DOCUMENT RESUME

ED 064 526 VT 016 158

AUTHOR Kratochvil, Daniel W.; Thompson, Lorna J.
TITLE The Cluster Concept Program Developed by the University of Maryland, Industrial Education Department.
INSTITUTION American Institutes for Research in the Behavioral Sciences, Palo Alto, Calif.
SPONS AGENCY Office of Program Planning and Evaluation (DHEW/OE), Washington, D.C.
REPORT NO AIR-21900-1-72-TR-18
PUB DATE Jan 72
CONTRACT OEC-0-70-4892
NOTE 70p.; Product Development Report no. 18

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Career Education; Case Studies; *Cluster Analysis; Construction Industry; *Educational Programs; Electromechanical Technology; *Industrial Education; Metal Industry; *Occupational Clusters; *Program Descriptions; Secondary Grades; Skill Development; Vocational Education

ABSTRACT

This report, one of 21 case studies, describes the history of a recent educational product. The Cluster Concept Program, developed at the University of Maryland, is directed toward the preparation of individuals for entrance into a spectrum of occupations. Three clusters of occupations are included: (1) Construction, (2) Electro-Mechanical Installation and Repair, and (3) Metal Forming and Fabrication. The program is targeted for boys and girls in Grades 11 and 12 who want some occupational preparation while remaining in the main stream of the educational program. It aims at giving students entry level skills for a range of related occupations. Although the 4-year study ended in 1969, the original developers have conducted several related activities since that time. They include: (1) assistance to schools, (2) further evaluation studies, (3) placement and performance research, and (4) development of additional clusters. (GEB)

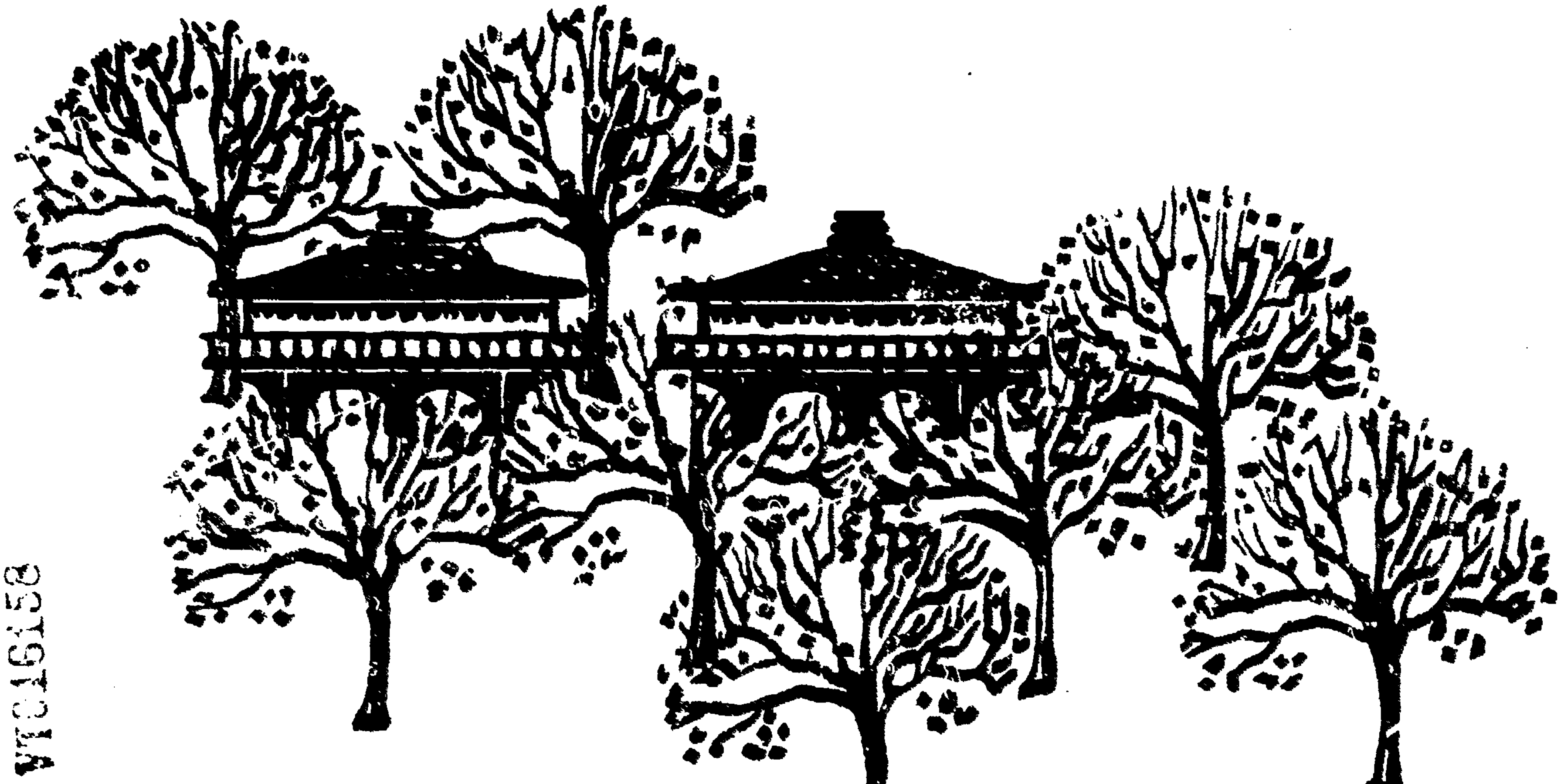
PRODUCT DEVELOPMENT REPORT NO. 18

THE CLUSTER CONCEPT PROGRAM

Developed By The University of Maryland, Industrial Education Department

January, 1972

Contract No. OEC-0-70-4892



AMERICAN INSTITUTES FOR RESEARCH
Post Office Box 1113 / Palo Alto, California 94302

ED 064526

AIR-21900-1/72-TR(18)

PRODUCT DEVELOPMENT REPORT NO. 18

Contract No. OEC-0-70-4892

THE CLUSTER CONCEPT PROGRAM

DEVELOPED BY THE UNIVERSITY OF MARYLAND,
INDUSTRIAL EDUCATION DEPARTMENT

Daniel W. Kratochvil
Lorna J. Thompson

American Institutes for Research
in the Behavioral Sciences

Palo Alto, California

January, 1972

The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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

Office of Education
Office of Program Planning and Evaluation

PREFACE

This product development report is one of 21 such reports, each dealing with the developmental history of a recent educational product. A list of the 21 products, and the agencies responsible for their development, is contained in Appendix G to this report. The study, of which this report is a component, was supported by U.S. Office of Education Contract No. OEC-0-70-4892, entitled "The Evaluation of the Impact of Educational Research and Development Products." The overall project was designed to examine the process of development of "successful educational products."

This report represents a relatively unique attempt to document what occurred in the development of a recent educational product that appears to have potential impact. The report is based upon published materials, documents in the files of the developing agency, and interviews with staff who were involved in the development of the product. A draft of each study was reviewed by the developer's staff. Generally, their suggestions for revisions were incorporated into the text; however, complete responsibility for interpretations concerning any facet of development, evaluation, and diffusion rests with the authors of this report.

Although awareness of the full impact of the study requires reading both the individual product development reports and the separate final report, each study may be read individually. For a quick overview of essential events in the product history, the reader is referred to those sections of the report containing the flow chart and the critical decision record.

The final report contains: a complete discussion of the procedures and the selection criteria used to identify exemplary educational products; generalizations drawn from the 21 product development case studies; a comparison of these generalizations with hypotheses currently existing in the literature regarding the processes of innovation and change; and the identification of some proposed data sources through which the U.S. Office of Education could monitor the impact of developing products. The final report also includes a detailed outline of the search procedures and the information sought for each case report.

Permanent project staff consisted of Calvin E. Wright, Principal Investigator; Jack J. Crawford, Project Director; Daniel W. Kratochvil, Research Scientist; and Carolyn A. Morrow, Administrative Assistant. In addition, other staff who assisted in the preparation of individual product reports are identified on the appropriate title pages. The Project Monitor was Dr. Alice Y. Scates of the USOE Office of Program Planning and Evaluation.

Sincere gratitude is extended to those overburdened staff members of the 21 product development studies who courteously and freely gave their time so that we might present a detailed and relatively accurate picture of the events in the development of some exemplary educational research and development products. If we have chronicled a just and moderately complete account of the birth of these products and the hard work that spawned them, credit lies with those staff members of each product development team who ransacked memory and files to recreate history.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Table | Page

PRODUCT DESCRIPTION

Product Characteristics

Name

The Cluster Concept Program.

Developer

The University of Maryland, Industrial Education Department.

Distributor

The materials produced for the Cluster Concept Program are in the public domain and are available as ED014554, ED016841, ED016842, ED016843, and ED016844 from EDRS, P.O. Drawer O, Bethesda, Maryland 20014.

Focus

The focus of the Cluster Concept Program is on vocational education directed toward the preparation of individuals for entrance into a spectrum of occupations. Three spectra or clusters of occupations make up the program; they are: (1) the Construction Cluster, (2) the Electro-Mechanical Installation and Repair Cluster, and (3) the Metal Forming and Fabrication Cluster.

Grade Level

Grades 11 and 12.

Target Population

The target population consists of eleventh and twelfth grade boys and girls, who typically would enroll in vocational education courses or in the general curriculum rather than in college preparatory courses, but who want some occupational preparation while remaining in the main stream of the educational program of the school. Thus, it is not for the individual who has decided he wants to be a specific craftsman or technician or for the person who has decided to attend college, but rather for the person who is still exploring and wants to retain all possible options.

Rationale for Product

Long Range Goals of Product

The four-year study of the Cluster Concept Program in vocational education ended in 1969. It was hoped that subsequent developmental efforts would help to tap the full potential of the cluster concept approach to vocational education. It was recommended that the approach be replicated and evaluated by professionals other than those who developed the concept. Neither of these occurred. With the completion of the fourth year of studying the cluster concept approach, the theory, methodology, and practical aspects of implementation had been investigated. However, since subsequent, related proposals were not funded, the long range goal of enriching vocational education by means of the cluster concept approach has not been realized, nor is it likely to be in the foreseeable future.

Objectives of Product

The Cluster Concept Program was not intended to make master craftsmen of students. Rather it aims at giving students entry level skills for a range of related occupations and a somewhat higher level of skills to insure that they may proceed beyond the entry level in their chosen occupational area. General objectives of the cluster concept approach are:

1. To provide students with the opportunity for a greater degree of mobility on a geographical basis;
2. To provide students with the opportunity for mobility within an industry or occupation;
3. To provide students with the opportunity for greater flexibility in occupational choice patterns; and
4. To develop students who will be able to adapt to technological changes.

More specifically, the courses in the Cluster Concept Program are directed toward the following objectives.

1. To broaden the students' knowledge of available opportunities in the occupations found in each cluster.
2. To develop job entry skills and knowledge for several occupations found in a cluster.
3. To develop safe habits and a favorable attitude toward work required in the occupations in a cluster.
4. To develop a student's insight into the sources of information that will be helpful to him as he moves through the occupational areas.

Philosophy and Theory Supporting Product

How valid is an educational system that expends its resources as though eighty percnet of the students were going to college, whereas the truth of the matter is that only twenty percent of the school population ever graduate from college? The answer of course is not easily arrived at, but the question and available facts indicate that vocational education should not be relegated to a position of unimportance in the American educational system. At a time when new trends and innovations in education are attracting increasing devotion and funds, little innovation has been done in vocational education. With this in mind, the researchers at the University of Maryland asked, "What kind of an education should the individual have who does not go on to college or other form of higher education and who has not definitely decided on an occupation appropriate to conventional vocational preparation?" The answer to this question took the form of the cluster concept for the following reasons.

1. Workers in our society require geographic mobility. Kimball Wiles states in The Changing Curriculum of the American High School that more than half of the current high school population will work in different communities than the ones in which they were educated;

2. In order to adapt to changes within a single industry in this era of rapid technolotical development, a worker must have versatility within his industry;

3. A broad training background is insurance against occupational obsolescence in a narrow field of industry; and

4. Few high school students know what their occupation will be; these students need a program that will enable them to keep as many career opportunities open as possible.

From these bases came the idea that a vocational education should allow a student both to remain in the mainstream of academic life and to develop a group or cluster of related skills that will prepare him for a variety of jobs rather than a set of skills that will prepare him for only one specific occupation.

The Cluster Concept Program was designed to give students a range of skills that would prepare them for entry level capability in a variety of related rather than specific occupations. It was anticipated that the students' potential employability would be enhanced by offering a wider range of entrance skills and a level of articulation across several occupational areas. This kind of fundamental training should enable the student to move laterally through several occupational categories as well as vertically within the occupation.

In addition, the cluster approach was designed to allow students greater flexibility with regard to making major decisions about their careers. By requiring only two hours each day rather than three, the cluster concept approach allows the students to remain in more academic courses if he has not yet made the decision that he will definitely terminate his academic education at the high school level. If the student has determined that he will pursue a career requiring only vocational education, he need not make a premature decision about which specific occupation he will follow.

Description of Materials

Organization of Materials

The organization of the Cluster Concept Program is highly structured and conforms to Figure 1 on the next page. Each of the three clusters is divided into the occupations or occupational areas that make the cluster. For example, the "Metal Forming and Fabrication" cluster is made up of four occupations: assembler, machinist, sheet metal worker, and welder.

