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ABSTRACT

This study sought to compare the relative values of the structured and unstructured approaches to the work experience portion of cooperative education programs with the additional objective of preparing guidelines for developing the structure of a work experience. A total of 32 students, 16 experimental and 16 control, from four Texas Community Colleges participated in the study. Four occupations, for which the National Occupational Competency Testing Institute (NOCTI) had prepared examinations, were selected. Competencies were identified for each occupation and the work experience was structured, based primarily on the identified competencies. All students were administered the appropriate NOCTI test as a pretest and assigned to training stations, where control students participated in a traditional unstructured work experience and experimental students participated in a work experience structured around the occupational competencies. At the end of four months all students were administered the NOCTI examination as a posttest. The conclusion showed that a more structured approach is more effective in teaching occupational competencies since students receive occupational knowledge at a higher, more consistent level. Lists of preliminary competencies are appended for air conditioning and refrigeration, printing trades, drafting, and auto mechanics. (Author/NJ)

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Final Report

Project No. VT0017VZ
Grant No. OEG-0-74-1707

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A STUDY OF STRUCTURED AND NON-STRUCTURED WORK EXPERIENCE PROGRAMS IN TEXAS

March 1976

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

National Center for Educational Research and Development

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ABSTRACT

The primary objective of this study was to determine the relative values of the structured and unstructured approaches to the work experience portion of the cooperative education program. An additional objective was the preparation of guidelines for developing the structure of a work experience program. Four institutions, representing the variations in population density and physical locations, were selected from community colleges in Texas. Four occupations for which the National Occupational Competency Testing Institute had prepared examinations were selected. Eight students were randomly selected from those enrolled in the selected cooperative education programs at each community college. The eight students were then randomly divided into two groups, four experimental and four control students. A total of thirty-two students, sixteen control and sixteen experimental, participated in the study. Competencies were identified for each occupation and the work experience was structured, based primarily on the identified competencies. All students were administered the appropriate NOCTI test, as a pretest, and assigned to training stations, where control students participated in a traditional unstructured work experience and experimental students participated in a work experience structured around the occupational competencies. At the end of approximately four months (one semester) all students were administered the appropriate NOCTI examination as a posttest. Pre and posttests were submitted to the National Competency Testing Institute for scoring, and the resulting data were analyzed by analysis of covariance. Conclusions are that a more structured approach to the work experience portion of cooperative education is more effective in teaching occupational competencies. Students receive occupational knowledge at a higher, more consistent level when participating in a more structured work experience program.

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FINAL REPORT

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PREFACE

The initiation and completion of this project was dependent upon the full cooperation of those institutions and their attendent personnel that permitted the alteration of their program format, so that experimental processes could be introduced. Appreciation is, therefore, extended to the instructional and administrative personnel of the College of the Mainland, Texas City; St. Philip's College, San Antonio; Tarrant County Junior College, Fort Worth; and Texas State Technical Institute, Waco.

Appreciation must also be expressed for the cooperation of the National Occupational Competency Testing Institute. They not only made available the test instruments used in this study, but expedited matters by hand scoring them.

Thanks also go to members of the Post-Secondary Division, Department of Occupational Education and Technology, Texas Education Agency, to personnel of Texas A&M University, and those others that served as members of the advisory committee. Their assistance was of utmost value.

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INTRODUCTION

Cooperative education has long been regarded by vocational educators as a practical means of providing students with an opportunity to learn the skills and technical knowledge required for effective functioning within an occupation. "Through such programs, existing educational opportunity is provided for the student to make the transition into the world or work. Equally important, cooperative vocational education is economically feasible for even the smallest school system (Butler and York, 1971)." Of particular benefit to the school system is relief from the requirement of properly equipping school laboratories and shops in a relatively sophisticated manner to simulate actual employment conditions. Of significance to the student is the opportunity to receive his occupational training within the actual environment of his future employment.

The Texas State Plan states that the term "Cooperative education program means a program of vocational education administered by a local public institution for persons who, through a cooperative arrangement between the school and employers, receive instruction by alternation of study in school with a job in any occupational field provided by public or private employers. Said experience must be planned and supervised by the school and employers so that each contributes to the student's education and to his employability (Texas State Plan for Vocational Education, 1972, p. 107)." The work experience or work experience program referred to in this study is that portion of the cooperative education program that involves on-the-job occupational competency development on the part of the student.

While the definition in the State Plan implies a fairly well structured work experience program with competency development within the occupational area as the primary objective, the design and execution of this training plan is left largely to the discretion of the employer conducting the training and the program coordinator. "An examination of the contracts for learning of over fifty colleges, universities, and secondary schools attempting experimental learning programs indicated that, with the exception of what is known as competency-based education, most of these agreements are imprecise. They seldom represent an understanding between student, employer, and the student's professor-advisor with respect to what is to be learned for what consideration, or by what means. Seldom is there a precise definition of the responsibilities of each party to the agreement, of what constitutes performance, or how it is to be measured (Graham, 1975, p. 167)." Since guidelines to ensure the uniformity of the work experience do not exist, one may assume that each person entering such a program may be the recipient of an entirely different learning experience from any other student, even though they are preparing for the same occupation.

Often personnel conducting the training are neither versed in instructional techniques necessary to transmit information to the student, nor properly prepared to measure the amount of learning. Furthermore, "Employers tend to expect productivity from cooperative vocational education students, while the student and the student's parents expect the on-the-job training station activity to have educational significance (Butler and York, 1971, p. 4)." In addition, "Findings indicate on-the-job training programs can be too narrowly conceived unless care is exercised to ensure students are moved through a planned sequence of skill development (Butler and York, 1971, p. 4)."

While paragraph 9.22 of the Texas State Plan for Vocational Education (1972) stipulates that such a program, ". . . not result in exploitation of the student-learners for private gain, and, is conducted in accordance with a written training plan or agreement between local education agencies and employers, . . ." the training plans do not, in most instances, state daily training objectives or competencies to be attained by the student. Nor do they provide for progressive attainment of competencies based on reliable evaluation. This leads to speculation that such training often provides less competency development than that which would be attainable through a more structured program.

Further confounding the issue is the fact that cooperative education practices in Texas have been largely restricted to secondary education (grade 9-12) with virtually no implementation at the post-secondary level. Enrollment in post-secondary cooperative education programs in Texas was estimated at 82 students during the academic year 1972-73, with a projected enrollment of 141 students for the 1974-75 academic year (Texas State Plan for Vocational Education, 1971, p. 121)." Rapid expansion of post-secondary cooperative education programs, where definitive guidelines have not been established, leads to the speculation that these programs could be totally unstructured and employment oriented as are many secondary programs, rather than educationally oriented.

The problem is thus seen as one of providing the student an educationally effective work experience while in cooperative education programs at community colleges in Texas and to insure that such programs prepare students with in-depth competency development in their specific occupations.

Since the community colleges of Texas have not become greatly involved in cooperative education as yet, this study is viewed partly as an instrument through which institutions may be encouraged to implement such programs and that the program will achieve the aims of vocational education to the degree that it will ". . . equip students with skills, knowledge and thought processes that will provide them with at least minimum performance capability for unimpaired entry into the national work force (Lorenzen, 1974)."

Most educational institutions readily admit the advantages and the necessity of structuring more formal course work through the use of lesson plans and behavioral or competency objectives. It was intended that this study develop guidelines which may be used to similarly structure work experience programs.

This study has also provided a determination of the relative values of the structured and unstructured approaches to the work experience phase of cooperative education programs. This determination will give educational planners hard data on which to base their approach to future programs in cooperative education.

In the book, Curriculum Improvement, Decision Making and Process, Ronald C. Doll states that, "A major consideration is the process of moving from objectives to concrete learning processes. That learning experiences for students may be defined as interactions between learners and their environment which create behavioral changes in the learner (Doll, 1970, p. 141)." The two sentences of this quotation are particularly significant since the first sentence provides the essential motivation for the study and the second defines the conditions under which the learner must develop job competencies.

Purpose

The primary objective of this study was the determination of whether a structured post-secondary work experience program possesses any significant advantage over a traditional (unstructured) post-secondary work experience program in developing occupational competencies. Preliminary research and review of pertinent literature did not reveal any evidence that suggests an effort to structure work experience at the post-secondary level. However, work experience structured around pre-defined competency goals may intuitively be suspected of having superior impact upon the competency development of any student preparing to enter an occupation directly related to the work experience.

Subordinate objectives may be stated as follows:

A. The preparation of guidelines for identifying occupational competencies.

B. The preparation of guidelines for developing structured work experience programs.

C. Clarification of the relative benefits that might accrue to students enrolled in either a traditional work experience program or a structured work experience program.

The 1968 General Report of the National Advisory Council on Vocational Education States:

> Vocational Education was created in response to a social need for an educated labor force, and was designed as a function and responsibility of public education. Vocational education in its total environment is, and must continue to be sensitive to the dynamism of contemporary society. As society changes vocational education adjusts accordingly. But through these adjustments its concern is directed toward people, in an educational setting, who provide the goods and services required by society. (1968)

The cooperative education program at the community college level is a recent educational change in response to current societal needs and the objective of determining the best of two alternative approaches to the execution of the work experience portion of this program would, logically, impact upon this change.

Hypothesis

In view of the possibility that a structured program of work experience is more effective in developing the skills and knowledge of students in cooperative education programs, the following null hypothesis has been selected for statistical testing:

Students enrolled in a structured work experience phase of a cooperative education program will not score significantly different on the written portion of the National Occupational Competency Testing Institute tests than students enrolled in a conventional non-structured work experience phase.

Assumptions

The basic assumptions of this research were predicated on a combination of existing conditions and specific actions. For example, the four community colleges participating in this study were selected, in part, to represent the range of town size from small, as with College of the Mainland in Texas City, Texas, to Tarrant County Junior College in Ft. Worth, Texas. In addition, thirty two students were selected, at random, as representative of the population of community college students in cooperative vocational education. This sample is assumed to be representative of the population since at the time of sample selection only six community colleges in Texas had programs of cooperative vocational education, with an enrollment of 141 students. The thirty two students selected in the sample were then placed in the control or experimental groups by random assignment.

Another assumption is that the one semester (approximately four months) instructional time was sufficient for attainment of measurable changes in the competencies of the students. This assumption is based on the fact that the semester has long been established in education as an adequate period of time for students to attain established objectives relative to subject matter, and students in this study had previously experienced formal in-class instructions in the subject area.

The student's performance as measured by the written portion of the occupational competency test, as developed by the National Occupational Competency Testing Institute, was used as an indication of the student's knowledge in his occupational area. "The National Occupational Competency Examinations were developed by skilled tradesmen and test development specialists from every part of the nation. Each examination was reviewed by experienced craftsmen, then revised and pilot tested in Area Test Centers throughout the nation. Competent people from each occupational area and candidates who took the examinations judge them to be fair, comprehensive samplings of the knowledge and skills the particular occupation demands (Educational Testing Service, 1974)."

It was also assumed that differences between the score means, obtained by the control and experimental groups, was a result of differences in teaching approaches. Variables that may have contributed to an invalidation of posttest scores were controlled by random selection of students for the investigation, random assignment of students to control and experimental groups, and random assignment of students to selected work sites. In addition data were analyzed by analysis of covariance to determine if significant differences existed between the control and experimental groups.

Differences in working environments between control and experimental students were assumed to have a tendency to balance out, and not significantly affect test performance between the two groups. Work sites were selected, where possible, to reflect the spectrum of opportunities that appear within each occupational area. Business size, volume, and location relative to city population were factors considered in making the selections of work sites.

Limitations

This study was subject to the following limitations:

Students participating in the study were selected from four community colleges in Texas; College of the Mainland in Texas City, St. Philips College in San Antonio, Tarrant County Junior College in Ft. Worth, and Texas State Technical Institute in Waco, Texas.

The student sample consisted of 32 students, 16 assigned to a control group and 16 assigned to an experimental group.

Both groups were limited to one semester (approximately four months) of on-the-job work experience.

The study was limited to five occupational areas, air conditioning and refrigeration, automobile mechanics, construction electrician, drafting and offset printing tracks.

Instruction provided for students in the control group was that which was agreed upon by the school and the business doing the training. Instruction provided to experimental students was based on specifically sequenced learning experiences which were judged necessary to develop pre-determined competencies and agreed upon by the employer, the research study advisory committee, and the investigator.

Students participating in the study were randomly selected from the population of students, in the four community colleges, who were entering the work experience phase of their cooperative education programs. In addition, students randomly selected for the study were randomly assigned to control and experimental groups.

In light of these critical limitations, it is not intended that the findings revealed in this study be generalized to circumstances beyond those described here.

Definitions

Definitions of the terms used in this study are listed below. The definitions come from a variety of sources, the source being indicated in each case.

Cooperative Education Program is defined as; "A program of vocational education administered by a local public institution for persons who, through a cooperative arrangement between the school and employers, receive instruction by alternation of study in school with a job in any occupational field provided by public or private employers. Said experience must be planned and supervised by the school and employers so that each contributes to the student's education and to his employability (Texas State Plan for Vocational Education, 1972, p. 107)."

Competency is defined as ". . . having requisite or adequate abilities or qualities (Websters Collegiate Dictionary, 1973)." For purposes of this study, competency takes on a more behaviorally oriented meaning. This condition is aptly described in the following: "By terminal behavior is meant the prescribed learner behavior occurring at the culimination of any instructional sequence. This prescription takes the form of explicitly stated instructional objectives describing end-of-sequence performance in competency terms (Lawson and Wentling, 1974, p. 63)."

Structured Programs as referred to in this study are those programs based on identified competencies that constitute a listing of desired terminal behaviors as described by the following:

> In order to determine the successful accomplishment of a terminal objective, one must first analyze the behavioral prerequisites (i.e., the en route behavior deemed necessary on the part of the learner). The analysis of a learning task, wherein the terminal objective is subordinately analyzed to ascertain interim behavioral requisites, will provide enabling instructional requirements for the derivation of effective learning activities. Beginning with the terminal objective, a behaviorally-based instructional strategy can be systematically

> formulated to provide for the design of learning experiences in which the learner may be involved to attain the objectives. This process will result in a task description of en route behaviors which subsequently suggest to the instructor criteria regarding sequencing and mutual identification of differing classes of learned performance which necessitate appropriate learning conditions (Gagne', 1970, p. 64).

<u>Unstructured Programs</u> are those cooperative education programs that are vague in many of the areas considered crucial to effective learning. This type of program is well defined in the following:

> An examination of the contracts for learning of over fifty colleges, universities, and secondary schools attempting experimental learning programs indicated that, with the exception of what is known as competency-based education, most of these agreements are imprecise. They seldom represent an understanding between student, employer, and the student's professor-advisor with respect to what is to be learned, for what consideration, or by what means. Seldom is there a precise definition of the responsibilities of each party to the agreement, of what constitutes performance, or how it is to be measured. They are not valid contracts. Rather, they are, as a rule, statements of intent with only general descriptions of a work setting and time to be spent there (Graham, 1975, p. 167).

