during assembly. The jig was designed to help position the legs on the base piece so that all four legs would touch the flat surface where it was placed for inspection. Figure 5, page 39, shows the working drawing of the assembly jig.

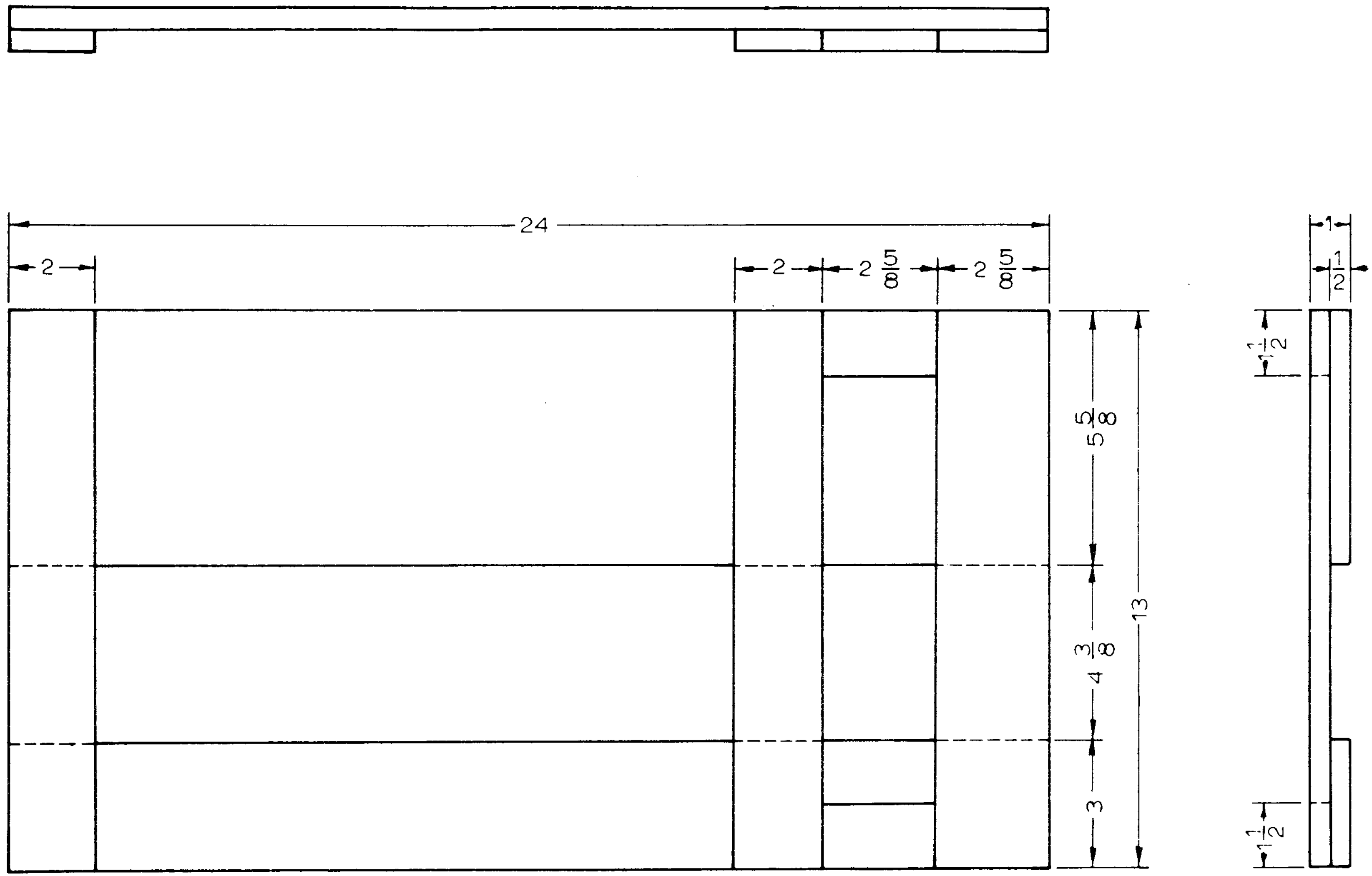

Figure 4. A Sabre Saw Jig.

A Sabre Saw Jig - Figure 6, Page 40

A jig to saw 1/4" x 4" x 48" hardboard stock to 1/4" x 4" x 4" coasters with a jig saw was designed and constructed. The jig was designed to have the stock material fed through from the rear and clamped securely in place with a "c" clamp for each slit with the sabre saw. Figure 6 shows the working drawing of the sabre saw jig for cutting 1/4" hardboard into 4" x 4" coasters.

IV. THE EVALUATIVE INSTRUMENT

The degree of success of the third grade mass production project was based upon the amount of change in measurable traits of the participants during the period of the study. A twenty item teacher constructed test (Appendix C, page 87) was used to measure the change in traits as a result of participating in the teaching unit.

Construction of Test Items

The tests were made up of two types of objective test items: (1) true-false and (2) multiple choice.

True-false items. When constructing the true-false items the following suggestions from Noll were considered:

> (1) Do not include more than a single idea in one true-false item, particularly if one idea is true and the other is false; (2) avoid negative statements wherever possible; (3) an approximately equal number of true and false items should be used;