Each of the occupations in a cluster is broken down into tasks. For example, welding consists of 52 tasks. "Arc welding ferrous metals with A. C. welder to produce a horizontal butt joint" is Task No. 1 in welding. Each task is coded Level I or Level II. Level I tasks are those that are needed immediately upon job entry. Level II tasks are those which are not needed immediately for job entry into an occupation, but will be needed soon after entering the occupation. "Arc welding ferrous metals with A. C. welder to produce a horizontal tee joint" is a Level I task in welding. "Brazing nonferrous metals to produce a horizontal butt joint" is a Level II task in welding.

Each task, whether Level I or II, is broken down further in terms of human requirements along the following lines:

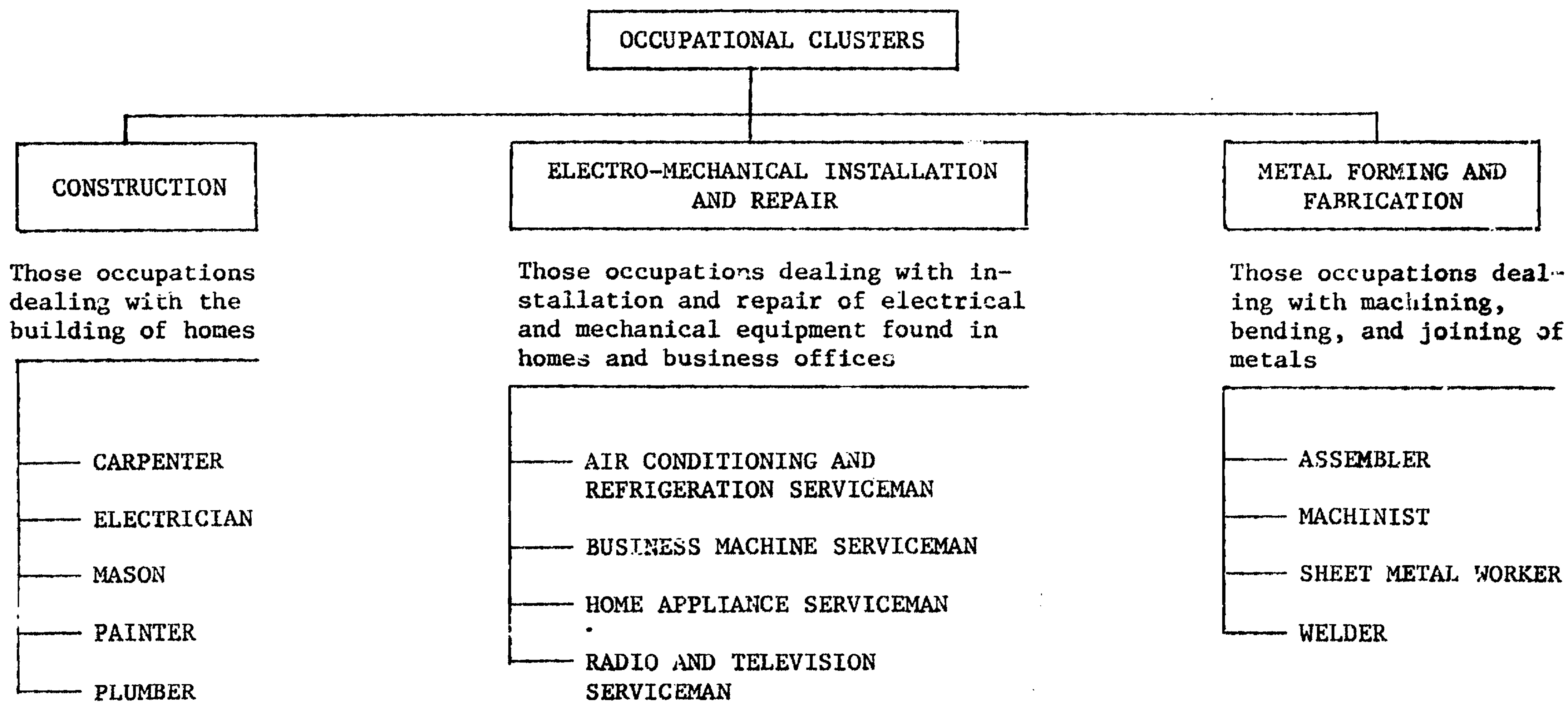
1. Communications: vocabulary, symbols, drawings and blueprints, systems of communications, speech, English, and maps.

2. Measurement: Time, temperature, weight, volume, length, width, depth, meters, instruments, systems of measurement.

3. Skills: Hand, mental, machine.

4. Mathematics and Science: practical and applied.

Figure 1. Occupational Clusters



5. Information: technical, operational, occupational, economic, social, safety, personal hygience, personal standards, occupational and job standards.

These elements of human requirements are the basis of commonality among the occupational areas in a cluster. Each occupation in a cluster has elements of communications, measurement, skills, mathematics and science, and information with the other occupations in the cluster. For example, Welding Task 1 is broken down into specific objectives classified under the five groups of human requirements. Some of these objectives are common to all occupations, some are common to more than one but not all occupations, and some are common only within the occupation. Under Welding Task 1: Communications, "Reading blueprint to determine size and characteristics of the workpiece" is common to all occupations in the cluster; Skills, "Laying out stock with a surface gauge" is common to more than one occupation in the cluster; and Science: "Exploring the electron theory of current flow in welding" is common within the occupation. Figure 2 on the next page illustrates how an occupation in a cluster is divided into tasks which are coded Level I or II and which, in their turns, are broken down into elements or objectives of human requirements, some common to all occupations in the cluster, some common to more than one occupation, and some common only within the occupation.

Format and Content of Materials

Three separate courses or clusters make up the Cluster Concept Program. As indicated in Figure 1, they are the Construction Cluster, the Electro-Mechanical Installation and Repair Cluster, and the Metal Forming and Fabrication Cluster. Materials for each course consist of a course outline volume and an instructional plans volume.

Each course outline volume contains:

1. for each occupation in the cluster, a list of tasks which are required for entry into the occupation. Each of these tasks are marked as Level I or Level II tasks (see Appendix A);

2. for each task a list of human requirements written in behavioral terms and grouped under communications, measurement, mathematics, science, skills and information (see Appendix B);

3. a suggested instructional sequence that may be utilized by the teacher in developing a lesson for each of the tasks in one occupation. The task is shown at the top of the page; headings for the areas of human performance are listed below the task; and under each heading the behavioral statements are arranged in a suggested instructional

sequence. The arrangement provides the teacher with an instructional pattern that can be used to develop lesson plans, materials of instruction, and visual aids (see Appendix C);

4. a list of the skills and knowledges that are common to all occupations and a list of those that are common to several occupations in the cluster (see Appendix D);

5. the course outline itself, divided into Level I and Level II programs. Units of instruction have been developed to provide the manipulative and verbal learnings required for job entry into each of the occupations found in the cluster. A list of suggested learning activities has been provided for each unit as well as a list of instructional materials for each occupational area. (See Appendix E)

The volume of instructional plans outlines in detail the implementation of the course outlines. The tasks and areas of human requirement are arranged in an instructional sequence for each occupation. Suggested teaching methods, instructional materials, student activities, and evaluation procedures are found opposite each area (objective) of human requirement. Instructional plans for occupational information are found at the end of each occupation. The instructional plan for Task No. 4, Erecting Wooden Guides and Columns, in the occupation carpentry which is in the construction cluster is found in Appendix F. Similar plans were developed for all of the tasks in all occupations in all clusters. The occupational information unit for carpentry is also found in Appendix F.

Cost of Materials to User

The course outline volumes and the instructional plans volumes can be obtained for a nominal cost from the ERIC Clearinghouse and the National Cash Register Company in Bethesda, Maryland. The major expense in using the cluster concept approach involves equipping the laboratories; this amounts to $25,000 to $40,000 for each cluster. An additional expense, which is sometimes significant, is often required for teacher training.

Figure 2. The breakdown of an occupation, Welding

Tasks	Level	Area of Human Requirements	Degree of Commonality
(Example from total of 52)			
#5. Arc welding ferrous metals with A. C. welder to produce a horizontal tee joint.	I	Communications (Example from total of 6)	
		Reading blueprint to determine type of weld required	Common to all occupations in the cluster
		Measurement (Example from total of 3)	
		Measuring stock with a rule or scale to determine length	Common to all occupations in the cluster
		Mathematics (Example from total of 4)	
		Applying knowledge of fractional parts of one inch--adding fractions to determine exact dimensions	Common to all occupations in the cluster
		Science (Example from total of 2)	
		Explaining the electron theory of current flow in welding	Common only within welding
		Skills (Example from total of 28)	
		Laying out stock with a center head	Common to more than one occupation
		Information (Example from total of 14)	
		Selecting proper type of file	Common to all occupations in the cluster

Procedures for Using Product

Learner Activities

Procedures for using the Cluster Concept Program are somewhat more complex than those for using a standard vocational education program. Students may work on a greater variety of projects in the same workshop at the same time; projects related to all the occupations in a cluster may be underway at the same time in the workshop where the cluster is being taught. Many types of equipment, tools, and materials are in use at one time, and students can work at their own rates. Programmed instructional materials allow the student to proceed without teacher assistance and provide for self-evaluation and review; however, not all of the material is programmed. Typical activities in a day include both individual and group efforts. Students often work on individual projects based on their particular interests; these projects provide experience in research, design, and manipulative activities. Many areas of human requirements are presented to a group of students by demonstration, lecture, or reference to a text; then students practice the "area" or skill. Whether the learning takes place in a group or individually, each task is approached methodically by mastering the necessary areas of human requirement.

Students deal with concrete problems. While students might wonder what possible use they will ever have for the knowledge that $a^2 + b^2 = c^2$ or that the Battle of Waterloo was in 1815, they know what they will be able to do as a result of accomplishing the cluster concept tasks. And because the Cluster Concept Program breaks learning tasks into small elements (i.e., areas of human requirements or specific behavioral objectives), rapid and successful progress can be made in achieving the stated objectives. To accomplish a task, each student moves sequentially, at his own rate, through areas of human requirements. Since the tasks are also referenced, the students build on previous learning while acquiring the job entry skills for an occupation. The students can find satisfaction in the completion of physical tasks and can demonstrate real products as a result of their efforts. Students thus have the opportunity, so rare in general high school education, to use what they learn, rather than just storing new-found knowledge in some brain cranny and hoping dubiously that there will be a need for that information at some point in the future.

Donald Maley, Director of the Cluster Concept Project, expressed it this way:

"The opportunities to realistically use mathematics, science, communications, and one's social skills are tied to practical applications in a new dimension for meaning. As an example, many non-readers in the regular school program literally devour the printed manuals of the automotive laboratory. Yes, reading in this case is for a purpose and the reason for reading is based on the need to know."

Of major importance to student motivation is the fact that the vocational education student will probably begin his employment within a year or so after completing his courses. By comparison, a student going on to college cannot anticipate the beginning of his career for several years beyond high school.

The Cluster Concept Program has two two-hour periods daily instead of the three-hour periods which are typical in vocational education programs. With two periods per day, the cluster program can more easily be fitted into the general curriculum program. It can thus provide employment opportunities for the student while permitting him to remain in the main stream of the educational program of the school.

Teacher Activities

The Cluster Concept Program recommends and provides for various teaching strategies through course outlines and instructional plans. Demonstration lessons involve the teacher in "show and tell" activities with the student and allow the student to practice the new skill in the teacher's presence. Teachers prepare job sheets which contain written instructions, illustrations, and a list of necessary tools and materials. The job sheets are used to assign work to students and to teach the operations necessary to perform a task. Instructional aids, such as models, films, and charts, are used to strengthen units which are generally of a verbal nature. These aids expose students to operations which cannot be covered in the classroom or on field trips and provide a means of enlarging hard-to-see demonstration areas. Teachers often work in pairs to pool the talents of staff members. They also make use of resource people from outside the school to present a unit of instruction through a coordinated effort. Organizational or occupational information is frequently presented to groups of students through lectures.

By using this variety of instructional strategies, the cluster concept teacher is able to give individual attention to each student. While the students are working individually, the teacher can "float" among the students and work areas.

the students are working individually, the teacher can "float" among the students and work areas.

Most teachers of standard, single-occupation oriented vocational education courses need more training before they can teach a cluster concept course, since a greater variety of skills are taught. A teacher of a standard vocational education course may be a master carpenter, but for the construction cluster, he would need electrical, masonry, painting, and plumbing skills as well. A tentative teacher preparation program was developed. The materials for the program included a listing of the major topics to be covered and a series of unit outlines under each topic. No other teacher training materials or opportunities are now available.

Considerable out-of-class preparation is also required even for well trained teachers, but these duties are no more than the teacher of a standard vocational education course would have. Construction materials must be ordered and inventoried, and job sheets (if used) must be prepared. The degree of detail provided by the course outlines and instruction plans perhaps even alleviates the out-of-class preparation load required of all vocational education teachers.

Provisions for Parent/Community Involvement

As noted above, the teacher often uses resource people from outside the school to help in the presentation of a unit of instruction. Furthermore, the school staff maintains various modes of interaction with leaders of industry to help assure the placement of their students. Parents have not been directly involved in major aspects of the Cluster Concept Program.