<u>Work Experience</u> for the purposes of this study is well defined under the term action-learning in the following: "Action-learning is learning from experiences and associated study that is or could be accredited by an educational institution. Action-learning embraces the experimental learning components of work study, cooperative education, work-service, on-the-job training, and self directed work and study . . . (Graham, 1975, p. 162)."

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

In many respects cooperative vocational education is a unique approach to teaching skills and knowledge to students in the educational system. It creates a dual responsibility shared by the schools and the community to provide an educational experience that will allow the student to develop into a productive part of society.

Cooperative vocational education is a "learn and work" program. From its beginning cooperative vocational education assumed the posture described in the following:

> Cooperative vocational education is a program of vocational education developed jointly by the school and business, industry and agriculture. Its goal is the development of occupational competency of the student. Choice of the occupational field studied while in school is based on the student's stated career objectives. Job skills and job adjustments are secured through an organized sequence of job related experiences in paid, part-time employment and classroom-related instruction (Huffman, 1971, p. 302).

Doctor Rupert N. Evans states that, "Over fifty years ago, the University of Cincinnati decided that engineers could be better educated if they spent part of their school career in employment and if the school program could be related to the things that the student learned on the job (Evans, 1971, p. 282)." Although the University of Cincinnati was among the first post secondary schools to recognize the need for practical experience as a part of education, this early beginning was preceded by cooperative education programs at the secondary and adult levels. For example:

> The distributive education movement had its beginning as an organized school activity in 1905 under the leadership of Lucinda Prince of the Womens Educational and Industrial Union. She organized her first class of eight girls for store training. In 1906, she started her third class with a promise from William Filene's Sons Company of practical store experience on mondays. High school retail training classes

> began in Providence, Rhode Island, about 1910 and Fitchburg, Massachusetts, about 1911. Daily work experience as a basic principle of cooperative occupational training was developed in those early classes (Mason & Haines, 1965, p. 32).

The fact that cooperative vocational education continued to grow is evident in that: "Forty-nine cooperative programs in retailing in 20 different states were organized between 1917 and 1936. Distributive education for adults grew through the organization of extension classes and the use of itinerant instructors (Digest of State Vocational Boards, 1959, p. 28)."

In 1936 the efforts of Dr. Paul Nystrom and Frederick G. Nichols were rewarded by the passage of the George-Deen Act. This act authorized the appropriation of up to $1,250,000 for distributive education each year and provided the first real impetus for progress in the field (Mason & Haines, 1965, p. 35).

The success experienced by distributive education programs was representative of the growth of all cooperative vocational education programs. "In 14 years, the cooperative part-time program grew from 3,600 students in 1938 to a total of 34,972 in 1952 (Mason & Haines, 1965, p. 35)."

In the early 1960's a number of societal pressures began to create a new meaningful thrust toward cooperative education programs.

> Why such interest in Cooperative Education? A number of events from the 1960's to the present account for the up swing: the rise of the 2-year community college, declining college enrollments coupled with shrinking financial support, inflation, recession, and a generation of students seeking to make practical contributions to society. But perhaps most important is increased acceptance of the notion that practical experience adds significantly to a student's total education (H.E.W., 1975, p. 2).

The acknowledged value of practical experience in the educational process contributed to a rapid expansion in the number of schools offering cooperative education programs. In the 15 years from 1960 to the present, cooperative education has grown from approximately 45 colleges and universities offering cooperative programs, to an estimated 1,000 colleges and universities with more than 160,000 students enrolled in cooperative programs. The movement toward cooperative education has been so persistant that some educators now estimate that by 1984 at least half the institutions in the United States will offer some form of cooperative education (H.E.W., 1975, p. 2).

One additional factor has created tremendous impact on the growth and expansion of cooperative education programs since the early 1960's. This is the participation by the Federal Government through legislation which provided guidance and funding to support the growth of cooperative education. The 1963 Vocational Education Act provided guidance to the states for the inclusion of cooperative education in state plans for vocational education. Federal funds in support of Cooperative Education were authorized by Title IV, Part D, of the Higher Education Amendments of 1968, however, program funds were not identified as a separate entity until fiscal year 1972. In fiscal years 1970 and 1971, one percent of the sum appropriated for the College Work-Study program was allocated for cooperative education. The full funding level of $10.75 million was reached in fiscal year 1973 and has remained at this level to the present (H.E.W., 1975, p. 2).

Federal participation in cooperative programs has generated a high level of interest among educators, employers and communities. The following table reflects this growing interest.

Table 1

RECENT FEDERAL FUNDING FOR COOPERATIVE EDUCATION PROGRAMS

FY	FUNDING LEVEL	AVG. GRANT	NO. OF GRANTEES	NO. OF APPLICATIONS RECEIVED	REQUESTS IN $$$
70	$ 1,540,000	$20,000	74	206	$ 8,500,000
71	1,600,000	17,582	91	344	12,300,000
72	1,700,000	20,238	84	291	11,000,000
73	10,750,000	30,281	355	642	28,000,000
74	10,750,000	33,527	371	641	28,000,000
75	10,750,000	*	*	770(est)	33,000,000

(* Figures not available) (Adapted from H.E.W., 1975, p. 2)

While it may be correct to say that cooperative education began as a local educational plan, the growth and success of that plan must look, in substantial part, to the substance provided by Federal support. The effect of federal leadership on the growth of cooperative education is evident in the above figures. Between FY'70 and FY'74, the number of applications for funding grew from 206 to 641, for an increase of over 300 percent. Even more astounding is the growth in the number of grantees, which grew from 74 in FY'70 to 371 in FY'74, for a 500 plus percent growth in only four years. In addition, the rapid growth in grantees has been accompanied by a substantial increase in the average value of each grant. (From $20,000 in FY'70 to $33,527 in FY'74) Estimations for FY'75 continue to reflect the expanding interest in cooperative education programs.

Current Status

Cooperative vocational education is a combination of on-the-job training and related classroom instruction. In this sense it fits a broad classification of programs that produce skilled workers through on-the-job training. In spite of broad similarities to other programs, cooperative vocational education is a unique program, as is seen in the following:

> Cooperative vocational education is unique in a number of ways: the age group involved is in-school youth, many of whom barely meet the minimum age prescribed by the child labor laws; it is a program in which learning activities are shared between the schools and business and industry in the community; the program is authorized by Congress and funded jointly by the local communities it serves.
>
> The primary objective of the program is to produce skilled, responsible young adults who can assume a productive place in our technical society after graduation from high school (Huffman, 1971, p. 301).

To accomplish the task of producing skilled, responsible young adults, requires the combined efforts of industry and schools in providing a program that will enjoy any level of success in achieving the stated objectives.

In the article, Cooperative Programs: Advantages and Disadvantages and Development, by Rupert N. Evans, a number of advantages are shown to be inherent in cooperative education programs. For example, the Advisory Council on Vocational Education established to evaluate the implementation of the Vocational Education Act of 1963, stated that cooperative education had the best record of all vocational programs in terms of the proportion of students placed in the occupation for which they were trained. Typical research studies for this period show that more than 80 percent of the graduates are so placed (Evans, 1971, p. 283).

In addition to the excellent record of effectiveness enjoyed by cooperative programs, a number of other advantages accrue to students and schools employing this method of education. One advantage of particular interest today is revealed in the following:

> Studies of the economics of vocational education show higher rates of return on investment in cooperative programs than in other types of vocational education. (Capital costs for the school are lower, and since the student is receiving wages for on-the-job portion of the program, the costs for the individual are lower (Evans, 1971, p. 283).

In speaking of the Vocational Education Act of 1963, and the economic position enjoyed by vocational education, Dr. Evans states that Congress has responded to this evidence by earmarking funds for cooperative programs and by authorizing for the first time the use of such funds to reimburse employers for the excess costs they incur through cooperation in the programs (Evans, 1971, p. 283).

Other advantages can be seen in the fact that cooperative education, by design, allows quick adaptability to changes in labor market demands, eliminating the problem of changing in-school vocational programs to meet the needs of a rapidly changing industrial world. Since students are placed on jobs during training, the opportunity to obtain full-time employment, in the same job, is vastly improved. Work atmosphere found in the job setting, is very difficult, if not impossible, to simulate in the school setting. This makes the development of realistic attitudes toward speed, quality, and efficiency an extremely difficult task. Yet in the jobs found in industry, both attitudes and atmosphere are an inherent part of the setting and are automatically a part of the education received by students working in this setting.

At first glance it may appear the cooperative vocational education is the perfect educational process that solves all problems and has nothing but good results to show in meeting its objectives.

Unfortunately this is not the case. Cooperative vocational education has a number of inherent disadvantages that constantly create new and difficult problems for educators.

Among these are the difficulty in adapting the program to some communities, those which are so small they offer a very narrow range of available training stations, communities which are declining in population, and communities which have occupations that are becoming obsolete.

In areas of strong unions and strong employee agreements, cooperative program coordinators may have difficulty finding training stations for students. This is especially true when unemployment is a problem (Evans, 1971, p. 286).

Often student availability for jobs exceeds the communities ability to provide training stations.

In some cases vocational educators in state offices are not in favor of strong cooperative education programs. This opposition finds voice in restrictive regulations as is seen in the fact that some states have regulations excluding cooperative work experience (CWE) in those occupations which require less than two years for the "average worker" to learn. In this sense, by definition, half of all students are below average in their ability to learn and half are above average. "Any attempts to specify the length of time required by an "average" person to learn an occupation may be described as an exercise in futility. All socially desirable occupations should be available to students through CWE (Evans, 1971, p. 288)."

Additional problems are involved in the operation of cooperative programs in larger cities. Coordinators, in order to place students, must get into the community. Thus travel time becomes a major factor in each day's planning. Further, large cities are more likely to have industries that have large union organizations that create a need for greater coordination between the school and the training station, to avoid problems of employing students (Evans, 1971, p. 288).

Two factors revealed by a recent study point out problems within the educational institutions that create difficulty for the school and student in cooperative programs. The first factor is seen in the following:

> While co-op education programs should be a "three-way partnership" among students, employers and schools, evaluators with the CONSAD Research Corporation found "No single or consistent structure, purpose,

> philosophy or objectives." This isn't necessarily bad, the report said, unless program goals are cloudy. In some cases schools adopt goals which are some times in conflict, and this can result in operational confusion, particularily where priorities are unclear. For example a school may adopt as a goal the provision of career exploration opportunities--which implies permitting students to try several different kinds of co-op assignments--and providing job skills--which implies having students return to the same co-op job repeatedly to gain such skill." the report noted (Ed. Daily, 1975, p. 6).

The second factor, applying directly to the objectives of this study, is seen in the following:

> Even if a program appears to be working, the lack of a commonly-accepted definition of co-operative education and resulting diversity of programs "indicates that no single set of 'performance' or 'success' criteria can be established for such programs." First you have to establish an individual programs' purpose and priorities and then evaluate how well it's stated goals are being met (Ed. Daily, 1975, p. 6).

One of the objectives of this study was to establish a comprehensive set of goal statements in the form of competencies the student will be able to perform at the end of his training period. By making the list of competencies a comprehensive representation of the objectives the student is working to attain, the criterion for performance and probability of success within a specific occupation can be established for purposes of student evaluation and, in time, program evaluation.

Competency Identification Process

Much of the research associated with competency identification has been accomplished by individuals involved in developing competency-based programs of teacher education. The process employed to identify such competencies did not appear to follow an established pattern or model. In addition the competencies identified for teacher education are substantially different than those required by industry. The primary difference being that competencies identified for competency-based teacher education programs are professional education competencies-defined as . . . "those knowledges, skills, and judgements included in the required education experiences (Cook and Richey, 1975, p. 30)." Industrially oriented competencies also include knowledge, skills, and judgements, but are more task oriented. A study of "Functional Job Analysis" defines the fundamental unit of work as the task, and then defines the task as follows:

> A task is an action or action sequence grouped through time designed to contribute a specified end result to the accomplishment of an objective and for which functional levels and orientation can be reliably assigned . . . (Fine and Wiley, 1971, pp. 9-10).

The ability to accomplish the task, as defined above, is competence.

The process by which one arrives at a comprehensive list of competencies is one of the objectives of this study. If principles and functional guidelines are to be held as valuable in providing direction in other facets of life, then it should hold true that a defined process or model to follow in identifying competencies would have value for those involved in such an activity. Further, data revealed in this study indicates a need for a framework on which to base a more structured approach to the instructional sequence for the work experience portion of the cooperative vocational education programs. A more structured approach, based on competencies, can best serve the needs of both the student and industry.

As viewed by the Competency Evaluation Laboratory, United States Air Force, the competency identification process allows a static picture of the entire career field or occupational area because it measures the performances of all levels of experience in developing a competency listing. The thrust of the process is to determine what competencies are required to do the job, how long the competencies will take to accomplish, and what are the relative difficulties in the competencies (Comp. Eval. Center Interview-1974).

The U. S. Naval Personnel Research Activity at San Diego, California, has developed the methodology employed by Naval organizations when structuring competencies. Tasks or competencies have been structured by level of complexity, which is defined as a hierarchical quality of tasks under which a series of other tasks is subsumed on an index of functional variety (Silverman, 1965, p. 2).

This study reviewed the competency identification processes of a number of activities, both industrial and educational, with the objective of combining the most applicable portion of each process into a single model to serve as a guide in identifying competencies for occupations involved in cooperative vocational programs.

CHAPTER III

METHODOLOGY

Introduction

When an investigation is conducted using the strategies of experimental research, there is an obligation to do more than make observations. The necessities in this form of research are well stated By Dr. Deobold B. Van Dalen: "Experimentation, as distinguished from observation, consists in the deliberate and controlled modification of the conditions determining an event, and in the observation and interpretation of the ensuing changes in the event itself (Van Dalen, 1973, p. 259)."

This investigation was conducted as experimental research and the methods and procedures employed were selected because they met the investigative needs of this study and followed the strategies of experimental research.

Procedure

Recognizing the presence of limitations to the generalizability of findings resulting from this study, it was decided that applicability might be enhanced by selecting institutions that represented diverse geographic regions of the state as well as differing community sizes. To this end, the cooperation of four institutions was obtained. These were: The College of the Mainland, Texas City, with its Gulf Coast location and representing the smaller community. The Texas State Technical Institute at Waco was selected because of the central and somewhat larger community location. St. Philip's College in San Antonio is located in the south-central part of Texas and serves a metropolitan area. Tarrant County Junior College in Fort Worth, with its northern location also represents the "metroplex" area of the Dallas-Fort Worth region.

All cooperative vocational education programs conducted by each of the selected institutions were identified. From each listing, cooperative education programs were chosen that provided training in those occupations for which the National Occupational Competency Testing Institute had prepared examinations. The occupations selected were, automechanics, air conditioning and refrigeration, construction electrician, drafting and offset printing.