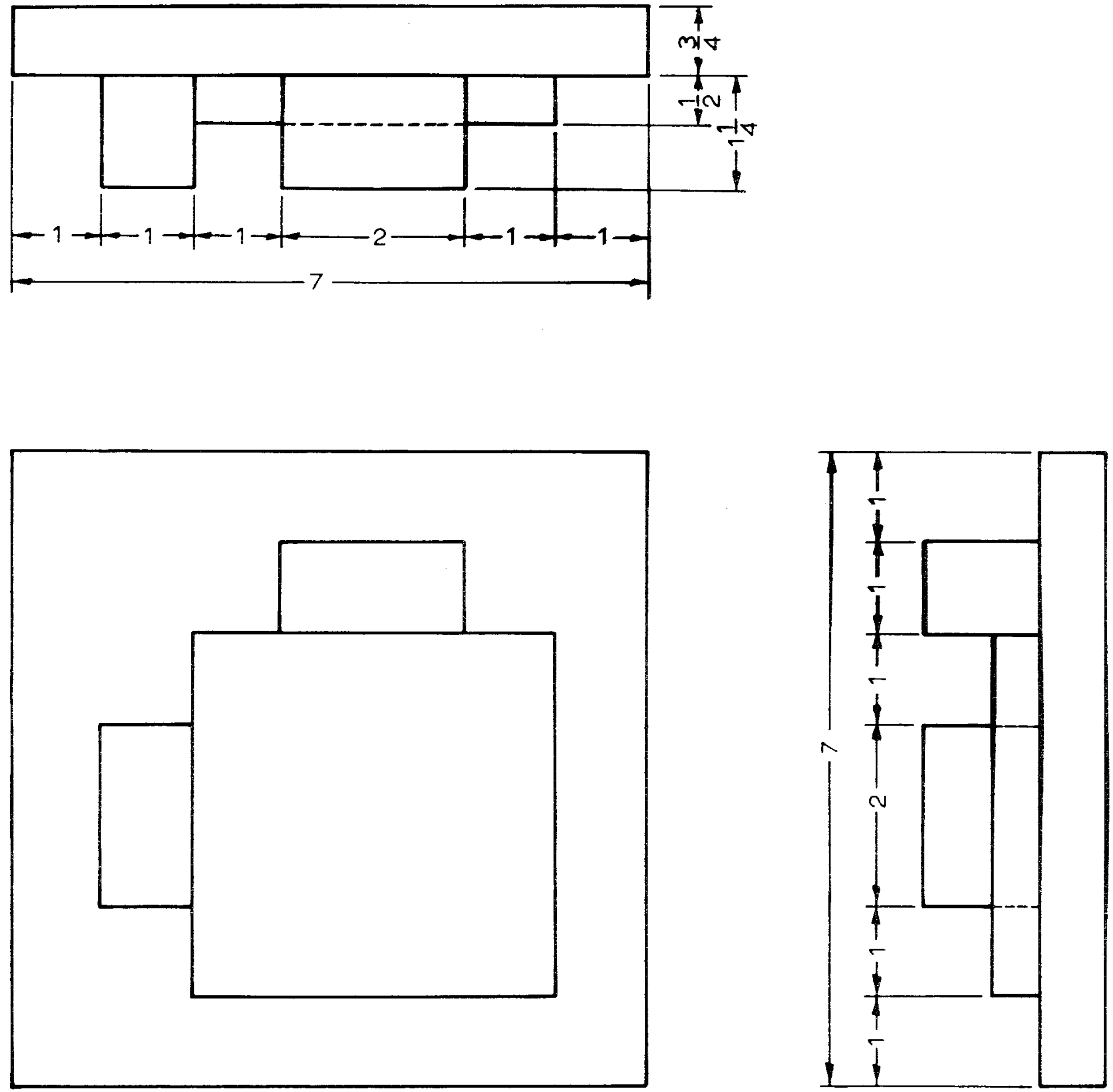

Figure 5. An Assembly Jig

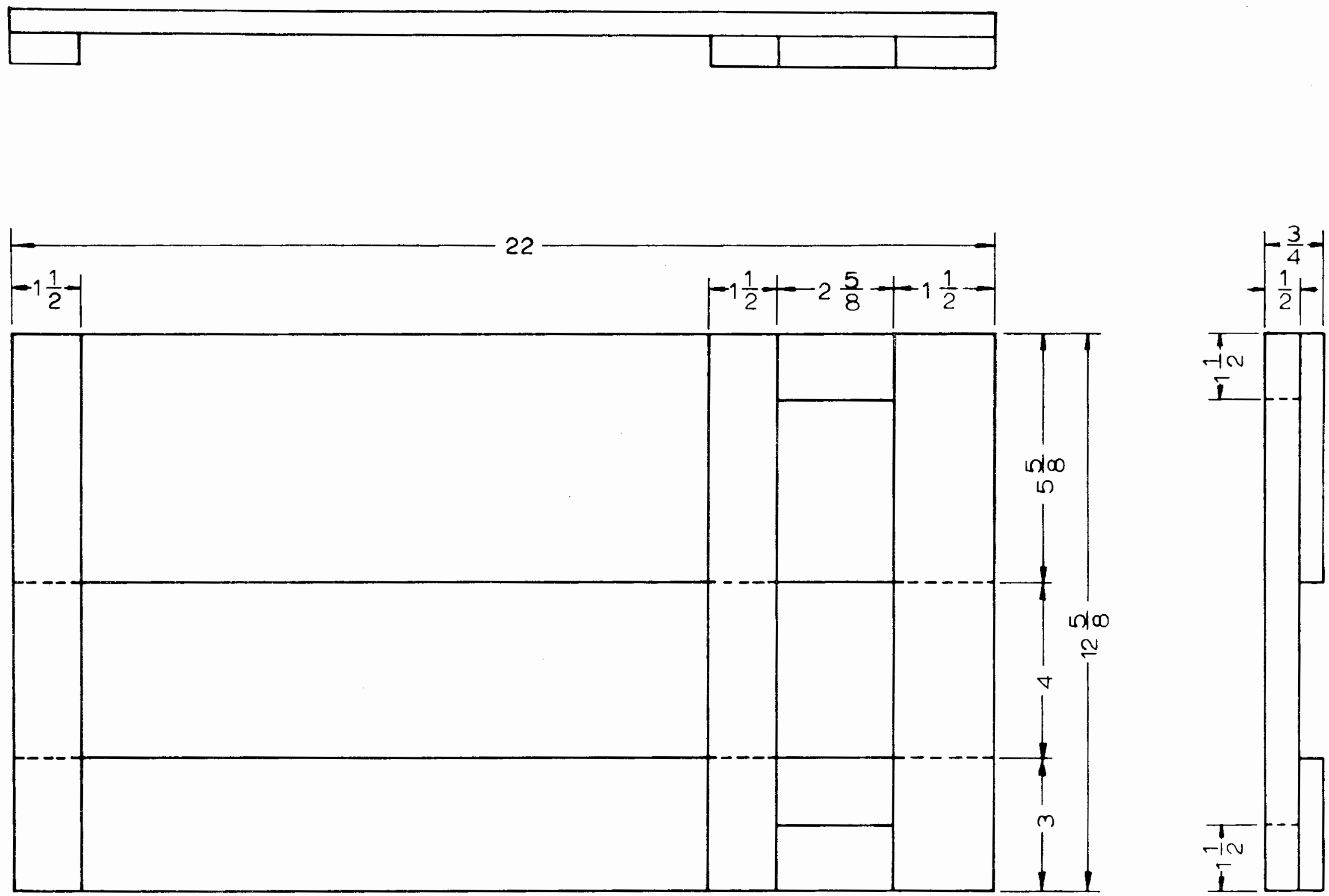

Figure 6. A Sabre Saw Jig.

> (4) avoid long, involved statements, especially those containing dependent clauses, many qualifications and complex ideas; (5) use the true-false form only with ideas which are truly and indubitably true or false as stated.[8]

Multiple choice items. According to Noll, "The multiple choice item usually consists of an incomplete declarative sentence followed by a number of possible responses, one of which is clearly correct or best."[9] Other suggestions taken into account when constructing the multiple choice items were:

> (1) One choice must be clearly the best, but the others must appear plausible to the uninformed, perhaps even more so than the correct choice; (2) a multiple choice item should not have more than one acceptable answer; (3) the choices in an item should come at or near the end of the statement; (4) the best or correct answer should be placed equally often in each possible position; (5) choices should be in parallel form wherever possible; (6) choices should fit into the stem grammatically; (7) the length of the choices should be determined by the purpose of the item; (8) the number of choices in multiple choice items should be at least four; (9) words that would be repeated in each response should be part of the stem.[10]

Content of test items. The content of each test item was based upon terms representative of industrial

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[8]Victor H. Noll, Introduction to Educational Measurement (Boston: Houghton Mifflin Company, 1965), pp. 144-146.

[9]Ibid., pp. 150-151.

[10]Ibid., pp. 152-156.

processes or industrial organization rather than upon knowledge of the individual operations performed in the manufacturing of the coaster sets.

Each word from the vocabulary list appeared at least once on each test form. Some words that were not on the vocabulary list, but which might appear as plausible answers, were included as foils in multiple choice items.

Selection of Test Items

Two twenty item test forms were developed for use with the third grade mass production project unit during the fall of 1971. Each test contained ten true-false items and ten multiple choice items. An item analysis was made of the test results of that study. The item analysis revealed that some items appeared to be more appropriate than others as indicated by their discrimination indexes and levels of difficulty.

The ten true-false items selected for the present study were the ten items from the two original tests that appeared to be the most appropriate for the study.