Special Physical Facilities or Equipment

In general, the Cluster Concept Program required considerably more equipment than typical standard high school vocational education shops have. Appendix C of the Phase IV Final Report provides a complete list of tools, equipment, and materials needed for each cluster. (Maley, 1969)

Recommended Assessment Techniques for Users

The area of feedback of student progress is not left to chance in the Cluster Concept Program. If the student has performed a task in the teacher's presence, both student and teacher know that the student has met the objective. An observer needs only to watch the student perform to evaluate his skill. There is little need to draw facts or thought processes from the student to determine if the desired learning is taking place.

While observation of student performance is the predominant method of evaluating a student's progress, quizzes, tests, and reports are also utilized. Optional points for use of these available testing instruments are indicated in the instructional plans.

As a means of recording evaluation information and of further motivating the student, the cluster concept provides each student with a Task Evaluation Chart listing all of the task statements that make up the objectives of the student's cluster. As a student progresses through the course, the instructor marks each task as satisfactorily or unsatisfactorily accomplished. Accomplishment of a task does not mean that the student has performed the task once, but it means that he has mastered the performance of the task through repeated practice. Copies of the Task Evaluation Chart are provided for the student, his parents, the school personnel, and the student's prospective employer. With such a detailed account of his capabilities at hand and knowing that an evaluation of his work is available for all concerned, most students demonstrate motivation to master the tasks listed.

ORIGINS

Key Personnel

Key personnel were from the University of Maryland. Donald Maley, who is a professor and head of the Industrial Education Department, was the principal investigator. Walter S. Mietus, who has extensive experience in teaching and industry, was the research coordinator. Nevin Frantz was the leader of the research staff, while working on his doctorate and prior to the arrival of Dr. Mietus. The research associates were: Joseph Abromaitis, Gregory Berbert, Luther Burse, John Gallinelli, and Kenvyn Richards.

Dr. Maley developed the ideas that evolved into the Cluster Concept Program. From the beginning to the end, he was the man behind the idea. Dr. Mietus and Mr. Frantz provided the administrative and research support that was needed. The research associates did much of the leg work and many of the production tasks.

Sources and Evolution of Ideas for Product

The inspiration for the Cluster Concept Program came directly from the personal experiences of Dr. Maley. Dr. Maley graduated from a technical high school during the depression and was fortunate enough to find a job as a sweeper in a local foundry. After 5-1/2 years there, Maley had reached the level of management intern and decided he wanted to go to college. The admissions officer at California State College in Pennsylvania frowned on Maley's vocational background; he had no mathematics or science courses. But the college president intervened in his behalf, feeling that experience in industry must have been of some value, and allowed him to enroll in the industrial arts department. The fact that he was nearly not admitted to college because of his vocational arts background made a great impression on Dr. Maley. He realized how easy and frustrating it can be to become limited by your background. He has since been devoted to the idea that such limitation is unnecessary and should be eliminated.

Other experiences in Dr. Maley's youth also played a part in his formation of the cluster concept. He grew up in a coal mining area where he saw many young people go to work in the mines. When mines closed down, there was nothing else they could do, nowhere else they could go. Many spent much of their lives on welfare and in poverty, hoping in vain that the mines would someday reopen. Here was a situation in which a group's range of skills was so narrow that their years of productivity were greatly diminished for lack of geographical mobility. As an intern at the Martin Company while working toward his doctorate, Dr. Maley recognized the need for mobility within an industry.

Dr. Maley has long been involved in innovative vocational education programs. He feels that the standard vocational education course that concentrates on pump handle lamps, tin cups, or book ends is a waste of the students' time. Statistics he cites seem to indicate that the students also believe this. Ninety-five percent of the boys in Maryland take industrial arts in junior high school; it is a required course. In ninth grade, however, when it is no longer required, many students drop out.

In 1952, Maley developed a program called Research and Experimentation in Industrial Arts in an attempt to make industrial arts courses more appealing to students. Although the program was not funded until 1959, it turned out, according to Dr. Maley, to be a great success. The program used the scientific method of problem solving and applied that method to materialistic rather than scientific elements of the culture.

In 1954, Dr. Maley developed the Maryland Plan, a junior high school industrial arts program that integrates mathematics, science, communications, and social sciences into industrial arts activities and also makes extensive use of inquiry, problem solving, and experimentation techniques.

The history of Dr. Maley's Industrial Education Department at the University of Maryland can be viewed as a factor in the development of the cluster program. Dr. Maley sees the department as unique. In existence since the 1930's, Industrial Education at first shared meager facilities with the Engineering Department. R. Lee Hornbake joined the staff as head of the department in 1945. His philosophy was a departure from the accepted belief that an industrial arts course should be designed around job and task analyses and that students should be molded to fit specific jobs. Hornbake placed more emphasis on the importance of people--he felt that courses should be designed to fulfill people's desires and to maximize their capabilities. As Dr. Hornbake's assistant, Dr. Maley assimilated the orientation-to-people philosophy which still permeates the Industrial Education Department today.

Thus the idea of the cluster concept was not a sudden inspiration that came to Dr. Maley; rather it was the culmination of a lifetime of personal and professional experience. Other factors than those already mentioned were also important in Maley's formulation of the concept. For one thing, Maley, realizing that many students graduating from college still do not know what career they want to follow, refused to accept the idea that most high school students are ready to choose one specific occupational goal. Most vocational education programs have the effect of locking a student into one occupational course after he has made even the most tentative and superficial career decision. Also relevant were the problems surrounding interest and aptitude tests that are so widely used by students, parents, counselors, and teachers in determining the best curriculum for individual students. Such tests never point to a specific occupation field; no test result ever recommends that a youngster be a riveter. Rather, one or more broad categories emerge as the student's area of interest or capability.

After more than 15 years of germination, the cluster concept finally sprouted in 1965 with Donald Maley's proposal to the U. S. Office of Education.

The efforts of many people went into the proposal. Maley submitted it to the university vice president, the dean of the School of Education, Dr. Hornbake, and the State Department of Education for comment and advice. They all received the idea of the cluster concept enthusiastically and helped Dr. Maley fill the "holes" in his proposal.

In March 1965, Dr. Maley was told the proposal would be approved. He then proceeded to hire Nevin Frantz and four graduate assistants. However, by September the contract was still not signed. Maley was over committed--he had staff but no money to pay them. Before government money came through, the university contracts officer agreed to give Maley an account with which he could pay his staff. Finally, the contract was signed and work began to proceed as scheduled.

Funding for Product

Development of the Cluster Concept Program was supported by U. S. Office of Education funds. Each development year a proposal was submitted and funds were obtained. Total support amounted to $278,731.

This total amount can be broken down in the following way:

1.	Development:	$150,000	2. Salaries:	$152,183
	Evaluation:	28,731	Materials, etc.:	126,548
		$278,731		$278,731

PRODUCT DEVELOPMENT

Management and Organization

The Cluster Concept Program was developed by members of the Industrial Education Department at the University of Maryland. Dr. Maley rates the department, which he heads, as one of the top three in the country. Vocational education, industrial arts, and management training are included in Maley's Industrial Education Department; typically, each of these areas makes up a separate department, and communication between the departments is rare.

Dr. Frantz was the first leader of the research staff. The staff were all friends socially, but Maley did not participate in their social activities. Maley reported, however, that he and the staff knitted themselves together into an effective team. According to Maley, the research team under Frantz did unbelievable amounts of work; they worked above and beyond their duties; while most were committed for 20 hours a week, they often worked 40 hours.

At the start, Maley sold Frantz on working on the Cluster Concept Project. Then, Frantz convinced the others. They were hesitant at first and saw it would be lots of work. They became enthusiastic. It wasn't like taking lay people and indoctrinating them into technologies as well as into a new program. They were already skilled in vocational education; what was new was the theory.

After the first two years, Frantz, as planned, received his doctorate and left. Dr. Mietus then joined the staff. The change in directors of research caused no disruption. Even though as Maley said, the staff "would have walked through fire for Nevin," they regarded working with Mietus as a good opportunity as they respected his experience.

Personal talents decided task assignments. Usually the director of research took care of the consultants and resource people. Teacher training duties were shared by all. The staff worked on the clusters with which they were most familiar. There was a great deal of fluidity, however, as everybody "pitched in" on many tasks.

Original Development Plan

The original development plan called for a four year time schedule. Cluster Concept Programs were to be developed as alternate forms of vocational education in response to constructive suggestions gleaned from the research in related disciplines. The programs were to be aimed at preparing eleventh and

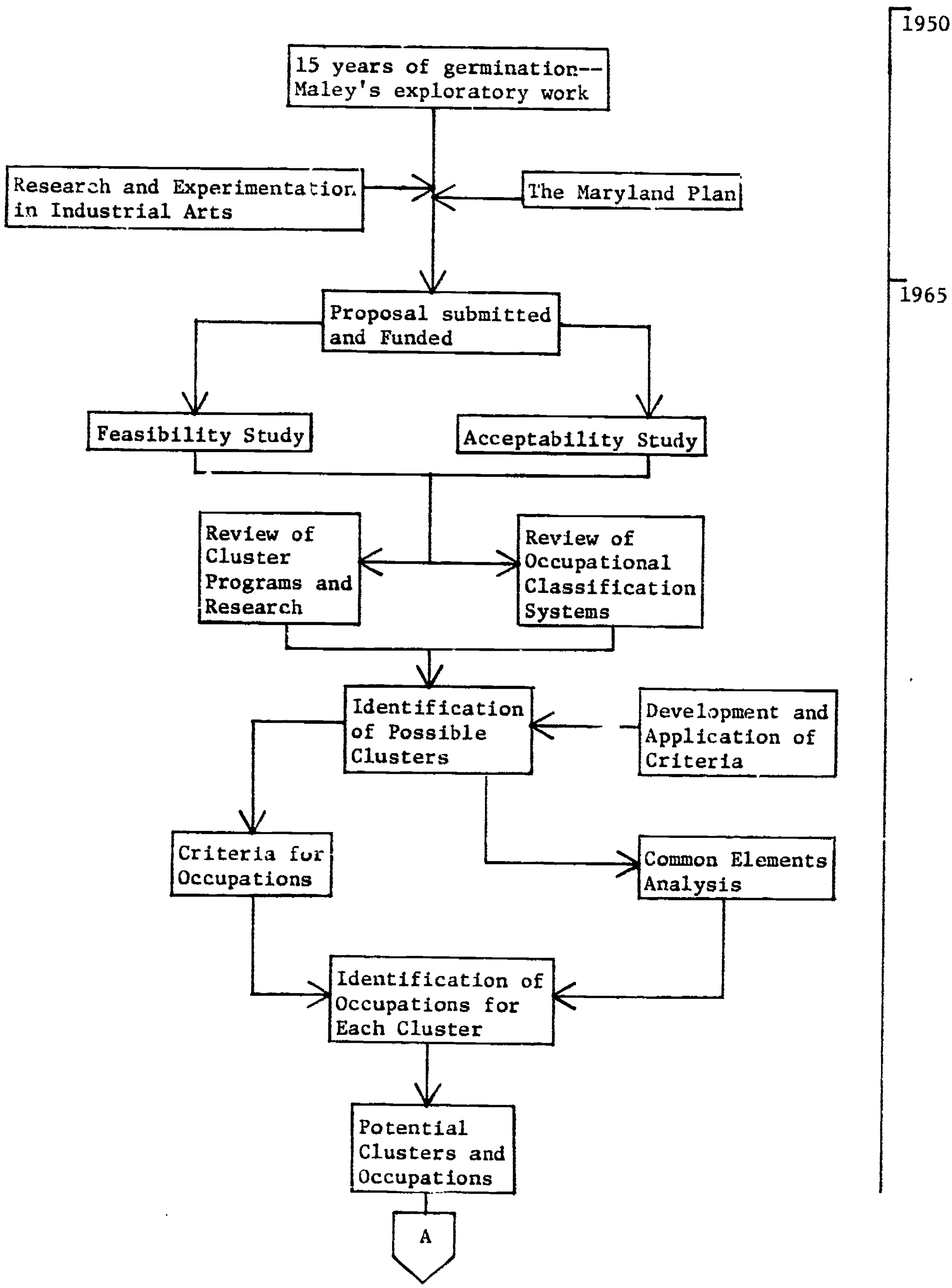
and twelfth grade youths for entry level capability into a variety of related rather than specific occupations. The development of these programs was to be based on the premise that educational experiences encompassing a range of related occupations appear defensible for most secondary students who have no realistic basis for decision making when selecting to study a specific trade. The programs were to be designed to enhance the individual's employability by providing a wide range of transferable entrance skills. Common job elements were to be incorporated in the programs to promote articulation vertically and horizontally across several occupations.