Eight students were randomly selected from those enrolled in the selected cooperative education programs at each community college.

The eight students were then randomly divided into two groups, four experimental and four control students. A total of thirty-two students (sixteen control and sixteen experimental) participated in the study.

Job assignments for control students were made without unusual coordination between the community colleges and local employers. Specific responsibilities of students while on the job and evaluation of their ability to discharge these responsibilities as well as determining the acceptability of their skill development was not modified. Coordinators were asked to follow their previously established routine in all aspects of training activities for the control group. To the extent that special modifications were not made, these activities were labeled as unstructured. Experimental student job assignments were made after special coordination between local employers, community college, and Texas A&M University (TAMU) research personnel. Employers were selected to provide experimental student training only after each employer had expressed an understanding of the approach to be used with experimental students, and had indicated a willingness to pursue this structured program. The instructional technique employed for the experimental students was based primarily on a set of identified and ranked competencies for that occupation. Progress of each student was closely monitored by shop instructors (employers) and community college coordinators. As the student achieved a satisfactory level of performance with respect to one competency, his job assignment was changed to allow pursuit of the next competency.

Competency Identification

Competencies identified for each selected occupation provided the basis for structuring the work experience. In this process the essential competencies for each occupation were identified and the sequence of events involved in the process are presented as the Competency Identification Model. The purpose of this model is to provide a sequential set of events that leads to the listing of competencies essential to a given occupation.

The first step in developing this model was to review the competency identification steps employed by a number of organizations throughout the United States. Each process was analyzed to determine those features that were both crucial to the process and applicable to the occupational areas in this study. The features that met these criterion became the primary elements around which the more comprehensive competency identification model was developed.

The organizations included in the review of competency identification processes were, the Competency Evaluation Laboratory

United States Air Force, U.S. Naval Personnel Research Activity, United States Navy, The Vocational Instructional Services, Texas A&M University, The Upjohn Institute for Employment Research, and Battelle Columbus Laboratories, for the Manpower Administration.

The United States Air Force

The competency identification process employed by the USAF is a two level process: the first being the procedure for identifying preliminary job competencies; and the second, the process employed for constructing more permanent job competencies.

Preliminary job competencies are identified by reviewing career development course (CDC) materials, Air Force job descriptions, and specialty training standards (STS) for the career area under study. From this review a tentative task listing is prepared. The tentative task lists are further reviewed in a personal interview between personnel from the occupational survey center and senior operational personnel within the career area. A preliminary list of occupational competencies is developed during this meeting.

The Occupational Survey Center, at Lackland Air Force Base, Texas, using the preliminary list of competencies, prepares a field review document and distributes the document to Air Force operational units throughout the world. Operational unit personnel review the document and make suggestions for additions and modifications in the preliminary list of competencies. Accepted changes are incorporated into the document by the Occupational Survey Headquarters, and the document is put in final form. The completed document is mailed to individuals within the career area, with the request that the competencies be rated as to the amount of time spent performing each competency, and the relative difficulty in accomplishing each competency.

The degree of comprehensiveness of the survey within a given career area is determined by the number of individuals assigned to the area. If less than 3000 persons are assigned, a 100% survey is conducted, if over 3000 persons a stratified random sample is selected for survey purposes.

When the data is returned to the Occupational Survey Headquarters, computer analysis is conducted to determine the amount of time spent on, and the number of people performing each competency. In addition, the relative difficulty of each task, based on the time required to learn and the time necessary to perform the competency, is determined. These data are used to establish instructional timing and sequencing.

This identification process reveals a static picture of the entire career field relative to the competencies, because it measures the performance of all skill levels within the skill area in a single survey. The thrust of this process is to determine what competencies are required to do the job, the relative difficulty of teaching, and the amount of time spent performing each competency (Competency Evaluation Center Interview, 1974).

The United States Navy

The United States Naval Personnel Research Activity at San Diego, California, has developed a methodology employed by Naval organizations when identifying competencies. For these purposes the task or competencies have been identified by level of complexity in the functional and equipment areas.

Complexity, for functional indexing purposes, is defined as a hierarchical arrangement of tasks under which a series of other tasks is subsumed on an index of functional variety. A group of judges, selected on a basis of experience, rate tasks and equipment in specific occupational areas to determine an index of functional complexity. These two indices are then combined into a consolidated score of complexity for each task identified as the task complexity classification index (TCC).

Validation of the TCC index is accomplished by:

1. A comprehensive review of occupational analysis and job evaluation literature to establish criteria, variables, and factors used in distinguishing different levels of skills within an occupation under study.

2. The development of scales. One scale for operations tasks and one for maintenance tasks, the levels of which are carefully defined in terms of technical tasks.

3. A definition of each level so as to include all those below it. Those having the ability to perform at level four, also have the competencies necessary to perform at levels one, two and three.

In an effort to eliminate marginal and deviant values, it was considered desirable to develop more discrete scale values for each task. The elimination of polar values in calculating the mean indices of functional complexity for the two scales was encouraged to promote the possibility of combining the operations and maintenance structures into a single scale. This procedure involved the following steps:

1. The ratings for each item on the task lists were recorded and arranged in the form of frequency distribution.

2. The model value in each distribution was identified and designated as a "core" value. If the value on either side of the "core" constituted at least 10 per cent of the total ratings of that task, it was retained for calculation of the mean. If a value that was two levels distance from the "core" constituted at least 25 per cent of the total, it was also included. All other ratings were eliminated.

3. The means were computed and recorded using the two structures of functional scales after elimination of deviant values.

The end product of this process is a task listing that considers the level of complexity, degree of difficulty, and hierarchical position of each task within an occupational area (Silverman, 1965).

Upjohn Laboratories

Upjohn Laboratories views human performance as involving three types of skills, these are adaptive, functional and specific content skills.

Adaptive skills refer to those competencies that enable an individual to manage the demands for conformity and/or change in relation to the physical, interpersonal, and organizational arrangements and conditions in which a job exists.

Functional skills refer to those competencies that enable an individual to relate to things, data and people (orientation) in some combination according to personal preferences and to some degree of complexity appropriate to abilities (level). They include skills like tending or operating machines, comparing, coupling or analyzing data, and exchanging and supervising people. These skills are normally acquired in educational training and vocational pursuits and are reinforced in specific job situations.

Specific content skills refer to those competencies that enable an individual to perform a specific job according to the standards required to satisfy the market.

In effect, the degree to which a worker can use his functional skills effectively on a job is dependent on the degree to which his adaptive skills enable him to accept and relate to the specific content skill requirements.

When observing workers on the job as part of the competency identification process, the observer must recognize that he will see only what is occurring in the foreground, and therefore must examine the job in more depth to discover information concerning the following:

1. The functional involvement with all three primitives; things, data, and people relative to level and orientation.

2. The nature of the instructions--what is prescribed and what is descretionary.

3. The specific conditions requiring adaptive skills.

4. The functional level of educational requirements.

5. The specific knowledge areas involved, and resources immediately available for acquiring information.

6. The methods by which standards are achieved.

Functional job analysis has been useful as an analytical tool because it conceptualized both the whole and the parts of human performance and purports to define all the possible ways of human functioning (Fine and Wiley, 1971).

Texas A&M University Vocational Instructional Services

The overall objective of the Texas A&M Vocational Instructional Services Department is to place the individual in the trade with sufficient skills and knowledge to be a complement to his trade, and a worthy citizen in his community.

The process employed to identify the skills (competencies) and knowledge, to meet the above objective begins with an advisory committee composed of experts in the specific trade area under study. This advisory committee provides: (a) an initial list of trade tasks, (b) an indication of the relative complexity of each task, (c) a review of each preliminary task to determine its need within the industry, and (d) the hierarchical positioning of each task in an instructional sequence.

The rest of the identification process used at TAMU is organized into phases. Phase one begins with a comprehensive review of all trade resource material to determine the accuracy and completeness of the preliminary list of tasks. In addition, a series of on site observations are conducted to further verify the accuracy and completeness of the task lists as seen by persons performing the tasks. Trade representatives who possess expertise within the occupation are selected to further develop the task lists and related information necessary for successful teaching of these tasks. TAMU subject matter specialists, aided by trade representatives, organize and publish the lists of tasks and related information.

In phase two, the tasks and related information are organized into major blocks and lessons for instructional purposes. Each block and its subdivisions are validated on the following:

- Are trade references adequate?

- Are teaching aids adequate?

- What is the fog index (clarity) of the teaching materials?

- Do the tasks and/or competencies meet the established objectives for the occupations?

In phase three, the validation of instructional materials is completed by instructors teaching the courses based on this material. As an instructor completes a teaching block, he evaluates the material on the validation items listed in phase two, and returns the evaluation to the Vocational Instructional Services Center at Texas A&M University.

An analysis phase is conducted by Texas A&M Vocational Instructional Services personnel in which each instructor's evaluation is included. The evaluations are analyzed to determine: (a) the relevancy of the trade tasks and/or competencies for instructional purposes, and (b) the adequacy of the teaching materials for the occupational area.

In the publication phase, the results of the instructor appraisals are incorporated into the next publication of task lists and teaching materials (Texas A&M Vocational Instructional Services Interview, 1974).

Battelle Laboratories

The major objectives of the Battelle Laboratories study were twofold: 1. To reduce discrepancies between the skills desired by the employer and the skills produced by existing curricula for ten entry-level occupations, and 2. To develop a methodology whereby school systems can keep this discrepancy small.

The initial procedure incorporated in the job-content methodology was to describe each entry-level occupation in terms of job tasks that an entry-level employee may have to perform within a hiring organization. This was accomplished by performing two principal steps. First a member of the research team determined job tasks as well as job-task classes for an occupation. This was accomplished by studying available occupational information (e.g., texts, curriculum guides, job descriptions, training manuals, etc.), consulting with selected employers, educators, practitioners within an occupation, and employment service personnel. Second after the occupation had been structured by job tasks grouped according to meaningful (in terms of the occupation) job-task classes, the job tasks were further reviewed by other members of the research team for clarity and by additional content experts for relevancy in the occupation (i.e., meaningful representation, omissions or errors in the tasks or classes, proper vocabulary, etc.).

Additionally, members of the research team studied occupational documents and interviewed employers, technologists, equipment manufacturers, and others in an effort to identify short-run changes in the ten occupations studied. It was felt that information about such changes would be useful in developing curricula that would remain current for, at least, a few years. The expected new job content was then expressed in terms of task content (Stuart, 1972).

Competency Identification Summary

Each of the task and/or competency identification processes, described in the previous section, included features considered essential to the competency identification process. As shown in Figure I, many of the steps are reflected by two or more of the reviewed sources. For example every source includes a review of occupational literature among the first steps to be accomplished in developing task lists. In addition, four of the five sources included a review of the task lists by occupational personnel prior to developing tentative lists of competencies for the occupation. The occurrence of specific identification steps in a number of the processes lends credence to the inclusion of that step in a model to be used in identifying competencies for all occupations. The salient features of each identification process have been incorporated into a Competency Identification Model and presented in this study.

FIGURE I

SUMMARY OF COMPETENCY IDENTIFICATION STRATEGIES

	Review of Literature	Tentative Task List	Review by Field	Tentative Competency Lists	Rating Competencies for: Teaching difficulty	Complexity	Time spent doing	Time required to do	Rating Competencies for: Adaptive skills	Functional	Specific skills	Final Review of Comp.
USAF	X	X	X	X	X		X				X	X
NAVY	X	X	X	X	X		X				X	X
UPJOHN	X	X			X	X	X	X	X	X	X	
BATTELLE	X	X	X			X	X	X		X	X	X
TAMU	X	X	X	X	X	X						X

The U. S. Department of Health, Education and Welfare/Office of Education, Publications, "Organization and Operation of a Local Program of Vocational Education," makes the need for advisory committees apparent in the statement, "Because vocational education has goals that involve preparation for the world of work, from the beginning it has been found necessary to turn to those who represent the occupational world for advice and information concerning the nature and content of the program (H.E.W., 1968, p. 29)." In this instance the guidance and information provided by the advisory committee was crucial to the development of a meaningful competency identification process. (Figure II)

The development of tentative task lists for each occupation is based on three data sources: The first being a review of pertinent literature to determine a set of tasks associated with each occupational area. The tentative task lists were then reviewed by representatives from associated industrial and educational areas for accuracy, completeness, and currency.

After modification of the tentative task list, the task lists were reviewed by personnel at the operational level of each occupation. This review involved an analysis of each task to determine the actual relevancy to, and level of need for the task, as seen by persons doing the jobs.

After each set of tasks were finalized a tentative set of competencies were identified from the task lists. Competencies identified at this point are those abilities the student most internalize in order to be able to accomplish the tasks. In addition, the physiological functional requirements of each task were determined to establish the physical needs relative to a specific occupation. Tentative competency lists were then reviewed by representatives from industry and education to insure their validity.

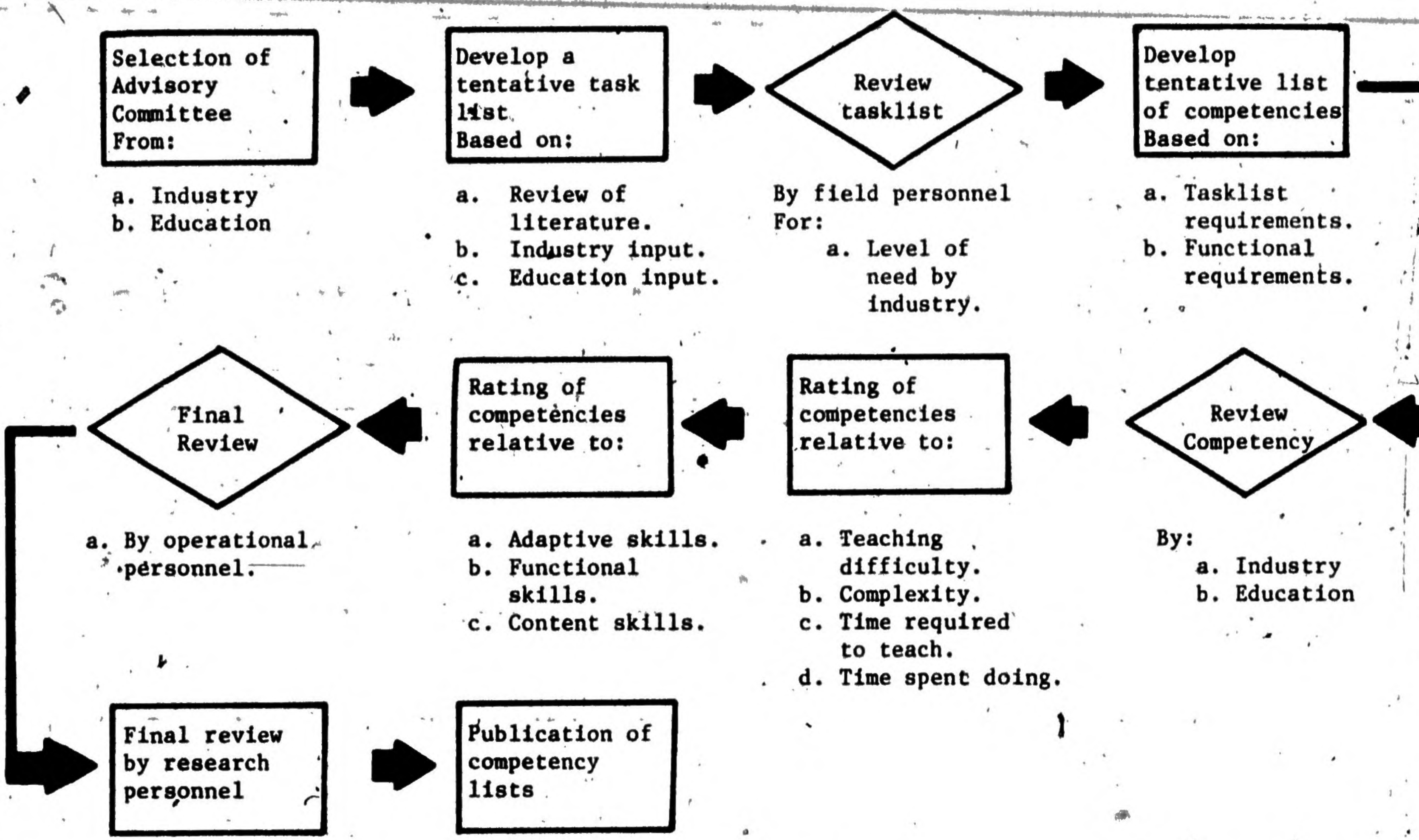
Educational personnel at each community college involved in the study rated the competencies in the following areas:

1. Teaching difficulty - competencies were ordered to allow progression from one competency to another based on the relative difficulty of teaching that competency.