The ten multiple choice items selected for the present study were the ten items from the two original tests that appeared to be most appropriate for the study.

Directions for Taking the Tests

The third grade students participating in the study were not familiar with test forms having separate answer sheets. Children in the Waterloo Schools normally are exposed to such tests for the first time during January of the third grade year when they take the Iowa Tests of Basic Skills. The supervision of each testing session by two people, the classroom teacher and the writer, helped solve many of the problems the students had with the mechanics of the test.

Written directions. When formulating the written directions for the tests the following suggestions from Noll were observed:

> Directions for the test and sub-tests or parts should be carefully worked out in advance and incorporated into the test. The ideal to strive for is to make the test as nearly self administering as possible, so that the pupil understands what he is to do with a minimum of supplementary explanations.
>
> Directions for each section of a test should precede the part to which they apply.
>
> With younger pupils not accustomed to objective type tests it is well to include a sample item with the directions.[11]

The directions for each part of the tests were written into the tests. A sample item was written into the true-false sections and was designated number one

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[11] Ibid., pp. 168-169.

on the tests and answer sheets. The sample item written into the multiple choice sections was designated number twelve on the tests and answer sheets.

The answer sheets. IBM 1230 answer sheets, Appendix D, were used with the pre tests and post tests to make possible the use of the services of the University of Northern Iowa Testing Bureau. The answer sheets were obtained from the University Mimeograph Office.

CHAPTER IV

IMPLEMENTATION OF THE MASS PRODUCTION PROJECT

Each third grade class in the experimental group (1) took the pre-test, (2) observed a demonstration of the mass production process at the Waterloo Recreation Center, (3) had an organizational session in the classroom to discuss the project and make individual job assignments, (4) mass produced coaster sets for sixty to seventy minutes at the Waterloo Recreation Center, (5) took part in culminating activities, and (6) took the post-test.

I. THE PRE-TEST

Pre-Test of the Experimental Group

The pre-test schedule was worked out with the classroom teachers so that each of the classes in the experimental group would take the test one week in advance of the mass production session.

Each classroom teacher prepared her class for the test session by explaining that the class was going to be involved in the mass production project that would include instruction on how to work with machines and the building of coaster sets at the Waterloo Recreation Center.

The writer explained the purpose of the test, passed out the test booklets and answer sheets, and read the directions aloud to the class. The writer and the classroom teacher assisted the students with the mechanics of marking answers on the answer sheets.

Students having trouble reading words could receive help in pronunciation from the writer or the classroom teacher. The meanings of words or sentences were not given. Students were told that if they did not know the meaning of words or understand a question they could leave the answer blank on the answer sheet and go on to the next question. The test was treated as a power test rather than a timed test. Most classes completed the test in ten to twelve minutes.

At the conclusion of the test setting the test booklets and answer sheets were collected by the writer. A coaster set was shown to the class with a brief explanation of mass production and what the students might look for in the coming demonstration session at the Waterloo Recreation Center.

Pre-Test of the Control Group

The pre-test was administered to the two classes of the control group during the same week that the classes of the experimental group took the test. Each teacher prepared her class for the test by explaining that the class would be involved in a mass production project and would have an opportunity to work with machines and build coaster sets.

The writer explained the purpose of the test and explained that the test would be given again in two weeks. The students were told that they would mass produce coaster sets after the second test was given.

The writer passed out the test booklets and answer sheets and read the directions aloud to the class. The writer and classroom teacher assisted the students with the mechanics of marking answers on the answer sheets.

Students having trouble reading words could receive help in pronunciation from the writer or the teacher. The meanings of words or sentences were not given. Students were told that if they did not know the meaning of words or understand a question they could leave the answer blank on the answer sheet and go on to the next question. The test was treated as a power test rather than a timed test. The classes of the control group completed the test in approximately the same time it took for the classes of the experimental group.

II. THE DEMONSTRATION LESSONS

Preparing the Production and Assembly Lines

Three rooms of the Waterloo Recreation Center were available for use in the mass production project. The rooms consisted of one large meeting room, a ceramics room, and a wood shop. An ideal situation would have been to set up the machines and equipment in lines as shown graphically on the flow chart with all of the production and assembly lines running parallel and converging for final assembly. However, this was not possible with the physical facilities available.

Production lines one and two were set up parallel to each other in the large meeting room.

The finishing stage of lines one and two assembly took place in the ceramics room where spattered and spilled stain would be of little concern.

Line three production took place in the wood shop where the dust from sawing the hardboard could be confined to a work area.

All parts were brought together in the large meeting room where the coaster holders were assembled and coasters placed in them for final assembly.

Transportation

Two demonstration lessons were scheduled for the Monday of the week of production. Three classes were scheduled to attend a morning demonstration and three classes were scheduled to attend an afternoon demonstration. The classes were transported from their schools to the Recreation Center in school busses provided by the Waterloo Community Schools.

The Monday morning schedule was arranged so that two classes from East Waterloo schools and one class from a West Waterloo school arrived at the Recreation Center at approximately 9:15 a.m. The morning demonstration lesson started at 9:20 a.m. and lasted until 10:15 a.m. The school busses returned the classes to their respective schools at the end of the demonstration lesson.

The Monday afternoon schedule was arranged so that two classes from West Waterloo schools and one from an East Waterloo school arrived at the Recreation Center at 1:00 p.m. The afternoon demonstration lesson started at 1:10 p.m. and lasted until 2:00 p.m. The school busses returned the classes to their respective schools at the end of the demonstration lesson.

The Demonstrations

The demonstrations were conducted by the writer. The classroom teachers and counselors from the participating schools were present for the demonstrations. Each teacher and counselor received a flow chart and job assignment sheets before the demonstrations began so they could take notes and ask questions if necessary during the demonstrations.

A coaster set was constructed during each demonstration following the steps outlined on the flow chart. Different students were used for each step in production and assembly. Correct operation of machines, expected output for each operation, accuracy and quality, and smooth flow of materials were given careful consideration throughout the demonstration. Vocabulary words from the vocabulary list were used during the demonstration along with vocabulary words that applied to the tools and materials used for producing the coaster sets.

Students participated in discussion throughout the demonstrations with many excellent observations about correct and incorrect ways of using tools and machines and how to be efficient in moving materials between jobs. Arithmetic was put to practical use by calculating the number of parts to be produced, holes to be drilled, sides to be sanded, base pieces and legs to be stained, and total production per hour.

Safety

The power machines used for production were altered for safe operation by third grade students. The blades for the jig saws were shortened for minimum exposure below their jigs. The drill press operators needed to use both hands on the controls of the drill when drilling in the drill press jig. As an added precaution safety operators were assigned to watch the operation of power tools and to disconnect the electric power cords if any problems arose while the machines were in operation.

III. THE CLASSROOM ORGANIZATIONAL SESSION

Materials Provided for the Session

Each classroom teacher received a pack of materials to be used during the organizational session. The pack included a flow chart for each teacher, counselor, and student; a vocabulary list for each teacher, counselor, and student; and identification tags for each teacher, counselor, and student; and three copies of the job assignment sheets.

The Organizational Session

The purpose of the organizational session was to prepare the students for the mass production session. Each classroom teacher conducted the organizational session for her class. In three cases the school counselor also attended the organizational sessions.