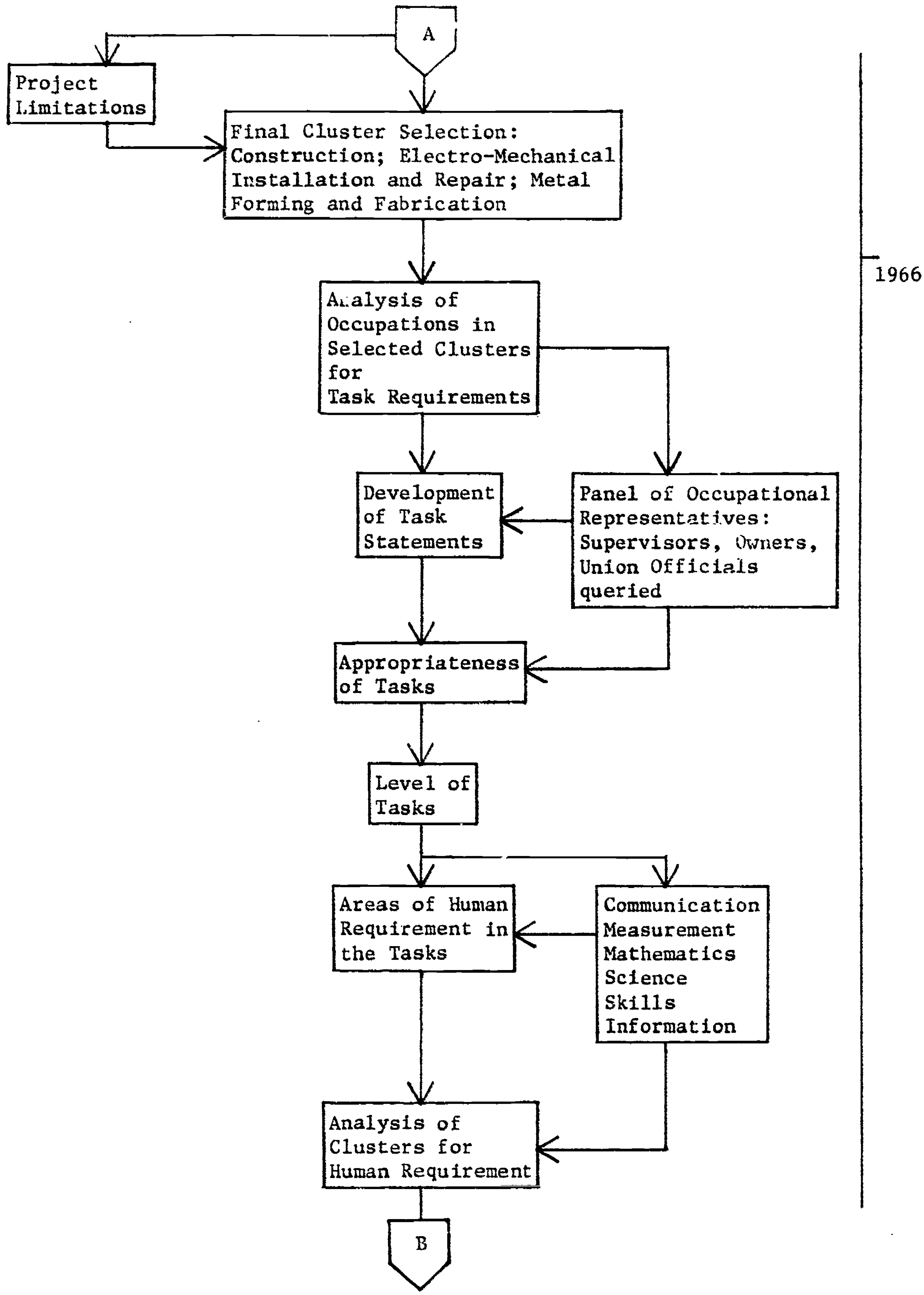
The project was to be divided into four phases, each one year long. During Phase I, the acceptability and feasibility of Cluster Concept Programs was to be determined and some curricula for the occupational clusters was to be generated. Phase II was to focus on the production of curriculum guides, course outlines, and instructional materials and the selection and training of teachers to implement the programs. Phase III was planned as an evaluation of the first year of field experimentation and implementation. Phase IV was to be an evaluation of the second year of experimentation with the pilot programs and was to include placement activities.

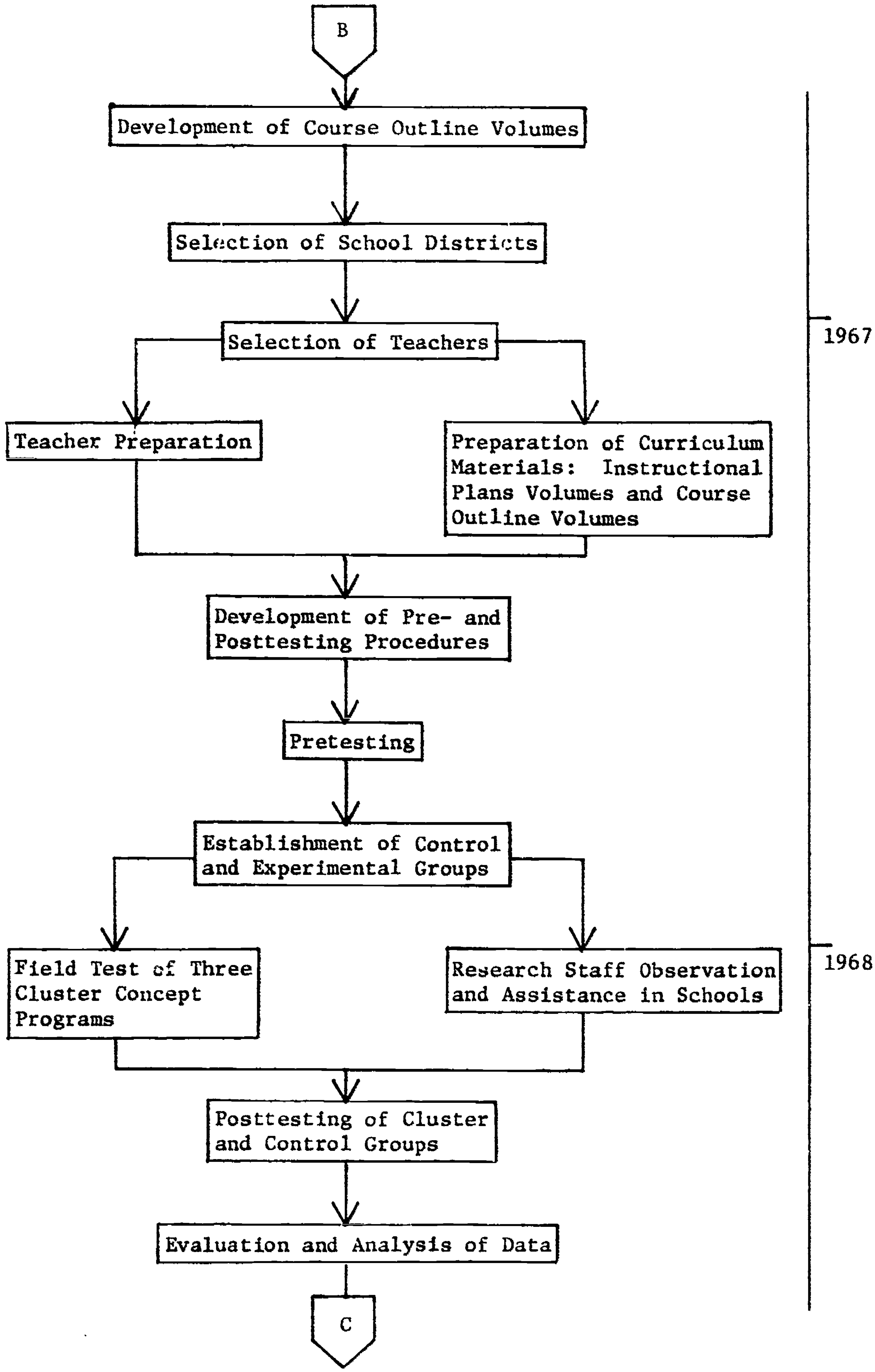
Modification of Original Development Plan

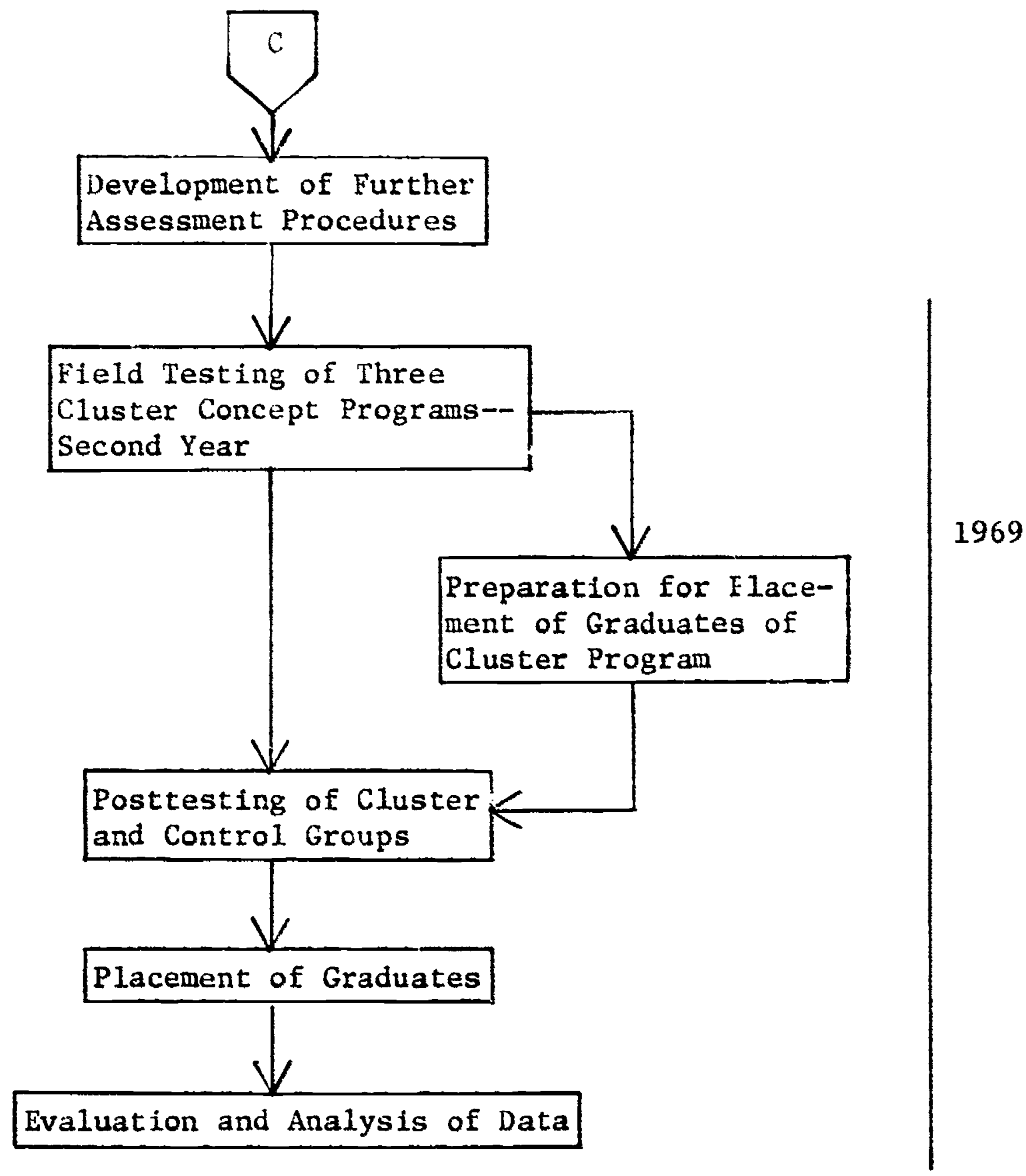
Actual procedures for development of the Cluster Concept Program closely followed those specified in the original development plan. (See major event flow chart on pages 18-21 for an overview of the history of the product.) The activities planned for the four phases were the activities actually completed. One major modification was made in the scope of the product. Originally it was planned that a minimum of seven clusters would be produced. However, within the first six months of operation, they decided they could not possibly handle seven clusters, so they aimed at three. Maley said he was "like a kid in an ice cream parlor." He wanted to do so many clusters, but he didn't realize the complexity of what was involved. They had also expected to write new texts to use with the courses, but they could only find time to write course outlines and instructional plans for each cluster.

Figure 3. Major Event Flow Chart




A
Project Limitations
Final Cluster Selection: Construction; Electro-Mechanical Installation and Repair; Metal Forming and Fabrication
Analysis of Occupations in Selected Clusters for Task Requirements
Development of Task Statements
Panel of Occupational Representatives: Supervisors, Owners, Union Officials queried
Appropriateness of Tasks
Level of Tasks
Areas of Human Requirement in the Tasks
Communication Measurement Mathematics Science Skills Information
Analysis of Clusters for Human Requirement
B
1966


B
Development of Course Outline Volumes
Selection of School Districts
Selection of Teachers
Teacher Preparation
Preparation of Curriculum Materials: Instructional Plans Volumes and Course Outline Volumes
1967
Development of Pre- and Posttesting Procedures
Pretesting
Establishment of Control and Experimental Groups
Field Test of Three Cluster Concept Programs
Research Staff Observation and Assistance in Schools
1968
Posttesting of Cluster and Control Groups
Evaluation and Analysis of Data
C


C
Development of Further Assessment Procedures
Field Testing of Three Cluster Concept Programs--Second Year
Preparation for Placement of Graduates of Cluster Program
Posttesting of Cluster and Control Groups
Placement of Graduates
Evaluation and Analysis of Data
1969

Actual Procedures for Development of Product

Development

The actual development of the Cluster Concept Program occupied four phases, each one year long, from August 1965 to August 1969. Each year dealt with a separate phase of development and analysis.