2. In addition to a teaching difficulty rating, each competency was rated for complexity. This provided additional data on which to base sequencing and time allotments for teaching the competency. Complexity ratings were assigned on the basis of the amount of cognitive data to be internalized by the student, as well as the number and levels of physical functions required to master the competency.

FIGURE II

COMPETENCY IDENTIFICATION MODEL



3. Time required to teach the competency was determined as a function of difficulty and complexity associated with the competency. This time rating is necessary to accurately establish a schedule for instructional purposes.

4. Time spent doing is a rating based on the proportion of the worker's time spent performing the associated tasks. This rating aids in the placement of the specific competency relative to all other competencies in the instructional sequence when structuring a work experience based on competencies.

One of the problems facing instructors attempting to teach information to students, is that seldom do students display the same ability. For this reason each competency was rated by educational personnel in three areas. These are: (Fine & Wiley, 1971).

1. Adaptive skills. These adaptive skills are those skills that a person possesses that enable him or her to adapt to conditions of the workplace to the degree that the unusual conditions found in many occupational settings will not interfere with the learning process. Examples of problems of the workplace are odors and fumes, oil and grease, and noise levels found in automobile shops, printing shops, and construction sites. If competencies concerned with these occupations require special adaptive abilities, those requirements should become a part of the competency description.

2. Functional skills. These functional skills are those skills concerned with physiological and psychological aspects of competencies that must be met by the individual in order to be able to function satisfactorily in the occupation. In the physiological area, the competency is reviewed to ascertain which physical abilities the employee must possess in order to accomplish that competency. For example, an individual may have difficulty developing a typing competency without two hands and ten fingers. In the psychological area, the competency is reviewed to determine special problems of a psychological nature that may tend to interfere with the accomplishment of the competency. An example of this is seen in occupations that require individuals to work in enclosed areas. If a person has a tendency toward claustraphobia, it is unlikely he or she will be able to develop competencies that require working in these areas.

3. Content skills. These content skills refer to the competencies that enable an individual to perform specific jobs according to the standards required to satisfy the market. These skills are as numerous as the many products that are produced and are as varied in standards and conditions as the employers that control the production.

After the competencies for each occupation had been identified and rated, they were returned to employers participating in this study for a final review by their operational level personnel. This review provided a final opportunity for personnel at the working level to comment on the degree to which the competencies met the needs of that occupation.

Research personnel at Texas A&M received each list of competencies, incorporating suggestions made by operational level personnel, and checking for accuracy of content prior to publication.

The process of structuring the work experience was developed as a joint effort by the advisory committees community college personnel, local employers, and TAMU research personnel. The structure is based primarily on the competencies identified for that occupation.

The process employed in structuring the work experience in this study is presented in Figure III.

The lists of competencies previously identified for each occupation were reviewed by local advisory committees to determine the degree to which the competencies fit local occupational needs. This review also afforded the committee an opportunity to add to or identify for emphasis, those competencies not previously identified.

Community college and local employers participating in the study independently reviewed the competencies for the purpose of identifying additional competencies considered essential to the occupation, or identifying those competencies requiring special emphasis during the work experience.

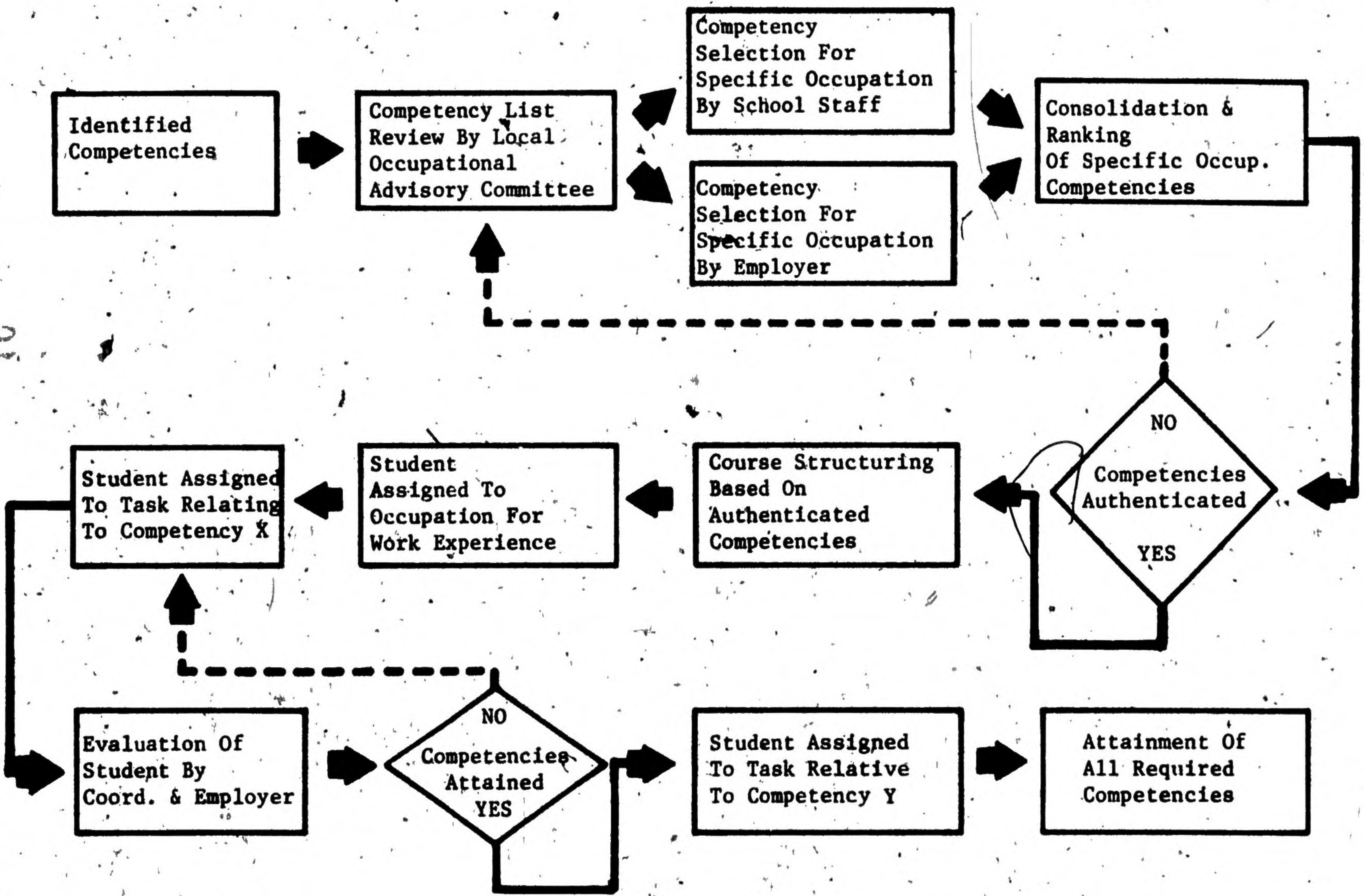
Local advisory committees, community college personnel, and local employers participating in the study jointly reviewed the competencies, consolidating the lists and ranking the competencies in a hierarchy to insure that student progression through the competencies will be from the simple to the complex tasks within the occupation.

Authentication of the competency lists was considered to be achieved when the local advisory committee, the community college, local employer, and TAMU research personnel had approved the lists.

Structuring of each work experience was based on the authenticated list of competencies. Upon completion of pretests experimental students were assigned to work sites employing the structured work experience, and control students were assigned to work sites not employing the structured approach.

FIGURE III

STRUCTURED WORK EXPERIENCE MODEL



All students were administered the appropriate occupational competency test, as a pretest prior to reporting to job site for work experience. Only the written portion of the National Occupational Competency tests were administered to students participating in this study. All test were obtained from the National Occupational Competency Testing Institute and Educational Testing Service regulations were carefully adhered to.

To insure maximum development of experimental student compentencies, each employer was encouraged to closely monitor experimental student progress. Progress of each student through the competencies identified for that occupation was in accordance with the model for structuring the work experience (see Figure III). As the student reached an acceptable level of performance with respect to competency X, his work assignment was adjusted to permit him to pursue competency Y. The decision as to when to permit a student to proceed from one competency to another was jointly made by the employer and the training coordinator. In those instances where the student was judged to be not yet qualified with regard to competency X, he was required to continue working at the task assignment until he had attained an acceptable level of performance.

Upon completion of the work experience all students were administered the appropriate occupational competency test as a posttest. Completed pre and posttest were submitted to the National Occupational Competency Testing Institute for scoring.

Research Design

Selection of a research design for this study was based on a number of factors. The design selected must be able to establish a direct relationship between the independent variable, the condition being evaluated, and the dependent variable, the criterion used to evaluate this condition. In addition, the design must permit the researcher to assume that any change that has occurred in the dependent variable during the course of the experiment can be attributed to the independent variable (Robb & Turner, 1971, pp. 65-66).

Another set of factors that may affect the outcome of an experiment is seen in the many extraneous variables that may be operating during the course of the experiment. Motivation, age, and intelligence are but a few of the possible variables that could create bias in an experiment. It is recognized that experimental design cannot achieve the ideal of eliminating all extraneous variables, but careful matching of design characteristics to the specific conditions of the research to be conducted will provide the researcher with data from which relatively valid inferences may be drawn.

Campbell and Stanley have indicated that the design selected for this study is a true experimental design. Specifically it is known as the Pretest-Posttest Control Group design. In this design the assignment of X (the treatment) to one group or the other is assumed to be random and under the investigator's control. Graphically, the design may be presented as follows:

$$R \; O_1 \; X \; O_2$$

$$R \; O_3 \quad O_4$$

Although experimental design and statistical procedures are recognized as independent tools or research, the quality of data achieved in a study can be closely related to both the experimental design and the statistical procedure employed to analyze the data.

The analysis of covariance statistical procedure was selected for this study. The reasons for the selection of this method of analysis are seen in the following:

> The most widely used acceptable test is to compute for each group pretest-posttest gain scores and to compute a t between experimental and control groups on these gain scores. Randomized "blocking" or "leveling" on pretest scores and the analysis of covariance with pretest scores as the covariate are usually perferable to simple gain-score comparisons. Since the great bulk of educational experiments show no significant difference, and hence are frequently not reported, the use of this more precise analysis would seem highly desirable (Campbell & Stanley, 1966, p. 23).

The use of the Pretest-Posttest Control Group design and the analysis of covariance statistical procedure has provided this study with an effective method of gathering the data and a statistical procedure that allowed valid inferences to be drawn from the data.

CHAPTER IV

RESULTS

Introduction

A comparison was made of group scores obtained by the control and experimental groups on the pre and posttests. Those factors being compared were the gain in knowledge as indicated by scores obtained on the written portion of the NOCTI examinations. This comparison provided an indication of the relative effectiveness of the two instructional approaches to the work experience phase of a cooperative education program.

In addition the actual scores attained by each subject were compared to the score means as posted by NOCTI for all persons, nationwide, who have taken the tests. This comparison gives the community colleges participating in this study an opportunity to compare the occupational knowledge of their students to the knowledge of the national group. By so doing the community college can get an indication of the effectiveness of their instructional programs.

A more basic comparison of the gains made by the experimental and control groups in each occupation is shown graphically. Each occupation has been partitioned into its major subdivisions for the purpose of comparing control and experimental group performance on the pre and post tests in each subdivision of the occupation. This comparison revealed the results that were obtained by the different instructional approaches in each occupational subdivision. In addition, this comparison suggests the possibility of societal influences on subject areas within the work experience. By recognizing the areas of occupations currently receiving extra attention in society, community colleges can better prepare the student for the work experience phase of cooperative education.

The average of the score gains of both groups were examined by analysis of covariance to determine if there was any significant differences between the gains of one group over the other. This also discloses an adjusted group mean which reveals the effective difference in mean gains between the control and experimental groups.

Comparison of Score Means

Score means and standard deviations were computed for pre and posttest scores obtained by control and experimental groups. These scores are presented in Table 2. The intent in this presentation is to show, in general terms, the performance of the control and experimental groups on the national occupational competency tests as compared to the national group.

Table 2

COMPARISON OF NATIONAL MEANS AND STANDARD DEVIATIONS TO MEANS OBTAINED BY CONTROL AND EXPERIMENTAL STUDENTS

	National			Control		Experimental	
Occupation	Mean	SD	Test	Mean	SD	Mean	SD
Auto Mechanics	66	9.2	Pre	55.2	11.44	50.8	10.73
			Post	53.7	11.01	55.2	9.75
Air Cond. & Refrig.	67	8.9	Pre	46.9	8.10	57.5	11.99
			Post	49.1	17.99	59.8	19.98
Printing	44	14.0	Pre	32.5	3.24	32.7	3.17
			Post	35.5	1.61	38.9	1.08
Drafting	73	8.6	Pre	38.5	*	42.9	*
			Post	41.5	*	46.6	*
Electrical Installation	54	8.0	Pre	42.9	*	49.7	*
			Post	43.5	*	50.3	*

* Standard deviations not meaningful due to the small number of students in the test area.