The recommendations from the writer were that the teacher:

1. Discuss the production of the coaster sets with the class using the flow chart as a guide.
2. Review the words on the vocabulary list in the same manner that words are reviewed for other school subjects.
3. Work out individual assignments with the students using the flow chart and job assignment sheets

as guides for better understanding of the total production process.

4. Fill out the identification tags giving the school's name, the student's name, and the job assignment.
5. Stress the importance of each student doing his job correctly and relate the specialization of machines and workers in this project to the specialization of machines and workers in industry.

The teachers reported that no special problems were encountered in the classroom organizational sessions. All teachers reported that students contributed to classroom discussions as a result of some students having knowledge of their fathers' or mothers' jobs in industry.

IV. THE MASS PRODUCTION SESSIONS

The mass production sessions were scheduled for two sessions, one each morning and one each afternoon on Tuesday, Wednesday, and Thursday following the Monday demonstration lessons. The classes were transported to the Recreation Center for the sessions in school busses provided by the Waterloo Community Schools and were returned to their respective schools on the same busses.

Supervision for each mass production session included the classroom teacher, the school counselor, an industrial arts major from the University of Northern Iowa, and the writer.

<u>Daily Schedule for the Mass Production Sessions</u>

9:00	The morning class was picked up at school and transported to the Recreation Center in the school bus.
9:10	The morning class arrived at the Recreation Center. Students' wraps were removed and hung on wall hangers in the hallway.
9:15	Students went to assigned job locations on the production lines or assembly lines. Began work when so instructed by adult supervisors.
10:15	Completed production if quota (one coaster set per student) was reached.
10:20	Broke for restroom, drinks, and washing hands.
10:25	Put on wraps and class assembled for distribution of coaster sets. One set distributed to each student.
10:30	Returned to school in the school bus.
12:45	The afternoon class was picked up at school and transported to the Recreation Center in the school bus.

12:55 The afternoon class arrived at the Recreation Center. Students' wraps were removed and hung on wall hangers in the hallway.

1:00 Students went to assigned job locations on the production lines or assembly lines. Began work when so instructed by adult supervisors.

2:00 Completed production if quota (one coaster set per student) was reached.

2:05 Broke for restroom, drinks, and washing hands.

2:10 Put on wraps and class assembled for distribution of coaster sets. One set distributed to each student.

2:15 Returned to school in the school bus.

Rate of Production

The production rate for individual jobs on the production lines and assembly lines varied from class to class. These variations were attributed to both the number of students per class and the ability of individual students performing the jobs. The differences in work rate of individuals was compensated for by changing workers between jobs when necessary to maintain a smooth flow of materials.

The overall production rate for five of the six classes was quite consistent. One class made up basically of non readers and taught by the only male teacher attained a considerably faster rate of production than the other classes as shown by the following timed rates of production.

Section	Number of Students	Coasters Produced in Sixty Minutes
I	26	27
II	24	29
III	24	32
IV	19	30
V	24	45
VI	26	31

V. CULMINATING ACTIVITIES

Each teacher was asked to have a classroom session following the mass production session. Suggestions for the culminating session were:

1. Review and evaluate the mass production session.
2. Discuss how the mass production of the coaster sets compared to mass production in industry.
3. Review the words on the vocabulary list.
4. Consider a field trip to a local industry.
5. Allow students to discuss their feelings about working in industry as an adult.

VI. THE POST-TEST

Post-Test of the Experimental Group

The post-test schedule was worked out with the classroom teachers so that each class in the experimental group would take the test one week after the mass production session.

The post-tests were administered following the same procedures as outlined for administering the pre-tests.

During the pre-test of section V it was learned that most of the students were practically non-readers making it necessary for the classroom teacher and the writer to read the questions to the individual students. For the post-test of section V the classroom teacher read each question aloud for the class and gave time between questions for the students to choose the correct answers and mark them on the answer sheet. No assistance was given to individuals beyond the reading aloud of the questions by the classroom teacher.

Post-Test of the Control Group

The post-tests of the two classes in the control group were scheduled fourteen days following the pre-tests to match the same elapsed time between test settings as that of the classes in the experimental group.

The post-tests were administered following the same procedure as outlined for administering the pre-tests. Upon completion of the post-tests the two classes of the control group went through the mass production sequence in their home school.

CHAPTER V

EVALUATION

I. MEASURE OF VARIANCES

The pre-tests and post-tests for the experimental and control groups were scored by computer in the Testing Department at the University of Northern Iowa. The computer print-out of the test results included measures of variance for the individual classes and the total population of the experimental group and the control group.

Table II, page 58, shows the increase in statistical means and the changes in the standard deviations for the six classes of the experimental group and the total experimental group from the pre-test to the post-test.

Table III, page 59, shows the increase in statistical means and changes in the standard deviations for the two classes of the control group and the total control group from the pre-test to the post-test.

II. ITEM ANALYSIS OF THE TESTS

The item analysis of the test used in this study is taken from the computer print-out of the test results. Phillips says:

> In item analysis the test constructor is concerned with two major factors, namely, the difficulty level of the test item and the discriminative power of the

TABLE II

VARIABLE MEASUREMENTS FOR THE SIX THIRD GRADE CLASSES OF THE EXPERIMENTAL GROUP ON THE RAW SCORES OF THE TWENTY ITEM TEST

Section	No. of students		Pre-test	Post-test
I	26	mean	4.58	9.88
		s.d.	3.51	3.31
II	24	mean	7.56	12.04
		s.d.	3.09	3.01
III	24	mean	5.88	12.63
		s.d.	3.69	4.17
IV	19	mean	4.53	12.47
		s.d.	3.05	5.13
V	24	mean	6.08	12.63
		s.d.	2.50	3.53
VI	26	mean	5.62	12.15
		s.d.	3.26	3.61
Total	153	mean	5.74	11.92
		s.d.	3.26	3.61
		reliability	0.66	0.74

TABLE III

VARIABLE MEASUREMENTS FOR THE TWO THIRD GRADE CLASSES OF THE CONTROL GROUP ON THE RAW SCORES OF THE TWENTY ITEM TEST

Section	No. of students		Pre-test	Post-test
I	31	mean	5.16	6.00
		s.d.	2.80	3.36
II	26	mean	5.58	6.23
		s.d.	3.08	3.30
Total	57	mean	5.34	6.11
		s.d.	2.93	3.33
		reliability	0.61	0.68

> test item. The difficulty level relates to the success of the group in answering a particular question, or how many students answered the question correctly. An item answered correctly by eighty percent of a group is obviously less difficult than one answered by forty percent of the group. The discriminative power of an item depends on how well it distinguishes between the brightest and dullest students in the group or students who scored high and students who scored low on the test.[1]

The computer analysis used for this study had each population divided to include 27 per cent in the high group, 46 per cent in the middle group, and 27 per cent in the low group.

Item Discrimination for the Tests

Noll says that the discrimination power of items on a test is a valuable index for evaluating their quality.[2] To measure the power of discrimination for an item the per cent of students in the high group answering the item correctly is compared with the per cent of students in the low group answering the item correctly. A simple formula for determining the discrimination index of a test item is:

$$D = \frac{n_H - n_L}{N}$$

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[1] Ray C. Phillips, Evaluation in Education (Columbus, Ohio: Charles E. Merrill Publishing Company, 1968), p. 68.