Phase I, lasting from August 1965 to August 1966, began with an exhaustive literature study in the areas of related studies, sociological factors, employment trends, economic trends, educational points of view, and potential research procedures. A series of studies aimed at determining the acceptability and feasibility of the cluster idea were also conducted. The results of these studies, which were actually structured interview sessions with a number of people representing industry, labor, and education, suggested that the cluster concept idea was both acceptable and feasible. The next major endeavor by the project team was a thorough study of occupations, job requirements, relationships between occupations and systems of classification that would lead to the development of valid occupational clusters.

The cluster development model in Figure 4 diagrams the series of steps through which the project moved in its actual selection of a series of clusters. One of the first procedures in the identification and development of a series of clusters was to review the following occupational classification indexes:

1. Dictionary of Occupational Titles
   (U.S. Department of Labor)

2. Classified Index of Occupations and Industries
   (U.S. Department of Commerce)

3. Alphabetical Index of Occupations and Industries
   (U.S. Department of Commerce)

4. International Standard Classification of Occupations
   (International Labor Office, Geneva, Switzerland)

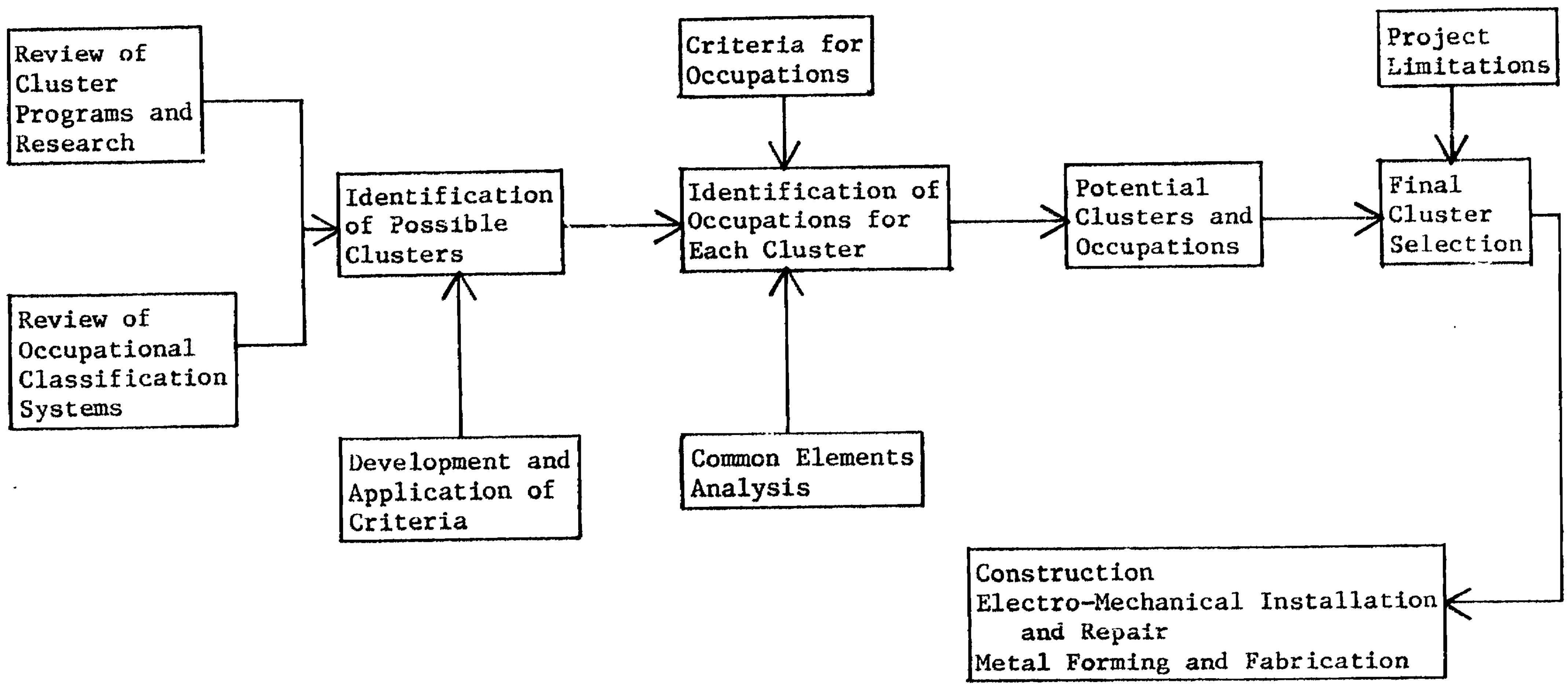
5. Manual of Enlisted Military Occupational Specialities
   (U.S. Army)

6. Occupational Handbook for Airmen
   (U.S. Air Force)

7. A Guide to Occupational Specialities and Schools
   (U.S. Marine Corps)

8. U.S. Navy Occupational Handbook
   (U.S. Navy)

Figure 4. Cluster Development Model



This accomplished, and the review of cluster programs and research completed, the actual identification of clusters of occupations could take place. The identification process was predicated on several independent but related ideas. These included the matter of criteria for the establishment of a cluster, commonality among selected occupations for a cluster, and a set of criteria that could be applied to the identification of occupations to be included in a cluster.

One of the techniques used in establishing clusters was based upon a procedure proposed by Altman and Gagné (1964) and which includes the following steps:

1. Preparation of a list of criteria to use in selecting occupational clusters and specific occupations within the clusters.

2. Development of a group of possible occupational clusters and selection of several clusters from the group for further analysis.

3. Development of a number of possible occupations for each cluster and selection of those occupations meeting the established criteria for further analysis.

The following criteria for the establishment of the clusters were specified:

1. The cluster of occupations should be in the area of vocational-industrial education.

2. The cluster should include occupations that have similarities in the areas of processes, materials, and products.

3. The cluster of occupations should be broad enough to include a wide variety of skills and knowledge.

4. The occupations in a cluster should not require more than a high school education for entry employment.

5. The occupations in the cluster should provide the potential for in-plant as well as geographical mobility.

Potential clusters that were identified in the early development of the project focused on such areas as:

Medical and Health
Home Facilities
Heavy Construction
Light Construction

Machining and Farming
Electricity and Electronics
Communications
Transportation
Food Processing
Office Occupations
Mechanical and Fabrication
Repair Service and Maintenance
Personal Services

Since it was felt that the occupations within a cluster should have certain bonds of commonality among them, a number of common elements were established. They are:

1. Communications: vocabulary, symbols, drawings and blueprints, systems of communication, speech, English, maps

2. Measurement: time; temperature; weight; volume; length, width, and depth; meters (electrical and mechanical); instruments; systems of measurement

3. Skills: hand, mental, machine

4. Mathematics and Science

5. Information: technical, operational, occupational, economic, social, safety, personal hygiene, personal standards, occupational and job standards

Prior to the acceptance of any occupation as part of a cluster, the following criteria were applied.

1. The occupation must have a favorable employment outlook.

2. The instruction related to the occupation must be capable of being carried out in a secondary school program.

3. The occupation should permit job entry upon graduation from high school.

4. It must have sufficient skills and information to provide an opportunity for the identification of commonalities with other occupations.

5. The occupations should have opportunities for advancement through further schooling, on-the-job training or apprentice programs.

Project limitations, associated with time, personnel, and facilities, made it impossible to deal with all of the areas identified in a manner required by the goals and intent of the project. The final selection of clusters for the project was as follows: Construction; Electro-Mechanical Installation and Repair; and Metal Forming and Fabrication. These three clusters are listed in Figure 1 on page 5, along with the appropriate occupations in each. This selection completes the steps in the cluster development model noted in Figure 4 on page 23.

Next, an extensive analysis of the three clusters was completed to determine the type and kinds of human requirements associated with each. The procedures that led from the identified cluster areas to the preliminary courses of study are diagrammed in Figure 5 on the next page.

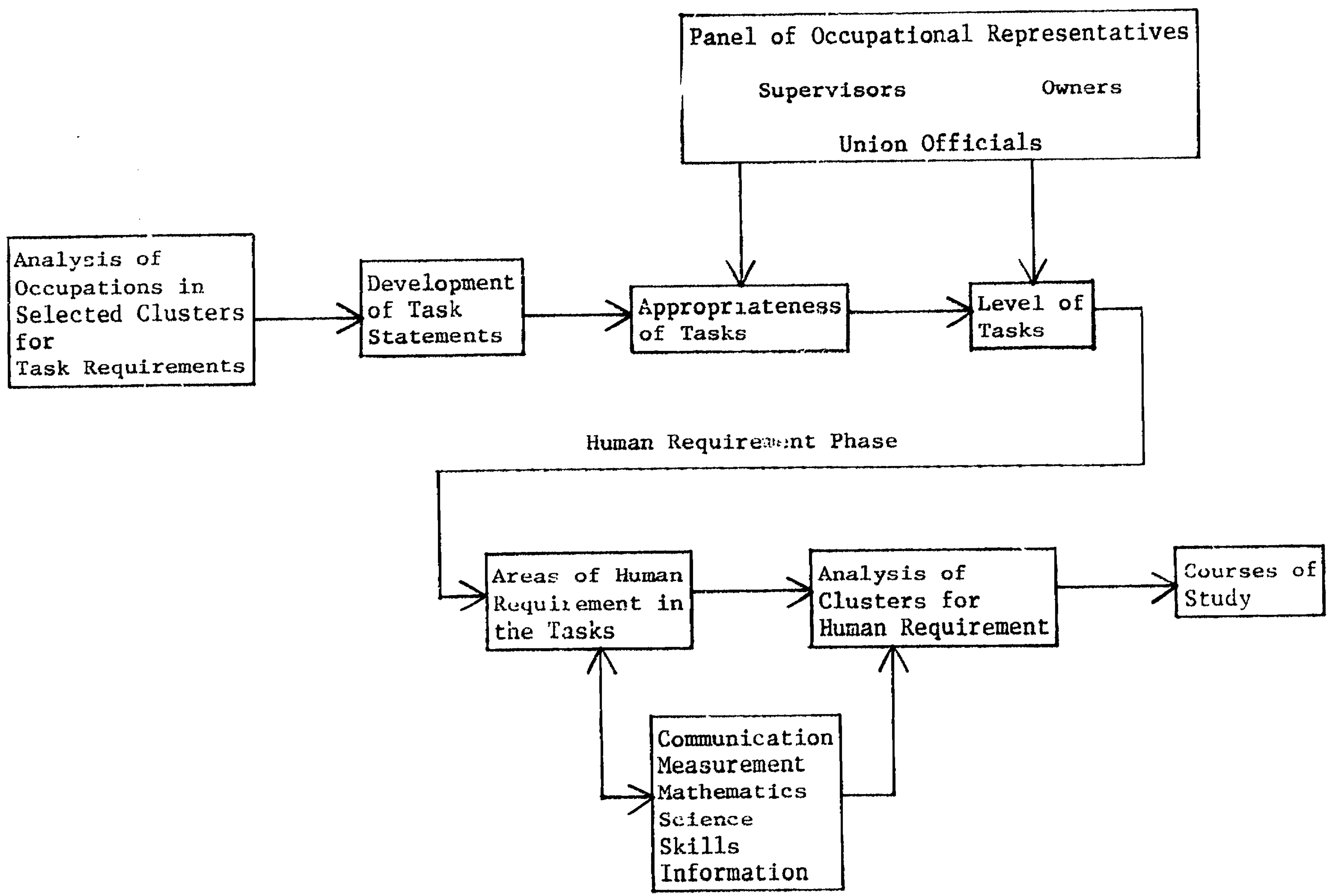
First, cluster occupations were analyzed for their task requirements. Each occupation was studied to determine what was required of the individual. The net result of this effort was a series of task statements for each occupation in the three clusters. The appropriateness of these tasks for the particular occupations was established through a special panel of representatives from industry and business. The group consisted of supervisory personnel, business owners, and union officials. This panel determined the appropriateness of the task to the particular occupation and established the level of the task. Level I tasks were those that were needed for performing satisfactorily upon entering the job. Level II tasks were advanced requirements that would be needed within six months after job entry. The net result of the panel's effort was a listing, for each occupation, of a series of task statements identified as either Level I or Level II.

A further analysis of these Level I and II tasks was then made in terms of the human requirements noted earlier. The combination of the task analyses and the human requirement analysis provided necessary data for the development of the courses of study. A tentative course of study was developed for each of the three clusters; these materials were further refined in the second phase of the project (see Appendices A through E for parts of the courses of study as they finally appeared).

The second phase of the project was designed to provide the instructional personnel, the physical facilities, and certain curriculum materials necessary to carry out an experimental field study of the cluster concept.

Selection of teachers for preparation was the first major task of Phase II. A series of conferences with top level school administrators (i.e., superintendents and supervisors of industrial education from four countries)

Figure 5. The Course Development Phase



were conducted. The actual selection of teachers involved the following interrelated considerations:

1. Each supervisor submitted a list of potential teachers from his county, whom he thought would be capable of handling such a program. The lists also included a number of persons who had expressed an interest in the program.

2. Group meetings were held with the identified teachers from each country. The purpose of these meetings was to communicate the nature and purpose of the cluster approach to vocational education.