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The pretest score means, 55.2 and 50.8 obtained by the auto mechanics occupation control and experimental groups do not differ greatly in magnitude from the national mean of 66. Standard deviations of 11.44 for the control group and 11.01 for the experimental group are considered acceptable when compared to the 9.2 standard deviation for the larger national group. This acceptability is based on the following: "The standard deviation of a mean, often called the standard error or standard error of a mean, is seen to be inversely proportional to the square foot of the number of observations in the mean (Steel and Torrie, 1960, pp. 19-20)." In this instance the control and experimental groups each had ten subjects while the national group contained 154 cases. The square root of these groups is 3.1622 and 12.4096 respectively. In view of the statement by Steel and Torrie, the standard deviation for the sample in this study could be as high as 3.9 times the standard deviation for the national group and still be within an acceptable range.

Posttest results show a loss in mean score for the control group from 55.2 to 53.75 indicating a loss in general knowledge between the pre and posttest. During the same period the experimental group shows a gain in mean score from 50.8 to 55.2, indicating more effective learning for the students in the more structured work experience. Standard deviations for the pretests of 10.73 for the control group and 9.75 for the experimental group, are even more acceptable than standard deviations experienced on the pretest.

In the Air Conditioning and Refrigeration occupation control group pre and posttest results (46.96 and 49.08) are substantially below the national mean of 67. If it is assumed that practical experience is the [illegible] difference between the control and national groups, then this practical experience may be considered a vital factor in the development of job skills. While the experimental students scored well above control students on the pre and posttests (57.57 and 59.80), test results are still substantially below the national mean, further indicating the need for mixture of classroom instruction and comprehensive on-the-job work experience.

Standard deviations in the pretest for the control and experimental student groups (8.1 and 11.99) are acceptable when compared to the national standard deviation of 8.9. However the standard deviations of 17.99 and 19.98 for the control and experimental student groups respectively, on the posttest, leads one to suspect these figures. The larger standard deviations experienced in the posttests appear to be due to the small number of students in each group (2), and the large variance in posttest scores obtained by students within each group. For example, the individual posttest results for the control group students was 36.36 and 61.81, while the posttest results for the experimental students was 45.68 and 73.93, making the large standard deviations an understandable result. These widely differing scores also cause the reported mean to be less valuable to the casual observer.

The printing occupation students obtained scores similar to practitioners on the National Occupational Competency Tests. Control students obtained pre and posttest scores of 32.5 and 35.48 which is relatively close to the national mean of 44. Experimental students obtained even better scores. The pretest score of 32.76 was very near the control group pretest score of 32.5, but the post test score of 38.91 is a substantial increase over pretest scores and compares very well to the national mean scores. This gives more substance to the position that a more structured work experience produces a higher level of learning.

Standard deviations for both student groups were well below the national standard deviation of 14. Control group pretest standard deviation was 3.24 and posttest standard deviation was 1.61. Experimental pre and posttest standard deviations were 3.17 and 1.08 respectively. Each student group contained only 2 students, and in each test the students in each group displayed very small variances in scores.

The drafting occupation control and experimental students scored substantially below the mean score obtained at the national level. Control students obtained 38.53 and 41.5 on the pre and posttests respectively, and experimental students obtained 42.98 and 46.68 respectively. While the experimental students did display a greater gain in knowledge than did the control students, neither group approached the national mean score of 73. Standard deviations for the drafting occupation were not considered meaningful due to the small number of students in this test area.

Control and experimental group mean scores for the Electrical Installation occupation are near in magnitude to the mean score obtained by the national group. The control group pre and posttest scores of 42.94 and 43.51 reflect well on classroom preparation when compared to the national mean of 54. Experimental group students scored considerably higher on both pre and posttests with 49.72 and 50.29 respectively, comparing even more favorably with the national mean. One significant fact in this area of the study is that each group experienced the 0.57 gain in knowledge between the pre and posttests.

Standard deviation information was not considered meaningful due to the small number of students in this test area.

Comparison of Test Gains

An analysis of the results obtained by students in each occupation and those major subdivisions, was considered essential to get an in-depth comparison of the affects of the structured and unstructured instructional approaches used in this study. For this analysis the occupational areas designated by the National Occupational Competency Testing Institute were used.

For auto mechanics these are: (a) shop principles to include management and control, (b) engines, (c) fuel systems, (d) electrical, (e) emission system, (f) engine system analysis, (g) drive line composition, (h) suspension to include steering and brakes, and (i) accessories. Control and experimental group performance in each of the above areas is presented in Figure IV. Analysis of this information indicates the following:

- Experimental students displayed a consistent gain in knowledge in all areas of the auto mechanics occupation, while control students displayed a gain in knowledge in only three of the nine areas of the occupation.

- In the three areas where control students did display a gain in knowledge, fuel systems, electrical, and emission system, it is speculated the current social pressures toward better fuel economy and a cleaner environment provided the necessary impetus in auto repair shops to cause emphasis to be placed on these instructional areas at the ultimate expense of the other six areas of the occupation.

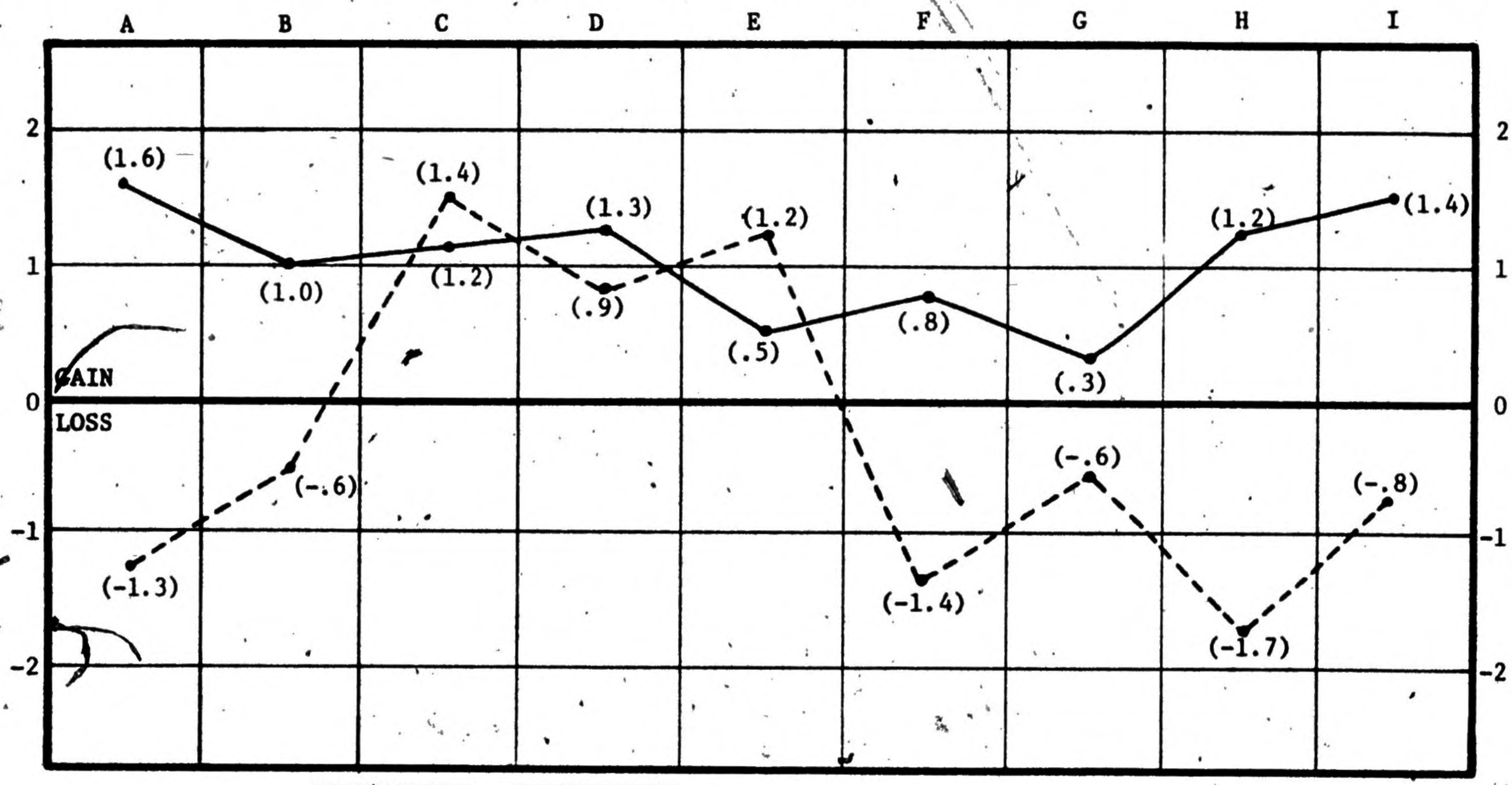
- Where a more structured approach to the subject is followed the student learns on a much broader basis, and is more knowledgeable in all areas of his occupation.

Data for the Air Conditioning and Refrigeration occupational area is presented in Figure V. The subdivisions of this occupation, as designated by the National Occupational Competency Testing Institute are: (a) domestic systems, (b) commercial systems, (c) residential air-conditioning, and (d) industrial refrigeration. The comparison of test gains shown in Figure V, suggests the following:

- The experimental group indicated a more consistent gain in knowledge by showing improvement in three of the four designated subdivisions, as opposed to improved performance in two areas for the control group students.

FIGURE IV

COMPARISON OF TEST GAINS OF CONTROL & EXPERIMENTAL STUDENTS
IN THE AUTO MECHANICS OCCUPATION



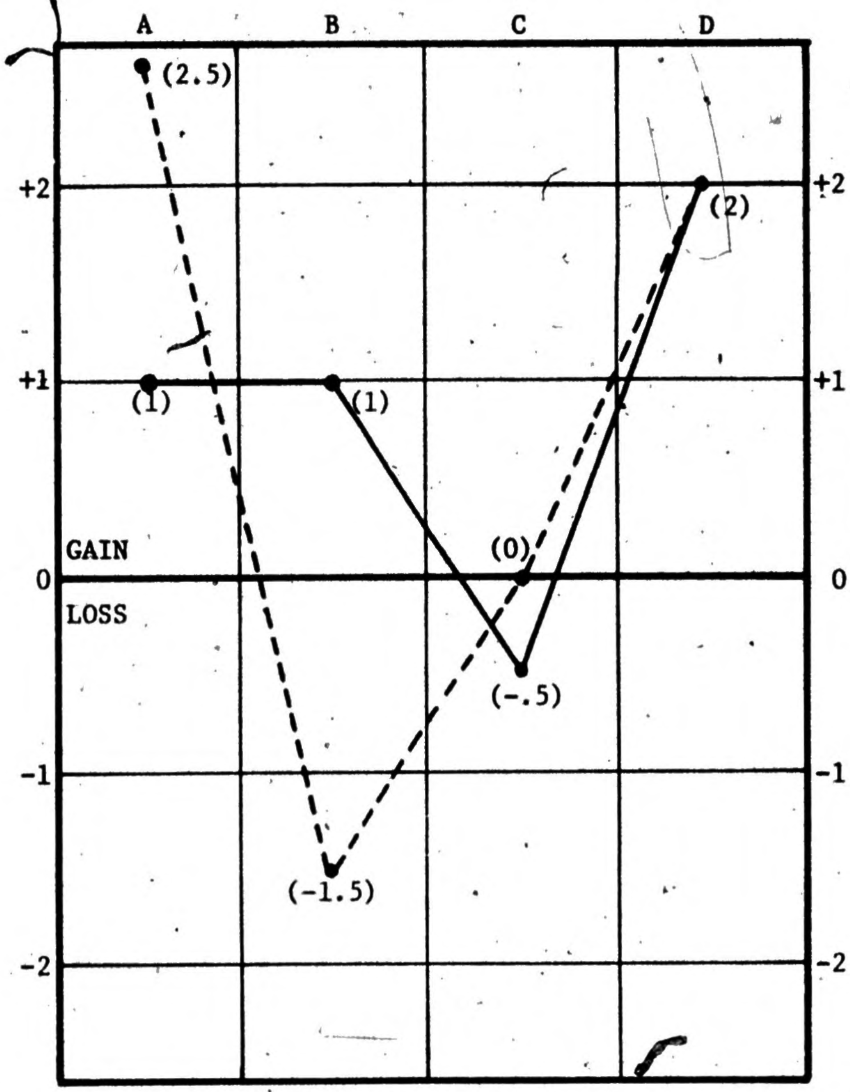
OCCUPATIONAL SUBDIVISIONS

A - Shop Principles
B - Engines
C - Fuel Systems
D - Electrical
E - Emission System
F - Analysis
G - Driveline
H - Suspension
I - Accessories

- - - - - Control
——— Experimental

FIGURE V

COMPARISON OF TEST GAINS OF CONTROL & EXPERIMENTAL STUDENTS IN THE AIR CONDITIONING AND REFRIGERATION OCCUPATION



OCCUPATIONAL SUBDIVISIONS

A - Domestic Systems
B - Commercial Systems
C - Residential Air Conditioning
D - Industrial Refrigeration

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- Instructional emphasis appears to be much more consistent in all areas for the experimental group, while control group results indicate a high emphasis on domestic systems and industrial refrigeration while placing less emphasis on commercial systems and residential air conditioning.

- The experimental student group appears to have received a broader, more comprehensive preparation in the air conditioning and refrigeration occupation.

The printing occupation has been divided into the following major areas by NOCTI: (a) design, (b) composition, (c) photograph preparation, (d) image carriers, (e) image transfer, and (f) finishing. Analysis of occupational area test scores (Figure VI) indicates the following:

- The experimental group showed score gains in all areas of the occupation while control group students displayed gains in five of the six areas.

- Score gains by the experimental group was at a higher level than the control group in four of the areas, equal in one area, and lower in one area of the occupation.

- The test performance by the experimental group was more consistent and at a higher level than control group students.

The machine drafting occupation was divided into the following areas by NOCTI: (a) redrawing and prints, (b) geometric construction, (c) sectioning, (d) isometric, and (e) work drawings. The analysis of area test scores (Figure VII) suggests the following:

- The experimental group shows a gain in test scores in three of the six areas while the control group shows a gain in two of the six areas.