[2] Victor H. Noll, Introduction to Educational Measurement (Boston: Houghton Mifflin Company, 1965), pp. 175-177.

where D = the discrimination index

n_H = the number in the high group answering the item correctly

n_L = the number in the low group answering the item correctly

N = the total number in either the high or low group

The range of discrimination indexes for the individual items of the pre-test of the experimental group and control group were quite comparable. Tables VI, VIII, and X of Appendix E show that 70 per cent of the items for each group had moderate to high discrimination indexes while 30 per cent of the items had low to very low discrimination indexes.

The per cent of items with moderate to high discrimination indexes and low to very low discrimination remained approximately the same on the post-test of the control group as shown in Tables IX and X of Appendix E.

On the post-test of the experimental group 95 per cent of the items had moderate to high discrimination indexes while 5 per cent, or one item, had a low discrimination index as shown in Tables VII and X of Appendix E.

Item Difficulty for the Tests

The level of difficulty of test items tells the test constructor whether the test is appropriate in difficulty for the group tested. An item that is answered by all or approximately all of the students in a group is not difficult enough for the group. An item that is answered by no students or very few students should be considered as too difficult for the group.

One objective of the test maker should be to construct test items that challenge the best students and at the same time provide ample opportunity for the poorest to show what they can do.[3]

A simple formula for determining the difficulty of an item is:

$$d = \frac{n_H + n_M + n_L}{N}$$

where d = the difficulty for the total group

n_H = the number in the high group answering the item correctly

n_M = the number in the middle group answering the item correctly

n_L = the number in the low group answering the item correctly

N = the total number taking the test

An analysis of the pre-test results indicated that the individual test items were quite difficult for the students of both the experimental and control groups. Tables VI, VIII, XI, and XII of Appendix E show that the

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[3] *Ibid*., pp. 279-280.

items were generally of high difficulty with fewer items of average difficulty and no items classified as low difficulty for the two groups.

The control group students had fewer items classified at the high difficulty level on the post-test than on the pre-test and no items of low difficulty as shown in Table XII. However, a comparison of difficulty indexes of the individual items of the pre-test and post-test, Tables VIII and IX, shows that no definite pattern of change in difficulty existed as some items had higher indexes on the pre-test than on the post-test while the inverse was shown for other items.

The experimental group students had no individual items classified in the high difficulty level on the post-test as shown in Tables VII and XI, Appendix E. Tables VI and VII show that all individual test items were less difficult on the post-test than on the pre-test for the students of the experimental group.

III. A STATISTICAL TEST OF THE HYPOTHESIS

Blommers says that the statistical testing of an hypothesis is a process for drawing some inference about the value of a population parameter from the information contained in a sample from the population.[4]

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[4]Paul Blommers and E. F. Lindquist, Elementary Statistical Methods (Boston: Houghton Mifflin Company, 1960), pp. 264-270.

The steps to be followed in making the inference, according to Blommers, are:

> Step 1. State the statistical hypothesis to be assumed true. . . .
>
> Step 2. Specify the level of significance to be used. . . .
>
> Step 3. Specify the critical region to be used. . . .
>
> Step 4. Carry out the sampling study as planned and compute the value of the test statistic. . . .
>
> Step 5. Refer the value of the test statistic as obtained in Step 4 to the critical region adopted. If the value falls in this region, reject the hypothesis. Otherwise retain or accept the hypothesis as a tenable (not disproved) possibility.[5]

The Statistical Hypothesis

The statement of the problem for this study reworded to be assumed true is: a mass production project can be used as an effective method to provide information about specialization of labor and industrial organization.

Level of Significance

Definition:

> In general terms, level of significance refers to the degree of improbability which is deemed necessary to cast sufficient doubt upon the truth of the hypothesis to warrant its rejection.[6]

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[5] *Ibid.*, p. 266-268.

[6] *Ibid.*, p. 267.

The .05 level of significance was chosen for this study. The probability points of t curves for determining t for the six individual classes and the population of the study were taken from Table VI of Blommers.[7]

The Critical Region

Definition:

> A critical region is a portion of the scale of possible values of the statistic so chosen that if the particular obtained value of the statistic falls within it, rejection of the hypothesis is indicated.[8]

The Statistical Formula Used

The computation of the test information was done by a computer programmed to compute the following formula from Ferguson:[9]

$$t = \frac{\bar{D}}{\sqrt{\frac{S_D^2}{N-1}}}$$

Meaning of Symbols Used - Table IV, Page 68, and Table V, Page 69

N Number of scores in a collection[10]

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[7] *Ibid.*, p. 516.

[8] *Ibid.*, p. 267.

[9] George A. Ferguson, *Statistical Analysis in Psychology* (New York: McGraw-Hill Book Company, 1959), p. 139.

[10] Blommers, *op. cit.*, p. 473.

n Number of scores in a subgroup of the collection[11]

α Level of significance used in testing an hypothesis[12]

R Critical region or region of rejection used in testing a statistical hypothesis[13]

t A test statistic of the sampling distribution[14]

$\leq$ "Less than or equal to"[15]

<u>Results of the t Tests for the Experimental Group</u>

Table IV, page 68, shows that all six of the classes of the experimental group and the total experimental group obtained t scores that do not fall in the R as specified.

The inference from the statistical test of the hypothesis is to accept the hypothesis as tenable (not disproven) for the experimental group.

<u>Results of the t Tests for the Control Group</u>

The purpose of the pre-test post-test sequence of the control group was to determine if third grade students

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[11] *Ibid.*

[12] *Ibid.*, p. 476.

[13] *Ibid.*, p. 481.

[14] *Ibid.*, p. 474.

[15] *Ibid.*, p. 470.

would make significant gains on the twenty item test without the benefit of the instruction given the experimental group. The t test results for the control group, Table V, page 69, show that the group did not make a significant gain as a result of participating in the pre-test post-test sequence.

TABLE IV

RESULTS OF THE t TESTS FOR THE EXPERIMENTAL GROUP

Section I

$n = 26.$
$\alpha = .05$
$R{:}t \leq 1.71$
$t = 6.41$ accept

Section II

$n = 24.$
$\alpha = .05$
$R{:}t \leq 1.71$
$t = 5.93$ accept

Section III

$n = 24.$
$\alpha = .05$
$R{:}t \leq 1.71$
$t = 9.15$ accept

Section IV

$n = 19.$
$\alpha = .05$
$R{:}t \leq 1.73$
$t = 7.51$ accept

Section V

$n = 24.$
$\alpha = .05$
$R{:}t \leq 1.71$
$t = 9.35$ accept

Section VI

$n = 26.$
$\alpha = .05$
$R{:}t \leq 1.71$
$t = 7.51$ accept

Total Group

$N = 143.$
$\alpha = .05$
$R{:}t \leq 1.65$
$t = 17.94$ accept

TABLE V

RESULTS OF THE t TESTS FOR THE CONTROL GROUP

Section I		Section II	
n =	31.	n =	26.
α =	.05	α =	.05
R:t $\leq$	1.70	R:t $\leq$	1.71
t =	1.10	t =	1.09

Total Group	
n =	56.
α =	.05
R:t $\leq$	1.68
t =	1.58

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

This study was undertaken to determine if a mass production project could be used as an effective method to acquaint third grade students with the world of work through practical experience and provide information about specialization of labor and industrial organization.

A coaster set was chosen as the construction project for the study. The students participating in the study consisted of six classes of third grade students in the experimental group and two classes of third grade students in the control group. The .05 level of significance was selected at the outset of the study as the basis for accepting or rejecting the hypothesis.