3. A series of individual interviews was held with the goal to get some appraisal of the candidate in terms of--

   commitment to teaching
   warmth
   cognitive organization
   orderliness
   indirectness
   ability to solve problems

The following data were collected for each teacher candidate:

1. The results of a dogmatism scale

2. The results of interviews

3. An evaluation of occupational experience

4. The nature of the teaching experience

5. The candidate's formal education

6. An appraisal of the school administration in terms of its acceptance and cooperation

7. The school or laboratory facilities appropriate for the program.

The final selection of the teachers was based upon a careful study of the accumulated data on each teacher by a committee consisting of the local supervisor, the Assistant State Director of Vocational Education, the Coordinator of the Cluster Concept Project, and the Principal Investigator. Initial selection resulted in all four counties having one teacher for each of the three clusters, except one county which did not have anyone for the electro-mechnaical installation and repair cluster.

The teacher preparation phase of the project took place during the Spring Semester and the Summer Session of 1967. During the Spring Semester, large group, small group, individual, and seminar meetings were the instructional procedures. Team teaching, educational media, self-analysis, independent study, class presentations, and class discussions were the instructional processes employed to achieve the following objectives.

1. Developing an understanding of the cluster concept as a program in vocational education at the secondary school level

2. Developing capability in preparing objectives in behavioral terms

3. Developing an understanding of the research procedures utilized in formulating content for the occupational clusters of the program

4. Applying knowledge about the types and proper use of instructional materials for a Cluster Concept Program

5. Applying information about a range of instructional systems and methods appropriate for use in a Cluster Concept Program

6. Applying knowledge about a range of evaluation methods for use in a Cluster Concept Program

The Summer workshop phase of the teacher preparation centered on two major objectives.

1. The development of the needed technical skills as well as the knowledge required to complement Cluster Concept Programs

2. The preparation of instructional materials needed to teach the occupational clusters

The summer workshop activities included internships in industries directly related to the teacher's cluster area, small group and seminar sessions, instructional materials development, special technical training workshops, development of occupational information files, instructional aids workshops, industrial visitation, program development, and teacher education program development.

Several products resulted from the second phase of the Cluster Concept Program. A tentative teacher preparation program, which included a listing of the major topics to be covered and a review of unit outlines under each unit, was developed. Topics and sub-topics of this program included:

I. Professional Competency Development for Cluster Concept Programs

   A. Cluster Concept Orientation

   B. Research Procedures Used in Determining Content for Occupational Clusters

   C. Task Analysis Techniques

   D. Preparation of Objectives in Behavioral Terms

II. Organization and Administration of Cluster Concept Programs

   A. Program Development

   B. Methods of Teaching

   C. Evaluation of Program and Curriculum

III. Technical Competency Development for Cluster Concept Programs

   A. Development of Technical Skills in the Specific Cluster

IV. Instructional Materials Development for Cluster Concept Programs

   A. Function of Instructional Media

   B. Types of Instructional Media

   C. Locating, Previewing, and Evaluating Commercially Prepared Materials

   D. Construction of Materials

Also during Phase II, the course outlines were improved, and a listing of equipment, tools, and physical facilities for each of the clusters was completed. Finally a number of teachers were prepared to initiate pilot programs in their schools.

Formative Evaluation (First Year of Field Experimentation)

Purpose. The third year of the project focused on examining and evaluating the cluster concept in a series of pilot programs conducted in the public secondary schools of the four counties from which the teachers were previously selected. The primary aim was to evaluate, in a "field setting," the adequacy and effectiveness of the curriculum guides, course outlines, and preparation of the teachers. The research conducted was characterized as "aexperimental" (Guba, 1965) where several variables were investigated. Full control of all the variables necessary for an ideal experiment was not achieved; therefore, this pilot testing was completed in the tradition of quasi-experimental design with full recognition of the factors which render the results equivocal. It was anticipated that such a pilot study would provide descriptive, comparative, and quantitative data that would contribute to the further refinement of the cluster program as well as present additional information about the problems and advantages of such an experience. In particular, the answers to the following three questions were sought.

1. What is the impact of the Cluster Concept Program on selected cognitive and affective behaviors and the task performances (psychomotor behaviors) of students?

2. Is the content of courses and instrucional materials adequate and appropriate?

3. Is the educational process, in particular the administrative support, teacher effectiveness, and environmental conditions, adequate and appropriate?

Subjects. While eleven teachers from eleven schools in four counties were selected, ten participated; one of the programs in the electromechanical installation and repair cluster was discontinued. A total of 143 students were enrolled in the experimental cluster programs. Figure 6 on the next page shows the number of students in each program (for each school by cluster).

Treatments. The programs for the most part were conducted for one year in comprehensive senior high schools. One program was in a vocational-technical center associated with a comprehensive high school. Control and experimental groups were established for each of the programs. This procedure was conducted on an individual school basis. Each cluster program group was compared with a control group composed of students from a traditional vocational education course. Comparability was established through the use of intelligence test scores, lingual or verbal abilities, and in one instance a mechanical reasoning test. Each school was considered and evaluated as a separate experiment. This comparison of experimental and control groups was made to answer the first question of concern, noted above.

Figure 6. Number of Students in Experimental Cluster Programs

Program	Construction Cluster
1	15
2	16
3	16
4	14
	Total 61

Program	Metal Forming and Fabrication
5	17
6	16
7	12
8	15
	Total 60

Program	Electro-Mech. Inst. and Repair
9	13
10	9
	Total 22

Measures. To investigate this first question of concern, the changes of behaviors of subjects from the experimental and control groups were evaluated by the administration of a battery of tests at the beginning and at the end of the school year. The tests included a newly developed achievement test for each cluster, the Minnesota Vocational Interest Inventory, the D.A.T. Mechanical Reasoning Test, and an instrument to evaluate the students' knowledge of occupational information. The Cluster Concept Achievement Test, developed by the research team, was designed to tap the content of the three occupational clusters involved in the study. The following criteria were used in building the test items for this instrument.

1. The items must be based on the content of "Level I" tasks for the particular cluster.

2. The items must require a student to solve a problem or apply knowledges or skills.

3. The items must be practical with verbalism held to a minimum.

4. The items should reflect the "Level I" human requirements as outlined in the courses of study.

5. The items should be of the multiple-choice type adapted to machine scoring.

6. A comprehensive test for each cluster was required.

To answer the second question of concerr, which dealt with the appropriateness and effectiveness of the course and instructional materials, field observations and records of specific overt behaviors of students and teachers were made in the experimental groups only. The specific behavi .rs were referred to as job tasks ans were set forth in behavioral objective terms. The tasks were incorporated into the course materials, inventory charts, and evaluation charts. Teacher progress in implementing the instrutional materials and student progress were recorded by use of these devices.

To answer the third question of concern, which dealt with the evaluation of selected supportive dimensions (e.g., administration, teacher, facilities, community acceptance), the following devices were used tc obtain research data on the experimental group only: anecdotal records; personal vita and records of teachers; survey inventory forms for tools, equipment, and materials; drawings of facilities; visual mediums and written descriptions of work performed; and student progress and evaluation charts.

Results. An analysis of the cluster achievement test data revealed the following with respect to the first question of concern, i.e., the impact of the cluster program on student performance.

1. Three construction cluster programs out of four achieved significantly higher scores than the control group. Three schools also were distinguished as making significant gains on the basis of initial and final scores. One school made very modest insignificant gains. None of the control groups achieved significant gains on the achievement tests.

2. All four schools implementing the metal forming and fabrication cluster program made significant gains on the achievement tests; no significant differences were observed in the control groups. All experimental groups achieved significantly higher scores than the control groups on the posttests.

3. Three schools initially were involved with the implementation of the electro-mechanical installation and repair cluster. Due to many failures to meet the specifications presented, one school operation was discontinued. Of the two schools, neither achieved significant gains or significantly higher scores than the control group.

Data derived from the D.A.T. Mechanical Reasoning Test (from each of the ten experimental and control groups) indicated that both types of vocational education programs had insignificant effects on the development of the abilities required to solve problems of applied science and technology.

The pre- and posttest scores of the Minnesota Vocational Interest Inventory indicated no clear patterns or trends. However, the cluster groups showed more flexibility of occupational choice and expressed greater appreciation for obtaining broad entry level skills, as opposed to specific in-depth training in high school, than did the control groups.

An analysis of the task performances was relevant to the second question of concern, i.e., the appropriateness and effectiveness of the materials. Students in the construction cluster completed from 34 to 67 percent of the tasks; it was concluded that 50 to 66 percent of the tasks would need further application the second year. Students in the electro-mechanical installation and repair completed approximately half of the tasks; two-thirds of these were marked for further teaching the second year. Students in the metal forming and fabrication cluster completed from 50 to 67 percent of the tasks; 25 to 34 percent of the tasks were marked for further attention the second year.

The developers pointed out that the failure to complete specified tasks was largely due to the lack of equipment, materials, and tools. Causes for repeating tasks were also suggested by them. They were the complex nature of the tasks and the shortage of time for exercises due to delay in remodeling or in setting up laboratories.

The third question of concern dealt with the evaluation of selected supportive dimensions. An analysis of the relevant data suggested the following positive outcomes.

1. The furnishing of an inventory of task statements to teachers, students, and parents provided a sense of direction for the program, a list of expectations, and an excellent communication device.

2. The ingenuity and resourcefulness of some of the teachers gave further clues regarding the nature and kind of laboratory experiences appropriate for such a cluster program.

3. The nature and kind of laboratory facilities required for the effective pursuit of cluster programs was another important outcome.

4. The preparation and background of teachers was another area of valuable insights. The proper placement of teachers constituted a vital area of understanding that grew out of the study.

5. The nature and kind of support by the board of education, supervisor, and principal became important

factors in the success and accomplishments of the individual programs.

Formative Evaluation (Second Year of Field Experimentation)

The first year of the research established the acceptability and feasibility of the programs and generated curricula for the occupational clusters of: construction; metal forming and fabrication; and electro-mechanical installation and repair. Completion of the second year resulted in the production of curriculum guides, course outlines and instructional materials (now found in the course outline volumes and the instructional plans volumes) and the selection and training of teachers to implement the programs. During the third year of the project, an evaluation was made of the first year of field experimentation and implementation. The primary purpose of the evaluation was to determine, in a field setting, the adequacy and effectiveness of the curriculum guides, course outlines, course contents, and the preparation of the newly trained teachers. Continuous feedback information and inferences from the data gathered enabled the identification of areas where improvement was needed and suggested how changes or additions could best be made.

During the fourth year of the project an evaluation of the second year of experimentation with the pilot programs was conducted. Since this year marked the completion of the two-year program and graduation for the subjects, placement activities were carried out and the first post high school jobs of students were analyzed. Research procedures used during the evaluation were replications of those used in the first year of the field experimentation. A pretest/posttest with control and experimental group design was employed, just as before.

Purpose. Answers to the same three questions posed during the first year field experimentation plus a question concerning placement were sought. These questions were:

1. What is the impact of the cluster program on selected cognitive, affective, and psychomotor (task performances) behaviors of the subjects of the experiment?

2. Are the content and methods of the cluster program and instructional materials sufficient and appropriate?

3. Is the educational process, e.g., administrative support, teacher performance, and environmental conditions adequate and appropriate?

4. What is the employability of the graduates of the cluster program in the occupation for which they sought to gain entry level skills?

Subjects. The same experimental and control groups that participated in the first year field experimentation participated in the second year field experimentation. The total "n's" varied, however, from the first to the second year. (See Table 1 on the next page.)

Treatment. The experimental groups completed two academic years of training in a cluster program taught by specially trained teachers. For the same interval of time a comparable group, the control group, pursued singular goal-directed vocational courses.

Measures. The same measures employed during the first year field experimentation were employed during the second year. For purposes of answering question one, which was concerned about program impact in student behavior, the experimental and control groups were tested on a battery of pretests and posttests measuring the variables considered central to determining the effect of the experiences in the cluster programs. The initial administration of the battery was completed in the Fall of 1967 and the final testing was completed in the Spring of 1969. To answer questions two and three, the same measures previously employed were utilized. For question four, new forms and inventories were developed.

Results. An analysis of the cluster achievement test data revealed the following with respect to the first question of concern, i.e., the impact of the cluster program on student performance.

1. One construction program out of four attained the objectives and achieved significantly higher scores than the control group. The other three programs achieved only moderate success and the experimental group performed only slightly better then the control group.

2. All four metal forming and fabrication programs achieved the cognitive objectives; the experimental groups scored significantly higher than did the control groups.

3. Neither of the two electro-mechanical installation and repair groups scored significantly higher than did their control groups; both only managed modest changes in behavior.

In summary, some programs were highly successful whereas others fell short of achieving the established cognitive objectives.

Table 1

Total Population Distribution by Cluster

School	Teacher	Number of students cluster or experimental group 1967-68		Number of students cluster or experimental group 1968-69	Number of students control group 1968-69	Cluster students graduating
Construction Cluster						
A	108	15		14	19	14
H	101	16		13	19	12
D	102	16		12	13	4
C	106	14		5	13	5
		61	Totals	44	64	35
Metal Fabrication Cluster						
B	110	17		16	10	12
E	105	16		11	10	8
F	111	12		7	16	4
J	104	15		12	20	12
		60	Totals	46	56	36
Electro-Mechanical Cluster						
M	109	9		7	15	7
G	107	13		20	15	4
		22	Totals	27	30	11
	Grand Totals:	143		117	150	82

Research data derived from the D.A.T. Mechanical Reasoning Test indicated that both types of vocational education programs had an insignificant effect on the development of the abilities required to solve problems of applied science and technology.