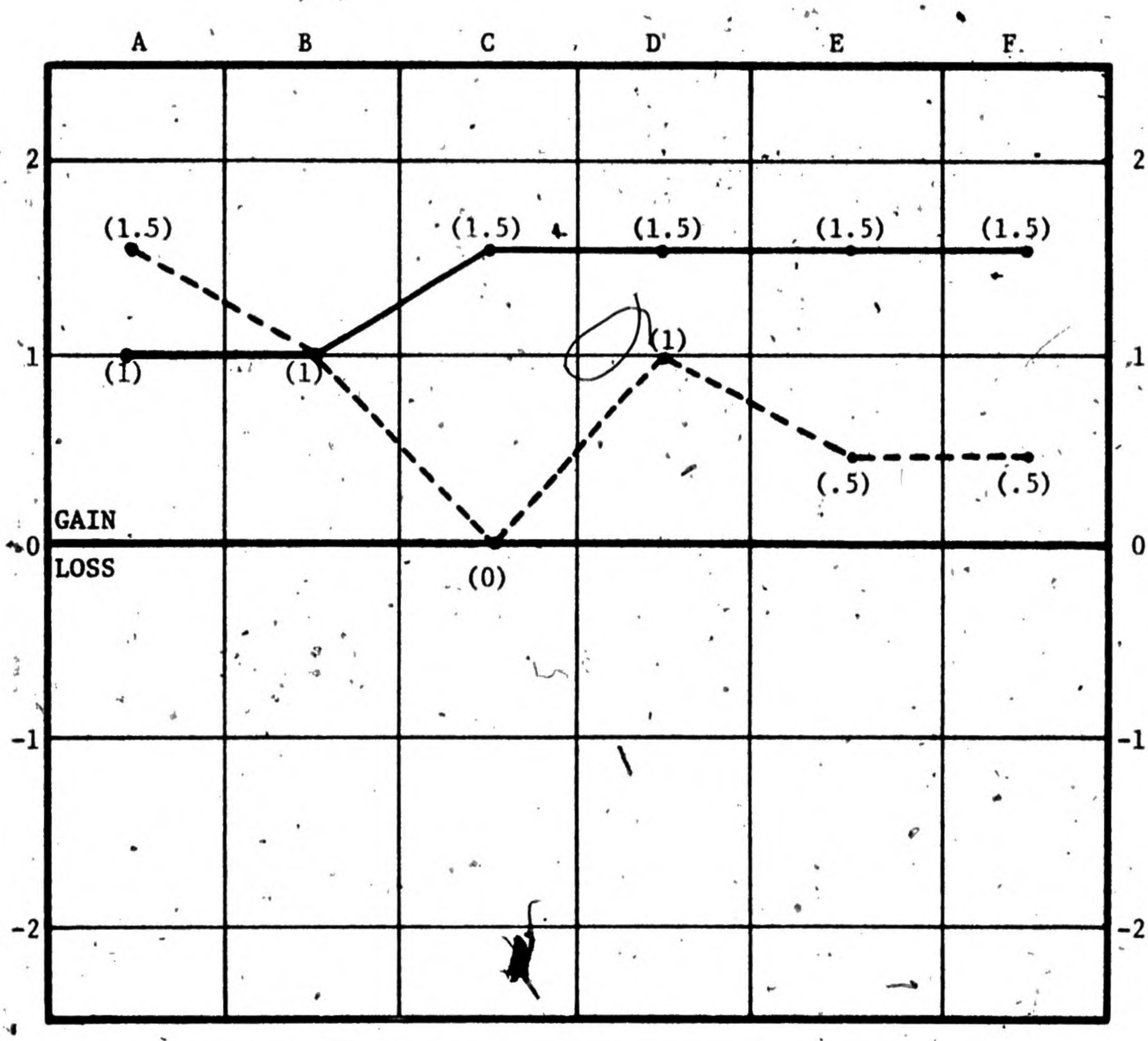
- While the overall gain in scores is slightly in favor of the experimental group, consistency of performance appears to be slightly in favor of the control group since the control group reflects a loss of knowledge in one area as opposed to a loss in two areas for the experimental group.

- Overall performance in this occupation appears to be approximately equal for the two groups.

NOCTI has divided the electrical installation occupation into the following areas: (a) reading work instructions, (b) code, safety, general trade information, (c) controls and rotating equipment, (d) power installation and maintenance, (e) principles of electricity magnetism, electronics, and (f) trade calculations.

FIGURE VI

COMPARISON OF TEST GAINS OF CONTROL & EXPERIMENTAL STUDENTS IN THE PRINTING OCCUPATION

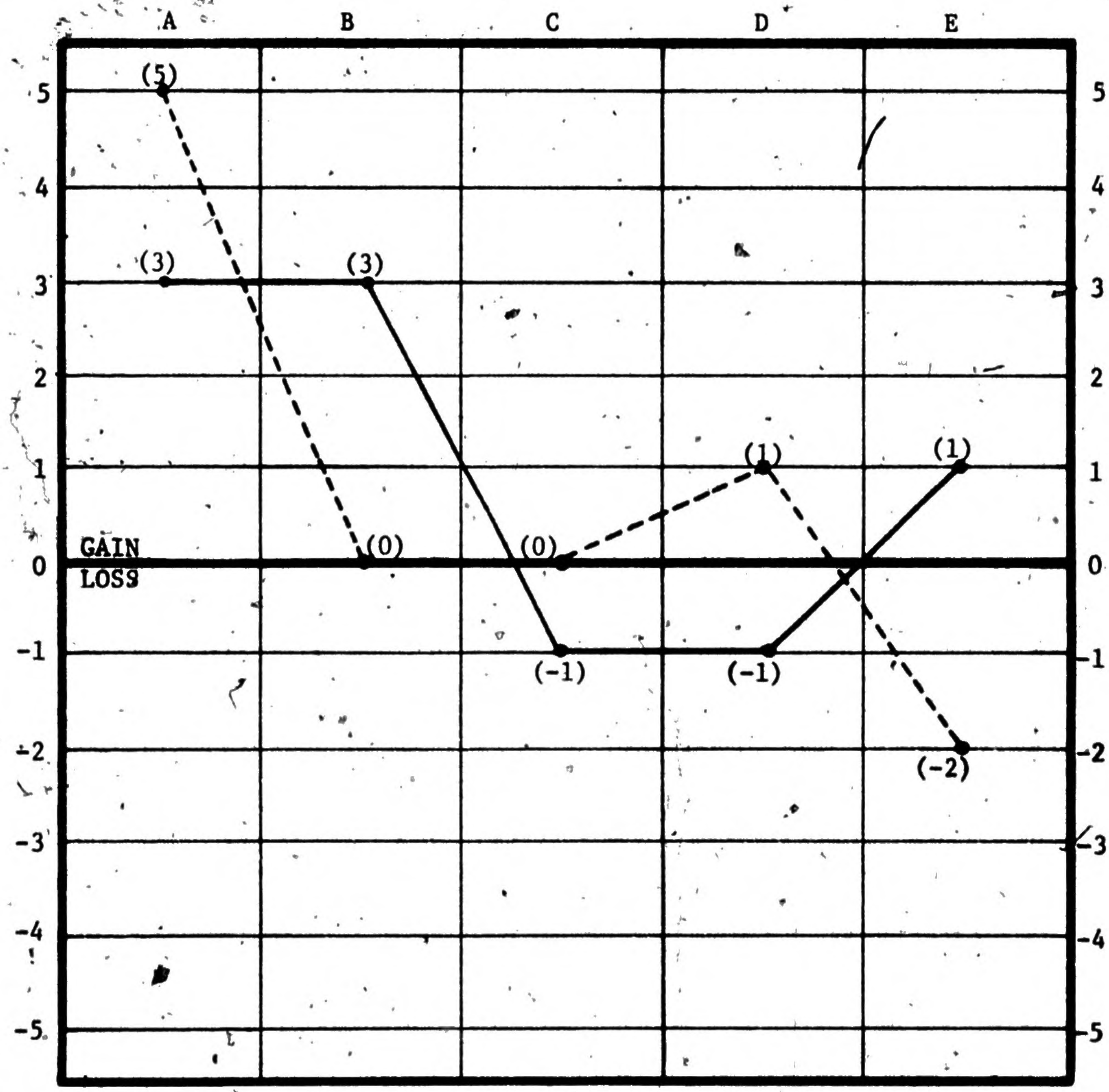


OCCUPATIONAL SUBDIVISIONS

A. Design
B. Composition
C. Photo Preparation
D. Image Careers
E. Image Transfer
F. Finishing

FIGURE VII

COMPARISON OF TEST GAINS OF CONTROL & EXPERIMENTAL STUDENTS IN THE MACHINE DRAFTING OCCUPATION



OCCUPATIONAL SUBDIVISIONS

A. Redrawing & Prints
B. Geometric Construction
C. Sectioning
D. Isometric
E. Working Dr.

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(Figure VIII) An analysis of the area test scores reflects the following:

- Control and experimental group students displayed approximately equal gains in that each group had positive gains in three of the seven occupational areas.

- Test performance by the two groups appears to be nearly equal in all respects with the following exceptions:

  (a) The control group shows a score gain in safety codes and general information as opposed to a knowledge loss for the experimental student group.

  (b) The experimental group shows a score gain in trade calculations as opposed to no gain for control group student.

The five occupational areas in this study were divided into 30 major subdivisions. An overall comparison of control group and experimental group scores indicates the following:

- The experimental group displayed a gain in 24 of the 30 occupational subdivisions as opposed to a gain in 15 of 30 subdivisions for the control group.

- The control group displayed no change with respect to five subdivisions and a loss in ten others as opposed to a loss in six subdivisions for the experimental group.

- Overall performance by the experimental group exceeds the control group performance adding substance to the position that a more structured program of work experience provides a more effective learning experience than does the traditional unstructured program.

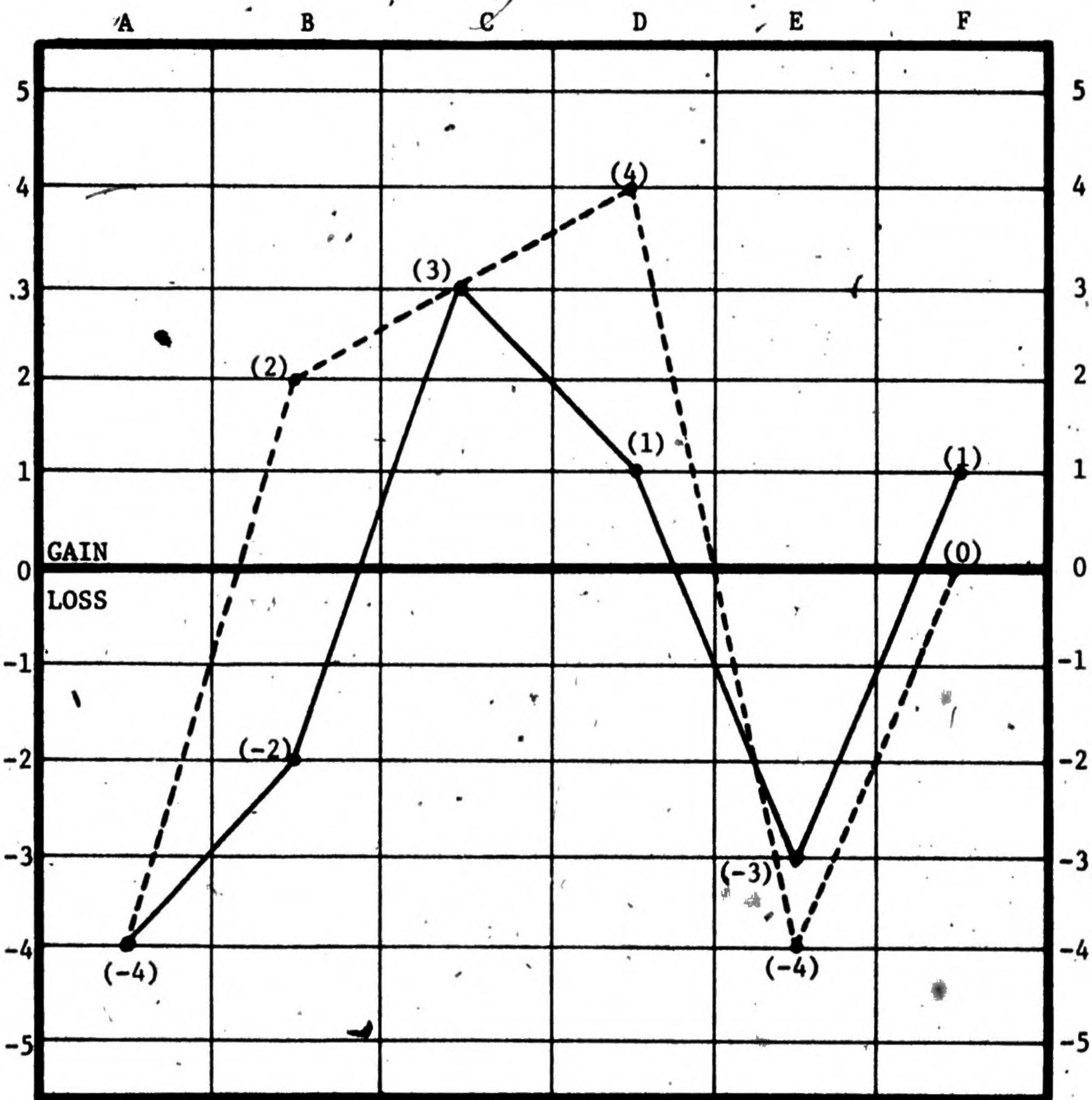
Analysis of Covariance

The final method of analysis employed in the study was the analysis of covariance. As stated in Myer's Fundamentals of Experimental Design:

> ". . . in the analysis of variance, the total sum of squares is partitioned; in the analysis of covariance, the adjusted total sum of squares is partitioned. The first component resulting from this partitioning, SS_1, measures the variability of the group regression coefficients about an average coefficient. The second

FIGURE VIII

COMPARISON OF TEST GAINS OF CONTROL & EXPERIMENTAL STUDENTS IN THE ELECTRICAL INSTALLATION OCCUPATION



OCCUPATIONAL SUBDIVISIONS

A. Reading Instruction
B. Safety Codes & General Info.
C. Controls & Rotating Equip.
D. Power Install. & Maintenance
E. Principles of Electricity
F. Trade Calculations

---- Control
—— Experimental

> term, SS_2, measures the variability of scores about each group regression line. The hypothesis of homogeniety of regression may be tested by a ratio of mean squares based on the two terms just described. If the F statistic is not significant, the two terms may be pooled to form a single estimate of error, which will be subsequently used in testing treatment effects (Myers, 1973, p. 332).

In this instance, the test for regression coefficients revealed an F ratio of 0.28 with 1 and 28 degrees of freedom. At 1 and 28 degrees of freedom, the homogeniety of regression for the control and experimental groups is established, allowing the pooling of the two terms for subsequent testing of treatment effects. (Table 3)

A Pearson product-moment zero order correlation coefficient was calculated to determine the within-groups relationships. "This method of correlation is to be used when the two variables are continuous and the relationship is rectilinear (Koenker, 1961, p. 54)." In this study the within-groups correlation coefficient between the covariate (pretest) and the dependent variable (posttest) was .95 indicating a high degree of relationships between the two variables.