The nature of current periodical literature concerning career education at the elementary school level is one of diversity. In Chapter II the literature reviewed was placed in the categories of (1) articles pertaining to general education or regular classroom instruction, (2) industrial education concerning the world of work, and (3) the guidance program wherein counselors give information and deal with attitudes and decision making. An attempt was made throughout the development and execution of the unit to utilize the diverse backgrounds and talents of the elementary classroom teachers and elementary counselors who took part in the study.

Chapter III dealt with the planning of the instructional unit used for the study. The materials developed for the study included (1) the coaster set to be mass produced, (2) the instructional materials for teachers and students, (3) the specialized tools and equipment to facilitate mass production, and (4) the twenty item test to be administered at the beginning and the end of the study.

The instructional unit began with the administration of the pre-test to the classes of the control group and experimental group. The experimental group proceeded through two instructional sessions, the mass production session, and the culminating activities. The post-test was then administered to the classes of the control group and the experimental group.

The test developed for the study was made up of items based upon vocabulary words and terms representative of typical industrial organizations and job classifications rather than upon the knowledge of individual operations performed in the manufacturing of the coaster sets.

The item analysis of the test results showed that the items were generally difficult for the students of the experimental and control groups on the pre-test and for the control group on the post-test. The difficulty level of all items was average to low for the post-test of the experimental group.

II. CONCLUSIONS

One aspect of this study was to provide practical experience in the world of work for third grade students. The manufacturing of coaster sets was accomplished by having each third grade student perform the specialized tasks of an occupational designation in the production sequence. The coaster set project appeared to be appropriate for third grade students as five of the six classes produced approximately thirty completed coaster sets per hour and one class produced forty-five completed sets in their one hour run.

The extent to which the practical experience of the mass production project plus the related instruction of the unit helped students increase their understandings of specialization of labor and industrial organization was based upon a comparison of pre test-scores with post-test scores of the students of the experimental group and the students of the control group.

There was no appreciable difference between the statistical means and standard deviations of the pre-test results for the students of the experimental group and the control group. The assumption was that the students of both groups had approximately equal understandings of specialization of labor and industrial organization at the start of the study.

The students of the control group experienced an insignificant total gain in test scores as a result of participating in the pre-test post-test sequence.

The students of the experimental group experienced significant gains from the pre-test to the post-test. The conclusion drawn from the statistical test of the hypothesis was that a mass production unit could be used as an effective method to acquaint third grade students with the world of work and provide information about specialization of labor and industrial organization.

III. RECOMMENDATIONS

This investigation has served to indicate that third grade students can learn about industrial organization and specialization of labor through participation in a mass production project. In light of the data presented and the foregoing conclusions, the following recommendations are made for further research in the area of career education at the elementary school level.

1. An experience similar to the mass production project should be used with elementary school students to determine if practical, hands-on experience can bring about attitudinal changes in individuals' aspirations for adult vocations.

2. Further study should be made to determine if various facets of career education can be used as a method for improving language arts instruction.

3. A study should be made to determine if the practical experiences of a career education unit can be used to make mathematics instruction more effective.

4. Further research should be undertaken to determine the levels at which various vocabulary words and concepts about the world of work can be most effectively introduced at the elementary school level.

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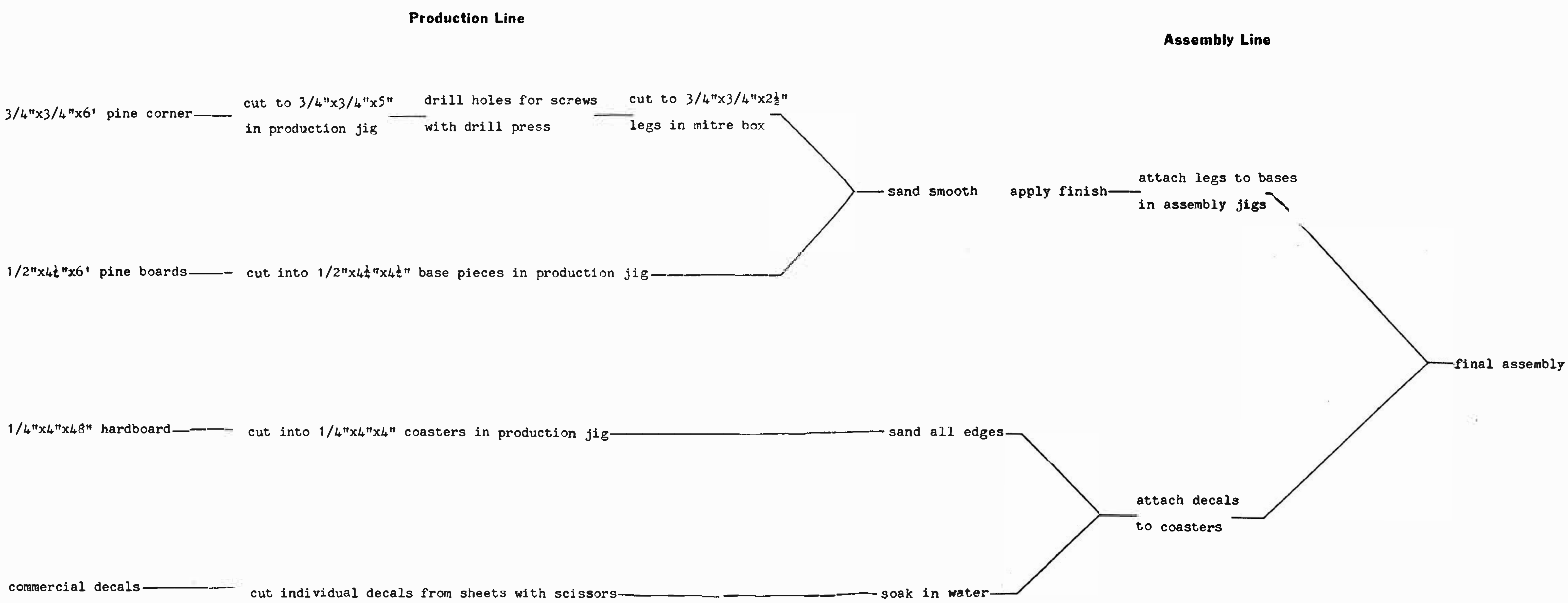
APPENDIX A

FLOW CHART

FLOW CHART


Production Line
Assembly Line
3/4"x3/4"x6' pine corner
cut to 3/4"x3/4"x5" in production jig
drill holes for screws with drill press
cut to 3/4"x3/4"x2½" legs in mitre box
sand smooth
apply finish
attach legs to bases in assembly jigs
1/2"x4¼"x6' pine boards
cut into 1/2"x4¼"x4¼" base pieces in production jig
final assembly
1/4"x4"x48" hardboard
cut into 1/4"x4"x4" coasters in production jig
sand all edges
attach decals to coasters
commercial decals
cut individual decals from sheets with scissors
soak in water

APPENDIX B

JOB ASSIGNMENT SHEETS

LINE 1 PRODUCTION

Line 1 Production Foreman* ______________________

Saw Operator ______________________

Saw 5" pieces from stock material.
Sand rough ends smooth.

Safety Operator ______________________

Disconnect electric cord when saw is not in operation.

Drill Press Operator ______________________

Drill four holes in each leg piece using the drilling jig.

Saw Operator ______________________

Cut 5" pieces into 2 1/2" legs in mitre box.

Line 1 Inspector* ______________________

Check all leg pieces to see if they are the correct length with holes correctly drilled.