Data derived from the Minnesota Interest Inventory were perplexing and generally unsatisfactory for clear analysis. Small differences between pre- and posttests and control and experimental groups were observed. No clear patterns or directions of student preferences were found.

A supplementary instrument was designed by the research staff to obtain an estimate of the student's knowledge and attitude relevant to selected job factors such as human relations, job status, security, advancement, and intrinsic and extrinsic feelings about jobs. A significant number of students showed an awareness of the meaning of the first job and the concept of career development as a life-long process. More diversity or flexibility of expressed job choice was observed to take place within the cluster group than within the control group. A greater degree of fluctuation in the direction of or away from occupations the students actively studied was observed, whereas less fluctuation of attraction for unfamiliar occupations was exhibited.

Thus far, all of the reported results pertained to question one, concerning the impact of the cluster program on student behavior. To answer the second question, which was concerned with the adequacy and appropriateness of the content and instructional materials, an analysis of the data obtained by the same instruments employed in the first year field experimentation was conducted. During the two-year pilot programs no field operation completed all the tasks structured into the programs. Programs implementing the metal forming cluster completed from 67 to 98 percent of the tasks. The construction cluster programs completed from 52 to 79 percent of the prescribed tasks. The electro-mechanical cluster groups completed from 29 to 60 percent of the tasks. There was sufficient evidence to indicate that, while the teachers understood the requirements of the new programs, they lacked the ability to fully integrate job task commonalities.

The third question was concerned with the evaluation of selected supportive dimensions including the administration, teacher, physical facilities, and community acceptance. Again, the same devices used to answer this question during the first year field experimentation were used during the second year. The use of school shops which were primarily designed for the study of a single occupation presented restrictions on the activities of the cluster programs. Some schools remodeled their facilities, thus providing the additional space and power requirements. There was a severe time lag between requisition and acquisition of tools, equipment, and materials. These problems caused the teachers to artificially emphasize certain units of study while they awaited the fulfillment of requisitions. The sequence and balance of the structured programs was disturbed. Where administrative support was strong, these problems were gradually resolved, whereas in a few schools these problems continued for the two-year period.

The final question was concerned with assisting the subjects of the cluster programs in making the transition from school to the world of work. Efforts such as developing school and community awareness, the systematic preparation and presentation of student cluster experiences, interests and abilities, and the systematic analysis of employer activities, provided an effective service to the students. Four weeks after graduation 86 percent of the subjects were gainfully employed and up to 60 percent of the subjects were working in cluster-related jobs. No longitudinal study was made since this research terminated in August 1969.

The research completed with the pilot programs suggested that Cluster Concept Programs have the potential of becoming effective, alternate forms of vocational education. It was found that in some schools the programs did significantly change the student behaviors in the direction of the stated objectives of the programs. Changes in cognitive abilities, broadened knowledge and job interests, flexibility of occupational choice, and growth in the performance of skill tasks were observed in some instances. The developers believe that the full power of the programs was not achieved in the pilot programs. There was considerable evidence to suggest that continued work and experience would be needed to bring out the optimum power of cluster programs.

SUMMATIVE EVALUATION

While the two years of field experimentation incorporated quasi-experimental designs and while modifications were still being made in the Cluster Concept Program, some of the findings could be considered as resulting from summative evaluations. Pre- and posttesting of both an experimental and control group duirng both years of field experimentation resulted in data that, when analyzed, suggest the following:

1. Some program components were highly successful, whereas others fell short of achieving the established cognitive objectives. In some instances the cluster concept students performed significantly better than did the control group; in other comparisons there were no significant differences between the two groups.

2. While there were no clear patterns or trends in the affective area, there was a tendency for the cluster concept students to show more diversity or flexibility in job choice and to express a greater appreciation for obtaining broad entry level skills than did the traditional vocational education students.

3. During the two-year pilot programs no field operation completed all the tasks structured into the two-year sequence of programs. The range of tasks completed, across clusters and students, was 29 percent to 98 percent. Failure to complete these tasks was attributed to: the lack of equipment, materials, and tools; the shortage of time and exercises due to delays in setting up laboratories; and the lack of teacher ability to fully integrate job task commonalities.

4. As suggested in "3," the selected supportive dimensions, including administration, teachers, physical facilities, and community acceptance, did not always positively affect the Cluster Concept Programs. Facilities were restrictive, and consequently the teachers often could not present the programs as designed. Administrative and community support varied.

5. Four weeks after graduation 86 percent of the students were gainfully employed, and about 60 percent were working in cluster-related jobs.

In short, while the results are not conclusive, there was evidence that in some schools the programs did significantly change the student behaviors in the direction of the stated objectives of the programs. Changes in cognitive abilities, broadened knowledge and job interests, flexibility of occupational choice, and growth in the performance of skill tasks were observed. Most importantly, a substantial number of graduates entered the world of work by being placed in cluster-related jobs. Additional developmental and evaluative efforts are needed to determine the potential of the cluster concept approach as an alternate form of vocational education.

DIFFUSION

Diffusion activities have been very limited and were conducted by the developers themselves. These activities included:

1. those related to the teacher selection and preparation for the field experimentations, e.g., workshops and conferences;

2. those related to the actual field experimentation, e.g., placement activities; and

3. sending the materials, upon request, to interested educators with subsequent follow-up discussions.

No diffusion strategy was apparent.

While the Cluster Concept Program is compatible with typical school practices, some characteristics of the program are critical. The facilities required are often more than many schools can afford. No teacher training is available, but teacher training is vital. Maley, himself, likened a regular vocational education teacher teaching the Cluster Concept Program for the first year to a pilot of a Piper Cub flying a 747 for the first time. The costs of the Cluster Concept Program materials are minimal, but the cost of equipping a laboratory for one of the clusters is $25,000 to $40,000.

ADOPTION

No record of the location, description, or number of users is available. A list of interested individuals who requested the materials from Maley is available.

FUTURE OF THE PRODUCT

Maley had hoped to continue his research and development beyond the four years. A proposal was prepared for the fifth year, but was not funded. The following activities have been conducted on a very small scale by some of the original developers: assistance to schools, further evaluation studies, placement and performance research, and development of additional clusters.

The State of Maryland did not continue with the cluster concept approach, even though they were the first involved. A few other states have expressed serious interest in implementing the program. The developers felt that the state departments of education should push the Cluster Concept Program--some have, but many have not.

It is interesting to note that the present trend toward career education has given new impetus to the "cluster concept idea." The cluster concept approach developed by Maley plays a critical role in current career education. The Cluster Concept Program is thus having an impact even though, as a product, it is probably used by very few.

CRITICAL DECISIONS

The following events are a good approximation of crucial decisions made in the four-year developmental history to the Cluster Concept Program. For each decision point, the following types of information were described: the decision that had to be made, the alternatives available, the alternative chosen, the forces leading up to choosing a particular alternative, and the consequences resulting from choosing an alternative.

Although an attempt has been made to present the critical decisions or turning points in chronological order, it must be clearly pointed out that these decisions were not usually made at one point in time, nor did they necessarily lead to the next decision presented in the sequence. Many of the critical decisions led to consequences that affected all subsequent decision making processes in some important way.

Decision 1: To Focus on the Cluster Concept Approach

The inspiration for the Cluster Concept Program came directly from the personal experiences of Dr. Maley over many years. Thus the idea of the cluster concept was not a sudden inspiration that came to Dr. Maley in a flash of realization. When the cluster concept finally sprouted in 1965 with Dr. Maley's proposal to the Office of Education, he was quite certain that he wanted to develop a vocational education program directed toward the preparation of individuals for entrance into a spectrum of occupations. This decision had both immediate and long-range consequences--some positive, some negative. Most importantly it initiated the development of an alternative vocational education program.

Decision 2: To Initially Determine the Acceptability and Feasibility of the Program

The idea of a vocational education program directed toward the preparation of individuals for entrance into a spectrum of, rather than one specific, occupation was a new one and the developers needed some assurance and cooperation from the real world that such a program was feasible and acceptable. By conducting a series of studies aimed at determining the acceptability and feasibility of the cluster idea, the developers were able to share their ideas with industry, labor, and education, to obtain useful feedback from these sources, and to prepare these sources for the actual existence of the Cluster Concept Program.

Decision 3: To Employ a Cluster Development Model

Given some assurance that their ideas were not too far afield, the developers needed to study occupations, job requirements, relationships between occupations, and systems of classifications that would lead to the development of valid occupational clusters. The decision to employ a cluster development model, which specified steps through which the project should move in its actual selection of a series of clusters, greatly facilitated both the identification and development of the clusters and the development of courses of study. By reviewing the literature, developing criteria for clusters, identifying common elements, and specifying project limitations, the developers were able to determine how many clusters and which ones they could develop. Many of the specifics of the courses of study were identified by employing the cluster development model.

Decision 4: To Employ a Course Development Model

Once the three clusters were identified for development, the developers needed to develop courses of study for each cluster. To employ a course development model to develop these courses of study was an obvious necessity, just as was the need to employ a model to select clusters. While the developers had narrowed down the scope of their work from the entire world of work of three clusters or about 13 broad occupational areas, they now had to examine numerous details of each occupation. A model was necessary to consider and to organize all the task requirements, levels, and human requirements. It also assured that the representatives from the various sources discussed above would review the courses of study at critical stages in their development.

Decision 5: To Select and Prepare Teachers

The Cluster Concept Program requires a teacher not only to understand the instructional materials provided, but also to have more technical skills.

A teacher of a standard vocational education course may be a master carpenter; however, if he is solely responsible for the complete construction cluster, he needs electrical, masonry, painting, and plumbing skills as well. During the second year of the project, the developers very carefully "selected and prepared" the teachers who would participate in subsequent field studies of the Cluster Concept Program. This decision turned out to more important than originally anticipated as the need for teacher training was much more crucial to the successful implementation of the Cluster Concept Program than had been initially considered.

Decision 6: To Tryout the Cluster Concept Program in the Classroom

Given the Cluster Concept Program developed in-house, the developers needed descriptive, comparative, and quantitative data that would contribute to the further refinement of the program as well as information about the problems and advantages of such an experience. The decision to try out the program in the classroom was actually made quite early and was indicated in the original proposal. However, the consequences of this decision were most apparent during the latter phases of the project when, on the basis of actual use in the classroom, the feasibility and acceptability of the program were being determined for the first time. While the results from both years of the pilot investigation were mixed, sufficient information was obtained and distributed to suggest the importance of the Cluster Concept Program as an alternative vocational education approach.

Decision 7: To Prepare For and Evaluate Placement

The decision to employ a placement strategy and to evaluate the effectiveness of the Cluster Concept Program on the basis of how many graduates were gainfully employed in cluster-related jobs was a decision rarely made by vocational education leaders. In learning that after graduation 86 percent of the students were gainfully employed and that about 60 percent were working in cluster-related jobs, the developers felt some closure; they knew they had a viable and perhaps effective alternate approach to vocational education.

REFERENCES

Altman, J. W. & Gagné, R. M. First interim report on research and general vocational skills. Pittsburgh: American Institutes for Research, October, 1964. AIR-090-10/64-IR.

Guba, E. G. Methodological strategies for education change. Paper presented to the Conference on Strategies for Education Change, Washington, D. C., November 1965.

Maley, D. The implementation and further development of experimental cluster concept programs through testing and evaluation including placement and follow-up of subjects. Final Report, Phase IV. College Park, Md.: Industrial Education Department, University of Maryland, August 1969.

Maley, D. An investigation and development of the cluster concept as a program in vocational education at the secondary school level. Course outline. Metal forming and fabrication cluster. (Final Report, One of Four Volumes.) College Park, Md.: University of Maryland, August 1966.

Maley, D. The preparation of curriculum materials and the development of teachers for an experimental application of the cluster concept of vocational education at the secondary school level. Final Report, Volume II. Instructional plans for the construction cluster. College Park, Md., Industrial Education Department, University of Maryland, August 1967.