The next function served by the analysis of covariance is the test for adjusted means. The specifics of this process are effectively described in the following:

> The third component of $SS_{tot(y')}$, SS_3, reflects the variability of treatment means about the line which gives the predicted value of $\bar{Y}_{.j}$. The fourth component, SS_4, measured the differences between the slope of that line and the slope of the average within-groups regression line. If variability of the means about this best fitting line is significant, then variation among the $\bar{Y}_{.j}$ is attributable to something more than the variation in $\bar{X}_{.j}$ and error variance; the "something more" is presumably treatment effects . . . (Myers, 1973, p. 332).

In this study the test for adjusted means produced a within-groups mean square of 128.14, (SS_3), with one degree of freedom, and a residual mean square of 14.23, (SS_4), with 29 degrees of freedom, which resulted in an F ratio of 9.00. This statistic is significant beyond the .01 level (Table 3). An F ratio of this magnitude presents statistical evidence that the more structured program of work experience enabled the experimental student to make significant gains in knowledge beyond those obtained by the students in the more conventional unstructured work experience program.

Table 3

ANALYSIS OF COVARIANCE

Test For Regression Coefficients

Source	Degrees of Freedom	Mean Square	F
Groups	1	4.14	0.28
Residual	28	14.60	
Within-groups correlation is 0.95			

Test For Adjusted Means

Source	Degrees of Freedom	Mean Square	F
Groups	1	128.14(SS_3)	9.00
Residual	29	14.23(SS_4)	
Group	Mean X	Mean Y	Adj. Mean Y
1	49.47	49.48	49.19
2	48.84	52.90	53.19

The final function served by the analysis of covariance is the adjustment of posttest scores to reflect independent variable affects during pretests. (Table 3) In this instance mean X (Pretest score) for the control group was 49.47 and mean Y (Posttest score) was 49.48. Holding mean X as the covariate resulted in an adjusted mean Y of 49.19 for the control group. The experimental group mean X was 48.84 and mean Y was 52.90. Holding the pretest score as the covariate and adjusting the mean Y score for the experimental group resulted in an adjusted mean Y of 53.19. The difference between the adjusted mean Y for the control group and the adjusted mean Y for the experimental group is four points, and is interpreted as being the effective gain in score mean obtained by the experimental group due to treatment differences. These four points represents the advantage in occupational knowledge, as measured by the NOCTI written examinations, that accrued to students participating in the more structured work experience program.

A separate analysis of covariance was conducted on data obtained from the automechanics occupational area. In this instance the control and experimental groups each contained ten students.

In the tests for regression coefficients and within-groups correlation, differences and similarities between the two groups are statistically determined. In the test for regression coefficients, an F ratio of .03 was obtained, which indicated no significant difference between the control and experimental groups, and the within-groups correlation was .96 indicating a high degree of similarity between the two groups. (Table 4)

In the test for adjusted means the F statistic with 1 and 17 degrees of freedom was 16.63 (Table 4). This statistic is significant beyond the .005 level and indicates that a more structured approach for the work experience portion of the automechanic cooperative education program has significant advantage over a less structured approach.

By holding mean X (pretest scores) for the control and experimental groups as covariates, mean Y (posttest scores) for each group can be adjusted to reflect the effective difference between the mean score gains for the two groups. In this instance the mean X was 55.20 for the control group and 50.80 for the experimental group. Mean Y for the control group was 53.75 and was 55.20 for the experimental group. Holding mean X as a covariate resulted in an adjusted mean Y of 51.71 for the control group, and a 57.24 for the experimental group. The difference between the adjusted mean Y for the control group and the adjusted mean Y for the experimental group, is 5.53 points and interpreted as the effective gain in score mean obtained by the experimental group due to treatment differences. This 5.53 points represents the advantage in occupational knowledge, as measured by the NOCTI written examinations, that accrued to students in the more structured approach to the work experience portion of the cooperative education program in automechanics.

Table 4

ANALYSIS OF COVARIANCE
AUTOMECHANICS

Test For Regression Coefficients

Source	Degrees of Freedom	Mean Square	F
Groups	1	0.27	0.03
Residual	16	9.32	

Test For Adjusted Means

Source	Degrees of Freedom	Mean Square	F
Groups	1	146.07	16.63
Residual	17	8.78	
Group	Mean X	Mean Y	Adj. Mean Y
1	55.20	53.75	51.71
2	50.80	55.20	57.24

It is interesting to note that the control group pretest mean was 4.40 points higher than the experimental group, giving reason to speculate that if any initial advantage existed for either group, it was in favor of the control group. In spite of this possible advantage for the control group, posttest mean scores indicate a significant change in position for the two groups. Control group students experienced a loss in mean score from 55.20 on the pretest to 53.75 on the posttest, while experimental students registered a gain from 50.80 on the pretest to 55.20 on the posttest. In the analysis of covariance process, gains in mean scores for the experimental group, between pre and posttest, are assumed to be due to treatment effect which, in this case, was the structuring of the work experience.

Even more significant is the difference in means reflected by the adjustment of mean Y as a result of holding mean X as the covariate. The adjusted mean Y for the control group is 51.71 while the adjusted mean Y for the experimental group is 57.24, resulting in an effective increase of 5.53 points in mean score for the experimental group. This indicates a substantial advantage for students in automechanics who undergo a more structured work experience based on occupational competencies.

The most obvious point demonstrated by the preceding analysis is that there was a significant gain by the experimental students when compared to gains experienced by control students. It is assumed that the primary reason for the differences in gains between the two groups is due to the differences in learning experiences during the treatment period.

Differences experienced by students within the same group may be attributed to a number of variables that existed at each individual work station. Some of these could be the differing abilities of instructors in the shops to transmit knowledge to the students, the intensity of work flow within the specific shop, the variety of jobs available within each shop, and the attitude of the employer toward the need to accomplish student training as opposed to profit making.

A number of instances were experienced where the profit motive of the employers seemed to run counter to the educational interests of the students. In those instances research personnel made special effort to promote the educational process without disrupting the work processes within the business. It should be noted that this is a continuing problem for all who work within cooperative education programs. It should also be pointed out that structuring the work experience provided employers with an additional awareness of the educational process taking place within the business.

Individual analysis, by analysis of covariance, was not considered feasible for the occupations of air conditioning and refrigeration, drafting, electrical installation, or printing trades since the small numbers of students in each occupational area would not support the more formal analysis. However the data collected from these occupational areas have been included in the analysis of covariance summary presented in Table 3.

In addition, mean score and standard deviations obtained on NOCTI written tests by control and experimental students in these occupational areas, was compared to the mean scores and standard deviations obtained by nationwide administration of the same tests. This information is presented in Table 2. An additional analysis of these occupational areas was obtained by breaking each occupational area into its major subdivisions and comparing the performance of control and experimental students within each occupational subdivision. Information obtained in this analysis is presented in Figures IV, V, VI, VII, and VIII. The above analyses were considered adequate, in lieu of individual analysis by analysis of covariance, to provide definitive and valuable information relative to student performance in structured and unstructured work experience programs.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary objective of this study was to determine the relative values of the structured and unstructured approaches to the work experience portion of the cooperative education program. An additional objective was the preparation of guidelines for structuring the work experience. Four institutions representing variations in population density and geographic locations were selected from community colleges in Texas. Four occupations for which the National Occupational Competency Testing Institute had prepared examinations which were also included as a part of the community college cooperative education programs were selected. Eight students were randomly selected from those enrolled in the selected cooperative education programs at each community college. The eight students were then randomly divided into two groups, four experimental and four control students. A total of thirty-two students, sixteen control and sixteen experimental, participated in the study. Competencies were identified and ranked for each occupation and the work experience structured around the identified competencies. All students were administered the appropriate NOCTI tests, as a pretest, and assigned to training stations, where the control students participated in a traditional, unstructured work experience, and experimental students participated in a work experience structured around attainment of the occupational competencies. At the end of approximately four months (one semester) all students were administered the appropriate NOCTI examination as a posttest. All tests were submitted to the National Competency Testing Institute for scoring, and the resulting data analyzed by analysis of covariance. Additional analysis consisted of breaking each occupation into its major subdivisions and comparing the performance of control and experimental students in each subdivision and also by comparing the scores achieved by students participating in this study to scores achieved by nationwide administration of the NOCTI examinations.

Conclusions

On the basis of the analysis of data, it seems evident that structuring work experience programs so that students are moved progressively from one competency attainment to another, does enable them to acquire greater knowledge of their occupation than they would if a less regimented approach were used. Although identifying competencies and basing a training program on the attainment of specific skills is not a new concept, the procedure of ranking competencies on a basis of simple to complex, and closely monitoring student progress as they proceed satisfactorily through the competency ranking, may be the critical element which permits the attainment of results such as previously described.

The progressive attainment of competencies gives the student an opportunity to gain new knowledge by building on the foundation of knowledge previously attained. Ranking the competencies insures that the competencies are arranged in a hierarchy that supports the students progressive growth in attaining the competencies in a particular occupation. Close monitoring of students as they progress through the occupational competencies insures the successful attainment of one competency before proceeding to a new, more difficult, task.

It is recognized that expenditures of time and effort to identify competencies and structure the work experience may not be justified in all circumstances. This would be particularily true where the work loads of coordinators would inhibit their availability to provide the close student monitoring required by the structured approach. Since the success of a structured work experience is dependent, to a substantial degree, upon the identification and ranking of competencies, and close monitoring of students to assure their successful attainment of these competencies, to conduct a structured work experience without these features may appreciably degrade the quality.

It should also be recognized that this program places additional responsibilities on the cooperating employer. If a structured work experience is to be successful the employer must understand the concepts involved and be willing to make a conscientious effort to administer the program in accordance with these concepts.

In the early stages of this study the economy of the United States went into a depressed condition. A number of employers who normally provided training stations for work experience were forced to either reduce the level or completely discontinue their participation in cooperative education programs. The affect on this study was to create substantial difficulty in finding and maintaining suitable training stations for students participating in this study. It is evident that the state of the economy has profound affect upon the ability to and/or the willingness of employers to participate in cooperative education programs. In spite of business concern for the proper education and training of young people, the economic viability of the business enterprise is their foremost concern. Criticism of this principle is not intended because financial support of all educational institutions relies upon the economic well being of the business industrial community.

Analysis of pre and posttest data has revealed a problem experienced by control and experimental students. Although more pronounced for control students, a loss of knowledge in some occupational subdivisions, between the pre and posttest administrations, was apparent for both groups of students. It should not be assumed that in-class instruction is providing more information than is necessary to function within the occupation since comparison of student score means to the national score means reveals that student knowledge is below the national group knowledge. It is speculated that student loss of knowledge is attributable to the fact that students are receiving greater in-depth knowledge than is necessary to function within an occupation at the entry skill level. It is also speculated that the loss in student knowledge is temporary and will return with time and experience in the occupation. In those instances where students displayed substantial loss of knowledge, it may be valid to suggest that the community college and local industry establish closer coordination to ensure a better fit between the needs of industry and what is taught during the instructional phase of cooperative education.

Recommendations

The decision to structure a work experience must necessarily include consideration of the factors discussed in this study as well as those that are unique to the situation at hand. Identifying competencies and structuring the work experience is a time consuming process, and requires that local employers assume more responsibility with regard to on-the-job training activities. Monitoring student progress required additional time for close coordination between the community college and employers. These are some of the factors which could be considered when deciding to pursue the structured approach to the work experience.

In addition to the negative factors that will influence the decision to structure the work experience, are a number of positive factors that should be considered. The fact that experimental students made significant gains in score means beyond those achieved by control students should not be ignored. Gains by experimental students in the occupational subdivisions were more consistent and at a higher level than those achieved by control students. The greater involvement of local advisory committees and employers should have secondary benefits for students seeking employment with local industry, and for the community college in planning future educational programs that require industrial support.

It is impossible to place quantitative values on the various factors that require consideration when deciding whether or not to structure the work experience. The value of producing a better qualified worker must be weighed against the costs of producing the desired quality. In many cases the end product must be a compromise between what is desirable and what is possible. Struoturing the work experience will, in many instances, be subject to this reality.

In those instances where community colleges decide to structure the work experience, the following suggestions will serve to make the process smoother and the program more effective in achieving its educational objectives.

Local advisory committees should be utilized to the maximum. These communities provide an essential link between the community college and local industry so that up-to-date occupational requirements are constantly made available to the schools. Advisory committees should become extensively involved in competency identification, ranking, and structuring of the work experience. This involvement should accrue a number of secondary benefits to both the community college and students in cooperative education programs. Training stations should be easier to locate within the business community, and students should find jobs more available as a result of their experience in the local industry. In addition, involving local industrial leadership in the educational process improves the opportunity to develop local support for existing and proposed educational programs.

It is recommended that the models for competency identification and work experience structuring, offered in this study, be utilized when developing a structured program of work experience. These models represent a comprehensive approach to the identification, ranking, and structuring processes, and provide detailed, time-saving guidance when structuring work experience programs.

It is further recommended that a longitudinal study be conducted to assess the value of similar structuring of both the instructional and work experience phases of cooperative education programs. This study would give an opportunity to analyze the affects on student achievement of structuring an entire cooperative education program. In addition, the structuring process of the instructional and work experience phases could be coordinated to provide maximum meshing between the two phases.

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APPENDIX A
PRELIMINARY
LIST OF AIR CONDITIONING AND REFRIGERATION COMPETENCIES

Rough in Copper Lines.

a. Take set of plans and locate position of furnace and condensing unit.
b. Roll out suction line, liquid line and drain line.
c. Install in place from furnace position to condensing unit.
d. Allow 12" to extend above level of floor. Also 12" outside of wall at condensing unit location.
e. Seal off line by welding with silver solder.
f. Tie to reinforcement steel and insulate copper from steel with felt paper. (Roofing paper)
g. Check to make sure all pipes are sealed and fastened securely in place.

Set Furnace

a. Locate copper refrigeration lines and drain lines.
b. Check furnace closet. Make sure floor that furnace is to be set on is high enough for return air and strong enough to hold furnace.
c. Cut hole in furnace floor for return air.
d. Set furnace in closet and secure to furnace floor making sure clearance of furnace walls conform to manufacturing recommendations and local code.
e. Make sure furnace floor has not lost the ability to support the furnace.

Set Condensing Unit

a. Locate copper refrigerant lines and drain line.
b. Set pre-poured slab. Convenient to refrigerant lines.
c. Set condensing unit on slab. Making sure of proper discharge of condenser air, in relation to summer wind direction.
d. Locate condensing unit as far away from outside wall of house as recommended by manufacturer.