LINE 2 PRODUCTION

Line 2 Foreman* ______________________

Saw Operator ______________________

Saw 4 1/4" pieces from stock material.

*The foreman and inspector assignments can be carried out by the workers if there are fewer than 32 students in the class.

Safety Operator ______________

Disconnect electric cord when the saw is not in use.

LINE 1 AND 2 ASSEMBLY

Assembly Foreman* ______________

Sander ______________

Sand all leg pieces and base pieces.

Finisher ______________

Dip all leg pieces and base pieces in stain sealer. Rub each piece dry with a clean rag.

Assemblers ______________ ______________

______________ ______________

______________ ______________

______________ ______________

Assemblers work in pairs. One assembler holds parts in the assembly jig while other partner drills pilot holes and attachs legs with screws.
Both partners must take care to see that the legs are held correctly in place during assembly.

Inspector* ______________

Check each completed coaster holder to see if the legs are correctly attached. Set each coaster holder on a flat surface to see if all four legs are touching the surface. Send coaster holders that do not pass inspection back to assembly foreman for repair or to instructor to salvage usable parts.

*The foreman and inspector assignments can be carried out by workers if there are fewer than 32 students in the class.

LINE 3 PRODUCTION

Line 3 Production Foreman* ____________________

Saw Operators ____________________

____

Saw hardboard into 4" x 4" pieces in production jigs.

Safety Operators ____________________

____

Disconnect electric cords when saws are not in operation.

Inspector* ____________________

Check coaster pieces to make certain that they are the correct size.

LINE 4 PRODUCTION

Decal Cutters ____________________

____

Cut individual decals from the decal sheets with scissors.

LINE 3 AND 4 ASSEMBLY

Sanders ____________________

____

Sand all four edges of each coaster piece.

*The foreman and inspector assignments can be carried out by workers if there are fewer than 32 students in the class.

Gluer ______________________

Glue one decal on each coaster piece.

FINAL ASSEMBLY

Assembler-Inspector ______________________

Gather coaster pieces and coaster holders. Put four coasters in each coaster holder. Keep a count of completed coaster sets.
Reject any defective parts.

APPENDIX C

SAMPLE TEST

The statements on this page are either true or false. Read each one carefully. If you think the statement is true, make a heavy black line in column 1 of the answer sheet beside the number of the statement. If you think the statement is false, blacken the space between the pair of lines in column 2.

SAMPLE. We will work number 1 together.

1. A crow is a large, black bird.

   Yes, this is a true statement. Mark the answer on the sheet and wait until it is checked by the teacher before doing the rest of the page.

When you have completed this page, turn your papers upside down and wait quietly for the other students to finish.

2. The planning stage comes before the production stage.

3. Materials go through the final assembly stage before going through the production stage.

4. Machine operators design products.

5. Planning is the first stage in manufacturing.

6. Engineers operate machines on the production line.

7. Products go through the production stage before crating and shipping.

8. Engineers work out the design of a product.

9. A flow chart has the same purpose as a jig.

10. Assemblers design products to be manufactured.

11. Interchangeable parts are produced through mechanization.

Turn your papers over and wait for the other students to finish this page.

Each of the following statements has four answers. You are to choose the one answer that you think will make the sentence correct. Then, on the answer sheet, find the row of answer spaces numbered the same as the statement. Fill in the answer space for the best answer.

SAMPLE. We will work number 12 together.

12. A crow is a large, black

    1. fish.
    2. bird.
    3. dog.
    4. cat.

    Yes, bird is the correct answer. Mark the answer on the answer sheet and wait until it is checked by the teacher before doing the rest of the test.

When you have completed the test, turn your papers upside down and wait quietly for the other students to finish.

13. Making things in large quantities is called

    1. planning.
    2. construction.
    3. mass production.
    4. charting.

14. A flow chart tells how to take steps in

    1. quality control.
    2. diagramming.
    3. encyclopedias.
    4. production.

15. A pilot model is made to correct errors and improve design before

    1. supervision.
    2. mass production.
    3. screening.
    4. charting.

16. Efficiency in manufacturing is insured by a

    1. time study.
    2. quality controller.
    3. design.
    4. diagram.

17. Specialization means that one worker does

    1. improvements.
    2. one job.
    3. pilot models.
    4. flow charts.

18. Inspection is used to insure

    1. engineering.
    2. industry.
    3. maintenance.
    4. quality control.

19. A jig is a device built to do

    1. electronics.
    2. engineering.
    3. one operation.
    4. supervision.

20. The final assembly stage is where all parts are brought together to make the

    1. product.
    2. jig.
    3. inspection.
    4. improvements.

21. A foreman is a person who supervises

    1. engineers.
    2. speed drills.
    3. workers.
    4. pilot models.

22. Speeding up work by using a machine is called

    1. specialization.
    2. inspection.
    3. supervision.
    4. mechanization.

Turn your papers over and wait for the other students to finish the test.

APPENDIX D

ANSWER SHEET

E______ LAST ______ FIRST ______ MIDDLE ______ DATE ______ AGE ______ SEX ______ (M OR F) DATE OF BIRTH ______

OOL ______ CITY ______ GRADE OR CLASS ______ INSTRUCTOR ______

E OF TEST ______ PART ______ 1 ______ 2 ______

IRECTIONS: Read each question and its numbered answers. When you have decided which answer is correct, blacken the corresponding space on this sheet with a No. 2 pencil. Make your mark as long as the pair of lines, and completely fill the area between the pair of lines. If you change your mind, erase your first mark COMPLETELY. Make no stray marks; they may count against you.

SAMPLE

. CHICAGO is

1-1 a country	1-4 a city
1-2 a mountain	1-5 a state
1-3 an island	

1 2 3 4 5

SCORES

1 ______ 5 ______

2 ______ 6 ______

3 ______ 7 ______

4 ______ 8 ______

IDENTIFICATION NUMBER

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
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0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

	T F		T F		T F		T F
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	1 2 3 4 5	6	1 2 3 4 5	7	1 2 3 4 5	8	1 2 3 4 5
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	1 2 3 4 5	14	1 2 3 4 5	15	1 2 3 4 5	16	1 2 3 4 5
	1 2 3 4 5	18	1 2 3 4 5	19	1 2 3 4 5	20	1 2 3 4 5
	1 2 3 4 5	22	1 2 3 4 5	23	1 2 3 4 5	24	1 2 3 4 5
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	1 2 3 4 5	30	1 2 3 4 5	31	1 2 3 4 5	32	1 2 3 4 5
	1 2 3 4 5	34	1 2 3 4 5	35	1 2 3 4 5	36	1 2 3 4 5
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	1 2 3 4 5	50	1 2 3 4 5	51	1 2 3 4 5	52	1 2 3 4 5
	1 2 3 4 5	54	1 2 3 4 5	55	1 2 3 4 5	56	1 2 3 4 5
	1 2 3 4 5	58	1 2 3 4 5	59	1 2 3 4 5	60	1 2 3 4 5
	1 2 3 4 5	62	1 2 3 4 5	63	1 2 3 4 5	64	1 2 3 4 5
	1 2 3 4 5	66	1 2 3 4 5	67	1 2 3 4 5	68	1 2 3 4 5
	1 2 3 4 5	70	1 2 3 4 5	71	1 2 3 4 5	72	1 2 3 4 5
	1 2 3 4 5	74	1 2 3 4 5	75	1 2 3 4 5	76	1 2 3 4 5
	1 2 3 4 5	78	1 2 3 4 5	79	1 2 3 4 5	80	1 2 3 4 5
	1 2 3 4 5	82	1 2 3 4 5	83	1 2 3 4 5	84	1 2 3 4 5
	1 2 3 4 5	86	1 2 3 4 5	87	1 2 3 4 5	88	1 2 3 4 5
	1 2 3 4 5	90	1 2 3 4 5	91	1 2 3 4 5	92	1 2 3 4 5
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	1 2 3 4 5	98	1 2 3 4 5	99	1 2 3 4 5	100	1 2 3 4 5
	1 2 3 4 5	102	1 2 3 4 5	103	1 2 3 4 5	104	1 2 3 4 5
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	1 2 3 4 5	126	1 2 3 4 5	127	1 2 3 4 5	128	1 2 3 4 5
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	1 2 3 4 5	134	1 2 3 4 5	135	1 2 3 4 5	136	1 2 3 4 5
	1 2 3 4 5	138	1 2 3 4 5	139	1 2 3 4 5	140	1 2 3 4 5
	1 2 3 4 5	142	1 2 3 4 5	143	1 2 3 4 5	144	1 2 3 4 5
	1 2 3 4 5	146	1 2 3 4 5	147	1 2 3 4 5	148	1 2 3 4 5
	1 2 3 4 5	150	1 2 3 4 5				