Hook Up Unit

a. Remove panels from condensing unit.
b. Remove all shipping tie downs.
c. Tighten all fans, screws and bolts.
d. Tighten and check all electrical connections.
e. Remove any dirt or any other material around refrigeration lines.
f. Open sealed lines coming from furnace closet.
g. Remove burrs and prepare lines for silver brazing.
h. Remove pressure from line connections on condensing unit.
i. Prepare condensing unit lines for silver brazing.
j. Make proper bends and cuts to connect condensing unit lines to

refrigerant lines going to furnace.

k. Cut seals from lines in furnace closet.
l. Attach set of refrigerant gauges to service connections on condensing unit.
m. Hook up nitrogen cylinder to center connection of service gauges and allow 5 PSIG of nitrogen to flow through lines to be silver brazed.
n. Lite welding torch and silver braze all connections that were out and fitted to lines.
o. Allow lines to cool.
p. Turn off nitrogen.
q. Go to furnace closet.
r. Remove front from coil case mounted above furnace.
s. Cut and fit lines from "A" coil to refrigerant lines located below furnace floor and prepare for silver brazing.
t. Set "A" coil in coil case make sure all valve connections are secure.
u. Turn nitrogen back on and silver braze line connections below furnace floor.
v. Turn nitrogen off.
w. Insulate suction line with proper insulation.
x. Make final silver braze connection at "A" coil.
y. Replace coil case panel.
z. Hook up drain line and insulate.

1. Make sure all line and insulation is away from exposure to fire and to the side of the furnace.
2. Clean up material and trash from furnace closet and floor and dispose of trash.
3. Go to condensing unit and apply 100 PSIG pressure of nitrogen to system lines.
4. Check for leaks at all silver braze connections.
5. If no leaks. Back seat service valves and remove service gauges.
6. Replace condensing unit panels.
7. Clean up material and dispose of trash.

Start System

a. Remove service panel from condensing unit.
b. Hook up refrigerant service gauges.
c. Purge nitrogen from lines.
d. Cut liquid line install a good filter dryer.
e. Hook a good vacuum pump to the center line of service gauges.
f. Open the compound gauge valve. Allowing the vacuum pump to pump from the low side of the system first.
g. Close compound side of service gauge.
h. Turn vacuum pump off.
i. Hook up refrigerant 22. Bottle to center. Hose and open hi side gauge valve.
j. Allow pressure to build up to 100 PSIG on compound gauge, turn R 22 off.
k. Remove R 22 Cyl.
l. Purge R 22 from lines through compound gauge valve.

m. Replace vacuum pump and repeat this process two more times.
n. Then pull a vacuum on the system down to 50 microns.
o. Hook up thermostat and controls to air cond. and furnace.
p. Close off compound gauge and hi side valves on service gauges.
q. Replace vacuum pump with proper refrigerant cylinder.
r. Turn thermostat to cool and set to 65°F.
s. Add refrigerant to the high side of system until 70# press appears on compound gauge.
t. Turn high side gauge valve off.
u. Add refrigerant to compound gauge side until sight glass clears or a cool suction line is apparent.
v. Close refrigerant cylinder and remove back seat service valves and remove gauges.
w. Replace service panels.
x. Clean area.

Check Operation

a. Check air velocity at grills for proper air flow.
b. Balance air flow to rooms.
c. Check air temperature at register.
d. Check temperature drop across coil.
e. Check relative humidity of air conditioned space.
f. Check amperage of furnace fan-motor.
g. Check amperage of condensing unit.
h. Check gas charge on condensing unit.

Trouble Shoot Service Problems

a. Check electrical.
b. Check thermostat.
c. Check for leaks.
d. Check for dirty filter and dirty condenser.
e. Make repairs and put system back into operation.

APPENDIX B
PRELIMINARY
LIST OF PRINTING TRADE COMPETENCIES

1. Be able to locate all characters, quads, and spacing in the California Job Case.

2. Be able to set composing stick correct measure as specified by the task.

3. Be able to print copy of work and correct for errors and spacing.

   a. Impression and inking
   b. Use proof press
   c. Types of proofs
   d. Pull proofs

4. Be able to employ the composition stick to set a line of type, read the line for errors, and justify line of type.

5. Be able to use the line gauge to measure type, and make the conversion of measurements from inches to picas to points.

6. Be able to remove type from composition stick, place type in galley, tie-up type on galley in preparation for storing.

7. Be able to distribute type from lead form back into correct case and box.

8. Be able to read proof, detect errors in type form, and mark errors using the correct proof readers marks to indicate errors, kinds, and types.

9. Be able to proof and correct errors in type form using type, furniture, and tweezers called for in the task.

10. Be able to select leads, slugs, and furniture, and assemble leads, slugs, and furniture according to directions without the use of line gauge in stick.

11. Be able to make a layout and work from the layout selecting the correct forms of type, series type, or family of type and hand set a printing job.

12. Be able to employ a slug cutter to cut line and word spacing materials to specifications.

13. Be able to select material, cut border on rule to size and position border on rule around type forms.

14. Be able to operate the composing room saw to cut spacing material and hot metal composition to set measure.

15. Be able to lockup type form for platen press printing.

16. Be able to ink, set impression, set margins, and new job on platen press.

17. Be able to clean, oil, and service platen press.

18. Be able to make lockup and adjust margins for printing job on the automatic platen press.

19. Be able to adjust fountain screws and obtain an even flow of ink for the printing press.

20. Be able to set margins, set impressions, adjust ink flow, set feed and delivery, and print material to specifications on the automatic press.

21. Be able to adjust, set ink, margins and impressions to specifications on an automatic cylinder press.

22. Be able to clean and maintain the hydraulic paper cutter.

23. Be able make calculations to determine stock size and amount, and cut stock and padding to required dimensions.

24. Be able to adjust, align, and operate the single head paper drill to drill specified holes in printed pages.

25. Be able to operate the drill bit sharpener.

26. Be able to prepare the wire stitcher for stitching operation.

27. Be able to employ the wire stitcher in saddle and side stitching pamphlets and books.

28. Be able to adjust, prepare, and operate desk type friction-feed folding machine.

29. Be able to set up and adjust suction feed folder and operate the machine in making fold in stock.

30. Be able to set up paper, and employ pen, "T" square, rule and layout and rule in a box.

31. Be able to draw a shadow box accurately, using proper equipment.

32. Be able to make preparations, work out assembly plan, and rough in material for layout, and use the rough layout fitting copy in a comprehensive layout for finished job.

33. Be able to make necessary adjustments and prepare camera for operation.

34. Be able to maintain the camera in good operating condition.

35. Be able to prepare darkroom for film development.

36. Be able to operate camera, shoot line copy, and develop film negative.

37. Be able to use screens, and make flash exposures to make halftone negatives.

38. Be able to use a screened copy and make a re-screened negative satisfactory for use in printing.

39. Be able to follow directions, select materials and equipment, and strip a flat or an opaque for one-up job.

40. Be able to strip a flat for multiple run jobs.

41. Be able to select materials and equipment and prepare a direct-wiage plate for flexible application from specified copy information.

42. Be able to use negative, and operate plate burner and develop plate for printing.

43. Be able to prepare, dampening system of press for operation.

44. Be able to prepare and install plate and blanket on offset press cylinders.

45. Be able to set ink, dampening, printing, feeding, and delivery of a small duplicator for executing printing jobs.

46. Be able to clean plates, blanket, ink and dampness system of offset press.

47. Be able to operate the linotype keyboard.

48. Be able to change the linotype machine and set different sizes of type and line lengths.

49. Be able to employ plunger cleaner and clean metal pot and clean space bands, in the service and maintenance of the linotype machine.

50. Be able to set justified copy by setting up and using typewriter.

51. Be able to set up and employ the composer in setting justified copy.

52. Be able to set display composition using headliner.

53. Be able to operate Teletype setter and set justified tape for line casting machine.

54. Be able to make up and set perforated tape for photographic typesetting.

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APPENDIX C
PRELIMINARY
LIST OF DRAFTING COMPETENCIES

1. Identify, use, and care for the basic instruments of the drafting trade.

   a. Straight edges
   b. Triangles
   c. Compasses, pen, pencil
   d. Divides
   e. Reeling pens
   f. Scales
   g. Miscellaneous instruments

2. Develop freehand sketches of mechanical objects using basic drafting equipment.

   a. Sketching fundamentals
   b. Sketching principals

3. Execute single-stroke vertical and inclined Gothic Capital and lower case letters and numerals.

   a. Single stroke lettering
   b. Uniformity in lettering
   c. Lettering instruments
   d. Lettering techniques

4. Make necessary calculations to lay out and set up the various drafting tasks.

   a. The geometry of drafting
   b. Geometric shapes and nomenclature
   c. Solid geometric shapes

5. Visualize and sketch, with accuracy, orthographic views of simple objects.

   a. Comparison-Orthographic as opposed to pictorial drawings
   b. Revolving objects to obtain those principal views
   c. Revolving objects to obtain six principal viewes
   d. Projection techniques
   e. Hidden edges, center lines, dimension and extension lines
   f. Missing views problems

6. Be able to dimension accurately.

   a. Dimensioning conventions
   b. Dimensioning directions
   c. Size and location
   d. Basic dimensions
   e. Fractions and decimals
   f. Angular dimensions
   g. Chamfers, arcs, fillets and rounds
   h. Coordinate, cumulative and angular dimensions
   i. Dimension contours, cylinder, hobs, and compound, reverse, and irregular curves
   j. Dimension machine patterns and forgings

7. Be able to correctly dimension, specify materials and finishes, and not special conditions on scaled orthographic projections involved in shop processes.

   a. The shop blueprint
   b. Blueprint notes for specifying manufacturing processes
   c. Nomenclature of the foundry and the forge, welding, machine, and assembly shops
   d. Shop processes

8. Be able to draw and dimension full and half section views of objects and identify materials by their correct symbols.

   a. Basic concept of sectional drawing
   b. Designation of imaginary cutting plane
   c. Spacing section lines
   d. Factors dictating direction of section lines
   e. Indicating breaks in shafts and tubing
   f. Designating materials by symbols
   g. Half section practices
   h. Fundamentals of sectional drawing

9. Be able to draw and dimension, broken-out, revolved, removed, and offset sections of drawings, and correctly identify materials by their symbols.

   a. Principles of drawing broken-out sections
   b. Revolved section interpretations, multiple sections
   c. Offset sectioning practices
   d. Practices for indicating webs, ribs, spokes, gear teeth, and similar elements in section

10. Be able to rotate objects to obtain aligned section views and prepare section drawings of objects adjacent to one another.

   a. Conventional methods for drawing aligned sections
   b. Principles for drawing assembly sections

11. Be able to draw primary auxiliary views projected from inclined surfaces.

   a. Basic concepts of primary auxiliary projections
   b. Construction of depth auxiliary views
   c. Construction of height auxiliary views
   d. Construction of width auxiliary views
   e. Plotting curves on auxiliary views
   f. Projecting features on auxiliary views onto orthographic views
   g. Construction of partial and half auxiliary views
   h. Construction of auxiliary sections

12. Be able to visualize and manipulate true shapes of oblique surfaces of objects by means of executing both primary and secondary auxiliary projections.

   a. Concepts of secondary auxiliary projections
   b. Projection of circles and arcs on secondary auxiliary views through primary auxiliary views and orthographic views

13. Be able to graphically revolve segments of objects to obtain true views of inclined and oblique surfaces.

   a. Revolutions compared with auxiliary drawings
   b. Primary revolutions
   c. Determine true shape of an inclined surface perpendicular to primary projection plane
   d. Determine the true shape of an oblique surface
   e. Practical applications of revolutions

14. Be able to construct isometric drawings with normal, inclined, or oblique surfaces.

   a. Classifications of projection drawings
   b. Limitations of multiview projections
   c. Advantages of pictorial drawings
   d. Fundamental principles of isometric constructions
   e. Isometric drawings with normal surfaces
   f. Isometric drawings with inclined surfaces
   g. Oblique surfaces on isometric drawings, intersections of oblique surfaces with isometric planes
   h. Isometric pictorials drawn on reversed axis
   i. Isometric drawings with long axis in horizontal position
   j. Plotting non-isometric lines
   k. Plotting angles in isometric views
   l. Isometric drawings of irregular objects

15. Be able to prepare isometric drawings with

    a. Arcs, circles, and irregular curves
    b. Isometric sections exploded assemblies

16. Be able to draw various classes of external and internal shreads for

    a. Bolts
    b. Cap screws
    c. Set screws
    d. Give proper specifications for each

APPENDIX D
PRELIMINARY
LIST OF AUTOMOBILE MECHANICS COMPETENCIES

Orientation:

a. chain of authority (respectful)
b. shop safety
c. use of hand tools and special tools
d. use of measuring instruments

Engine:

1. Inspection, Troubleshooting, Repair/Replacement of Components

a. cooling
b. lubrication
c. emission
d. fuel
e. cylinder head service
f. engine assembly

Electrical System:

1. Inspection, Troubleshooting, Repair/Replacement of Components

a. battery
b. circuitry (wiring)
c. starter
d. charging
e. controls (regulator, gauges, etc.)
f. ignition (distributor)
g. lighting, and warning system
h. test equipment (scope, tach/dwell meter, etc.)

Power Train:

1. Inspection, Troubleshooting, Repair/Replacement

a. clutch, pressure plate, throw out bearing
b. automatic transmission
c. drive shaft, u-joints
d. differentials

Brakes and Suspension:

1. Inspection, Troubleshooting, Repair/Replacement

a. drum/disc brake assemblies
b. cylinders (masters-wheel-booster)
c. controls (differential-equalizer switch)

d. power assist components
e. steering components/linkage
f. shocks, springs, wheel balance

APPENDIX E
PRELIMINARY
LIST OF TRADE COMPETENCIES FOR CONSTRUCTION ELECTRICIAN

1. Test voltage using voltmeter.
2. Make a pigtail splice.
3. Wire a single pole switch controlling one light.
4. Wire a single pole switch controlling two lights.
5. Wire two single pole switches controlling two lights.
6. Wire a single pole switch controlling one light with pilot indicator.
7. Wire 3-way switch as selector.
8. Wire two 3-way switch controlling two lights.
9. Interpret electrical plans.
10. Interpret electrical symbols.
11. Fasten and support NMC on wood structure.
12. Measure and cut EMT with hacksaw.
13. Bend EMT with hand bender.
14. Form standard offsets in EMT.
15. Form box offsets in EMT.
16. Join EMT conduit couplings.
17. Install EMT connectors.
18. Drill, insert, and fish rigid metallic through hollow masonry walls.
19. Determine required wire size for circuitry.
20. Color code electrical wiring.
21. Determine wire length to be pulled.
22. Use normal fish tape in raceway.
23. Prepare wire for pulling.

24. Identify wires properly.

25. Attach wire to fish tape.

26. Install wires to proper circuit.

27. Insulate connected solderless splices.

28. Insulate with rubber and friction tape for 120/240 volts.

29. Insulate with plastic tape for 120/240 volts.

30. Install service conductors to meter.

31. Install service switch at meter.

32. Ground nonmetallic sheathed cable (NMC) system.

33. Wire installation 120 v. unit air conditioning.

34. Wire installation 240 v. unit air conditioning.

35. Install low-voltage transformer.

36. Wire 240 v. dryer for installation.

37. Wire residential automatic washer for installation.