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IBM 805 FORM NO. 1000 A 309

APPENDIX E

TABLES

TABLE VI

DISCRIMINANT AND DIFFICULTY ANALYSIS BY ITEMS
FOR THE EXPERIMENTAL GROUP PRE-TEST

Item	Correct responses: High group	Middle group	Low group	Discrimination index	Difficulty of total group
1	sample true-false item				
2	23	25	7	0.410	0.382
3	31	20	5	.667	.389
4	13	16	2	.282	.215
5	30	34	6	.615	.486
6	21	18	2	.487	.285
7	29	18	2	.692	.340
8	20	27	3	.436	.347
9	27	25	4	.590	.389
10	12	12	0	.308	.167
11	16	15	3	.333	.236
12	sample multiple choice item				
13	15	12	1	.359	.194
14	16	12	7	.231	.243
15	11	16	4	.179	.215
16	14	23	4	.256	.285
17	23	29	6	.436	.403
18	11	16	2	.231	.201
19	17	14	0	.436	.215
20	14	16	4	.256	.236
21	20	16	1	.487	.257
22	21	10	2	0.487	0.229

TABLE VII

DISCRIMINANT AND DIFFICULTY ANALYSIS BY ITEMS FOR THE EXPERIMENTAL GROUP POST-TEST

Item	Correct responses High group	Middle group	Low group	Discrimination index	Difficulty of total group
1	sample true-false item				
2	37	44	22	0.385	0.720
3	32	43	14	.462	.622
4	21	24	12	.231	.399
5	38	57	24	.359	.832
6	27	25	10	.436	.434
7	35	42	13	.564	.629
8	36	53	23	.333	.783
9	31	52	10	.538	.650
10	29	36	12	.436	.538
11	32	40	11	.538	.580
12	sample multiple choice item				
13	33	38	17	.410	.615
14	35	41	12	.590	.615
15	31	37	11	.513	.552
16	29	34	13	.410	.531
17	37	51	20	.436	.755
18	23	22	7	.410	.364
19	36	39	13	.590	.615
20	33	36	9	.615	.545
21	36	39	9	.692	.587
22	32	32	11	0.538	0.524

TABLE VIII

DISCRIMINANT AND DIFFICULTY ANALYSIS BY ITEMS
FOR THE CONTROL GROUP PRE-TEST

Item	Correct responses High group	Middle group	Low group	Discrimination index	Difficulty of total group
1	sample true-false item				
2	13	18	5	0.500	0.621
3	11	7	0	.688	.310
4	7	4	3	.250	.241
5	11	13	0	.688	.414
6	6	5	1	.313	.207
7	10	14	1	.563	.431
8	8	5	0	.500	.224
9	7	5	0	.438	.207
10	8	4	2	.375	.241
11	8	6	0	.500	.241
12	sample multiple choice item				
13	6	7	2	.250	.259
14	6	4	2	.250	.207
15	6	8	0	.375	.241
16	5	10	4	.063	.328
17	7	8	1	.375	.276
18	5	6	0	.313	.190
19	5	1	0	.313	.103
20	4	12	0	.250	.276
21	6	4	0	.375	.172
22	2	4	0	0.125	0.103

TABLE IX

DISCRIMINANT AND DIFFICULTY ANALYSIS BY ITEMS FOR THE CONTROL GROUP POST-TEST

Item	Correct responses High group	Middle group	Low group	Discrimination index	Difficulty of total group
1	sample true-false item				
2	14	15	3	0.733	0.571
3	10	5	1	.600	.286
4	8	6	1	.467	.268
5	11	14	1	.667	.464
6	10	8	2	.533	.357
7	11	14	1	.667	.464
8	10	8	1	.600	.339
9	8	6	0	.533	.250
10	5	7	1	.267	.232
11	9	7	2	.467	.321
12	sample multiple choice item				
13	6	3	1	.333	.179
14	6	4	0	.400	.179
15	1	2	2	- .067	.089
16	9	7	1	.533	.304
17	10	14	2	.533	.464
18	8	5	0	.533	.232
19	3	7	1	.133	.196
20	3	11	2	.067	.286
21	4	9	1	.200	.250
22	4	9	2	0.133	0.268

TABLE X

ITEM DISCRIMINATION BASED UPON THE DIFFERENCE OF CORRECT RESPONSES BETWEEN THE UPPER AND LOWER 27% OF THE TOTAL SAMPLE

Experimental group

		Pre-test	Post-test
High (more than .40)	Very good	55%	80%
Moderate (.30 through .40)	Good	15	15
Low (.20 to .30)	Fair	25	5
Very low (less than .20)	Marginal	5%	0%

Control group

		Pre-test	Post-test
High (more than .40)	Very good	35%	60%
Moderate (.30 through .40)	Good	35	10
Low (.20 to .30)	Fair	20	10
Very low (less than .20)	Marginal	10%	20%

TABLE XI

SUGGESTED AND OBSERVED PERCENTAGES OF DIFFICULTY INDICES OF ITEMS USING THE TOTAL NUMBER OF STUDENTS ANSWERING THE ITEM CORRECTLY

Experimental group pre-test

	Suggested	Observed
High difficulty (less than .30)	5 - 10%	65%
Average difficulty (.30 through .70)	80 - 90	35
Low difficulty (more than .70)	5 - 10	0

Experimental group post-test

	Suggested	Observed
High difficulty (less than .30)	5 - 10%	0%
Average difficulty (.30 through .70)	80 - 90	80
Low difficulty (more than .70)	5 - 10	20

TABLE XII

SUGGESTED AND OBSERVED PERCENTAGES OF DIFFICULTY INDICES OF ITEMS USING THE TOTAL NUMBER OF STUDENTS ANSWERING THE ITEM CORRECTLY

Control group pre-test

	Suggested	Observed
High difficulty (less than .30)	5 - 10%	75%
Average difficulty (.30 through .70)	80 - 90	25
Low difficulty (more than .70)	5 - 10	0

Control group post-test

	Suggested	Observed
High difficulty (less than .30)	5 - 10%	60%
Average difficulty (.30 through .70)	80 - 90	40
Low difficulty (more than .70)	5 - 10	0