APPENDIX A

AN EXAMPLE OF A LISTING OF TASKS FOR ONE OCCUPATION

WELDING OCCUPATION, LEVEL I TASKS

1. Arc welding ferrous metals with A.C. welder to produce a horizontal butt joint.

2. Arc welding ferrous metals with A.C. welder to produce a horizontal lap joint.

3. Arc welding ferrous metals with A.C. welder to produce a hornizontal outside corner joint.

4. Arc welding ferrous metals with A.C. welder to produce a horizontal inside corner joint.

5. Arc welding ferrous metals with A.C. welder to produce a hornizontal tee joint.

6. Arc welding ferrous metals with A.C. welder to produce a vertical lap joint.

9. Arc welding ferrous metals with D.C. welder to produce a horizontal butt joint.

10. Arc welding ferrous metals with D.C. welder to produce a horizontal lap joint.

11. Arc welding ferrous metals with D.C. welder to produce a horizontal inside corner joint.

12. Arc welding ferrous metals with D.C. welder to produce a horizontal inside corner joint.

13. Arc welding ferrous metals with D.C. welder to produce a horizontal tee joint.

14. Arc welding ferrous metals with D.C. welder to produce a vertical lap joint.

17. Pad welding low areas on metal stock to renew stock to original height.

18. Gas welding ferrous metals stock to produce a horizontal butt joint.

19. Gas welding ferrous metals stock to produce a horizontal lap joint.

20. Gas welding ferrous metals stock to produce a horizontal outside corner joint.

21. Gas welding ferrous metals stock to produce a horizontal inside corner joint.

22. Gas welding ferrous metals stock to produce a horizontal tee joint.

23. Gas welding ferrous metals stock to produce a vertical lap joint.

24. Gas cutting ferrous carbon steels.

25. Brazing ferrous metals to produce a horizontal butt joint.

26. Brazing ferrous metals to produce a horizontal lap joint.

27. Brazing ferrous metals to produce a horizontal outside corner joint.

28. Brazing ferrous metals to produce a horizontal inside corner joint.

29. Brazing ferrous metals to produce a horizontal tee joint.

30. Brazing ferrous metals to produce a vertical lap joint.

(Maley, 1966. P. 1-2)

APPENDIX B

AN EXAMPLE OF A LISTING OF HUMAN REQUIREMENTS

Task 1: Arc Welding Ferrous Metals With A. C. Welder To Produce a Horizontal Butt Joint

COMMUNICATIONS

1. Reading blue print to determine:

   Δ a. Size and characteristics of the workpiece
   Δ b. Type of weld required
   Δ c. Finish and accuracy required
   * d. Number of items to be welded
   Δ e. Kind of material

2. Reading equipment manual to determine equipment set-up.

MEASUREMENT

Δ 1. Measuring stock with a rule or scale to determine length.

2. Checking fit up with a rule and square to obtain an accurate assembly.

3. Checking work with fillet gauges.

MATHEMATICS

Δ 1. Applying knowledge of fractional parts of an inch:

   a. Multiplying fractions to determine exact dimensions
   b. Adding fractions to determine exact dimensions
   c. Subtracting fractions to determine exact dimensions
   d. Dividing fractions to determine exact dimensions

SCIENCE

ϕ 1. Explaining the physical properties of the fusibility of various metals.

ϕ 2. Explaining the electron theory of current flow in welding.

SKILLS

1. Laying out stock with a:

Δ a.	Square	* f.	Surface gauge
Δ b.	Rule or scale	Δ g.	Dividers
Δ c.	Combination square	* h.	Trammel points
* d.	Center head	Δ i.	Scriber
* e.	Hemaphrodite cali ers	Δ j.	Center punch

2. Cutting metal to dimensions with:

* a. Hand hack saw
* b. Power hack saw
* c. Power band saw
ϕ d. Gas cutting torch

* 3. Grinding stock to specific dimensions.

ϕ 4. Grinding a bevel on heavy plate for adequate penetration.

ϕ 5. Connecting electrical components on welder according to manual specifications.

Δ 6. Clamping work to obtain fit up.

ϕ 7. Grounding work to obtain adequate conductance.

* 8. Cleaning metal parts to be welded to obtain weld with necessary strength.

ϕ 9. Tacking fit up assembly to minimize warpage and buckling.

ϕ 10. Preheating weld area to bring metal to proper welding temperature.

ϕ 11. Striking an arc to join metals together.

ϕ 12. Running a bead on weld joint according to specifications.

ϕ 13. Stopping and re-starting a bead for specific weld dimensions.

ϕ 14. Cleaning weld with chipping hammer and wire brush for additional welding or finished weld.

Δ 15. Removing burrs from finished work with:

a. File
b. Abrasive cloth

INFORMATION

Δ 1. Selecting appropriate layout tools for the task.

* 2. Selecting appropriate hacksaw blades for the task.

ϕ 3. Selecting appropriate grinder for the task.

ϕ 4. Selecting correct type of electrode for size and type of metal to be welded.

ϕ 5. Selecting proper heat for type and thickness of metal being welded.

ϕ 6. Positioning work to be welded in most advantageous position for gravitational effects on appearance of bead.

ϕ 7. Applying different electrode angles in relation to type and thickness of metal being welded.

ϕ 8. Identifying flux for removal with chipping hammer.

Δ 9. Selecting proper type of file.

Δ 10. Selecting abrasive cloth for removing burrs.

11. Practicing proper safety precautions when using electric welding equipment:

    * a. Wearing goggles or face shield
    * b. Wearing appropriate apparel
    ϕ c. Maintaining equipment regularly
    * d. Shielding welding area

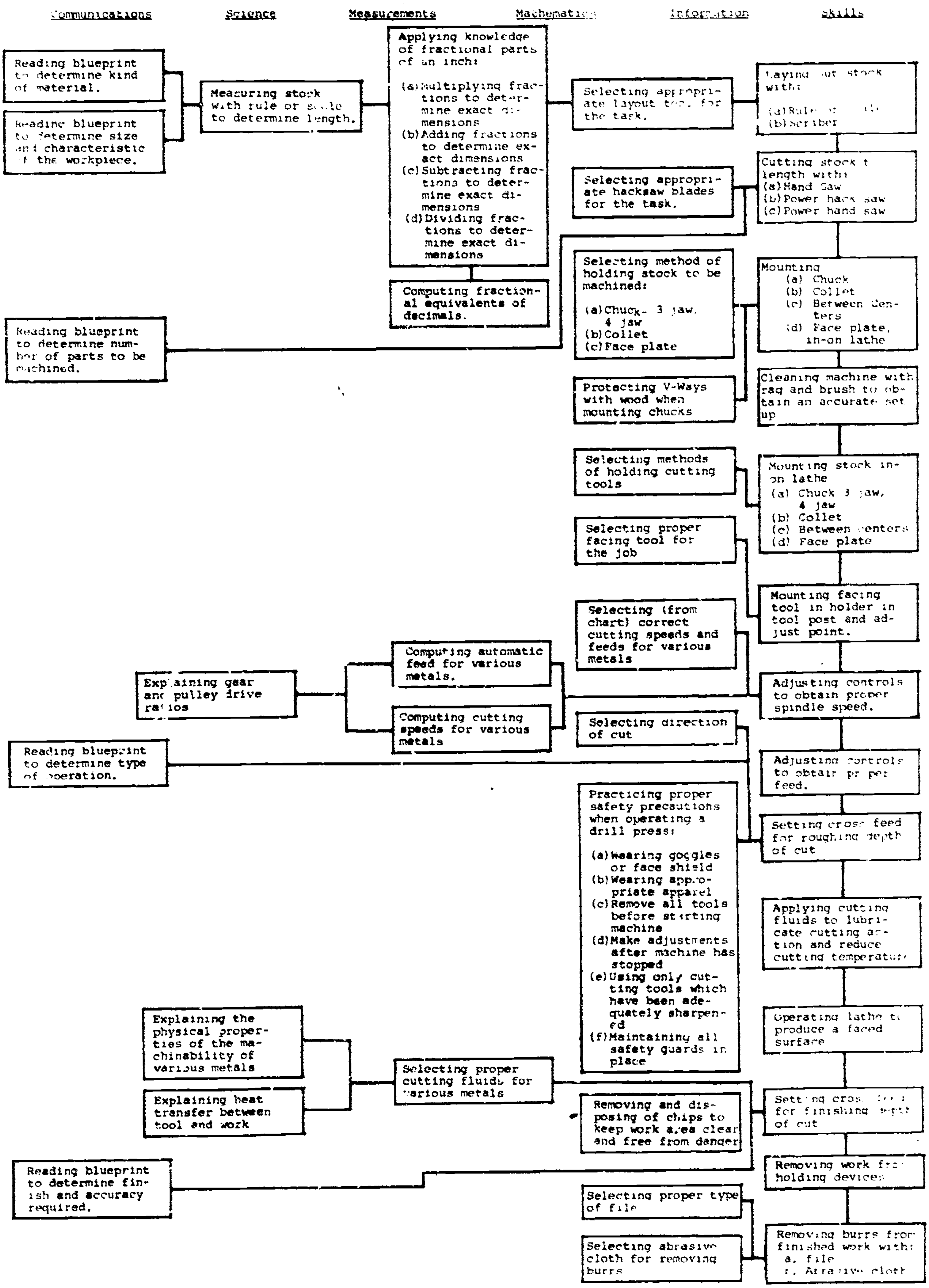
Δ Common to all occupations in the cluster.
* Common to several occupations in the cluster.
ϕ Common within welding.

(Maley, 1966. Pp. 89-91)

APPENDIX C

AN EXAMPLE OF A SUGGESTED INSTRUCTIONAL SEQUENCE--METAL FORMING AND FABRICATION CLUSTER

TURNING STOCK ON LATHE TO PRODUCE A FACED SURFACE



(Maley, 1966, P. 160)

APPENDIX D

AN EXAMPLE OF LISTINGS OF COMMON AREAS OF HUMAN REQUIREMENT--
NUMBERS REFER TO FREQUENCY OF APPEARANCE PER OCCUPATION

AREAS OF HUMAN REQUIREMENT COMMON TO ALL OCCUPATIONS IN THE
METAL FORMING AND FABRICATION CLUSTER

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
COMMUNICATION				
1. Reading blueprints to determine:				
a. Size and characteristics of work piece.	31	51	9	14
b. Material to be used.	31	52	9	9
c. Finish and accuracy.	27	52	9	14
d. Type of operation required	26	52	9	9
MEASUREMENT				
1. Measuring stock with a rule or scale	17	52	13	10
MATHEMATICS				
1. Applying knowledge of fractional parts of an inch:				
a. Adding fractions to determine exact dimensions.	25	52	19	7
b. Subtracting fractions to determine exact dimensions	25	52	19	7
c. Multiplying fractions to determine exact dimensions	25	52	19	7
d. Dividing fractions to determine exact dimensions.	25	52	19	7
SKILLS				
1. Laying out stock with a:				
a. Rule or scale.	18	51	9	7

(Maley, 1966, P. 161)

AREAS OF HUMAN REQUIREMENT	MACHINIST	WELDER	SHEET METAL WORKER	ASSEMBLER
b. Square.	18	51	9	7
c. Combination square.	10	51	1	1
d. Dividers	17	51	9	6
e. Scriber	17	51	10	6
f. Center punch.	9	51	10	3
2. Mounting stock with clamps	17	51	4	3
3. Mounting stock in a vise	17	1	1	3
4. Removing burrs from stock with:				
a. File	23	52	9	1
b. Abrasive cloth	28	52	9	3
INFORMATION				
1. Selecting the appropriate layout for the task	18	51	9	7
2. Selecting the appropriate clamps for the task	17	51	4	3
3. Selecting the appropriate vise for the task	17	1	1	3
4. Selecting the appropriate file for the task	23	52	9	1
5. Selecting the appropriate abrasive cloth for the task	28	52	9	3

(Maley, 1966, P. 162)

APPENDIX E

AN EXAMPLE OF A UNIT OF INSTRUCTION FOR THE OCCUPATION WELDING AND A SUGGESTED LIST OF INSTRUCTIONAL MATERIALS FOR WELDING

WELDING EXPERIENCES - LEVEL I - Unit I

Title: Arc Welding Ferrous Metals With A.C. and D.C. Welders.

Objective: To develop in the individual the capability for arc welding ferrous metals with A.C. and D.C. welders, the following joints: horizontal butt, horizontal lap, horizontal inside corner, horizontal outside corner, horizontal tee, vertical lap, butt joints on pipe stock while fixed and while rolling, and pad welding.

Manual or Manipulative Learning:

A. Laying out stock with: (square, rule or scale, combination square, center head, hermaphrodite calipers, surface gauge, dividers, trammel points, scriber, center punch).
B. Cutting stock to length with: (hand saw, power hack saw, power band saw, gas cutting torch).
C. Grinding stock to specified dimensions.
D. Grinding a bevel on heavy plate for adequate penetration.
E. Connecting electrical components on welder according to manual specifications.
F. Clamping work to obtain fit-up.

Verbal Learning:

Communication:

A. Reading blueprints to determine: (size and characteristics of work piece, type of weld required and accuracy required number of parts to be welded, and kind of material).
B. Reading equipment manual to determine equipment setup.

Measurement:

A. Measuring stock to determine length with rule or scale.
B Checking work fit up with rule and square.
C. Checking work with fillet gage.

(Maley, 1966, P. 201)

G. Grounding work to obtain adequate conductance.
H. Cleaning metal parts to be welded to obtain weld with necessary strength.
I. Tacking fit up assembly to minimize warpage and buckling.
J. Striking an arc to join metals together.
K. Running a bend on the weld joint according to specifications.
L. Stopping and re-starting a bead for specific weld dimensions.
M. Cleaning weld with chipping hammer and wire brush for additional welding or a finished weld.
N. Removing burrs from finished work with abrasive cloth or file.

Mathematics:

A. Applying knowledge of fractions (adding, subtracting, multiplying, dividing).

Science:

A. Explaining the physical properties and the fusibility of various metals.
B. Explaining the election theory of current flow in welding.

General Information

A. Selecting appropriate layout of tools for the task.
B. Selecting appropriate hacksaw blades for the task.
C. Selecting appropriate grinder for the task.
D. Selecting correct type of electrode for size and type of metal to be be welded.
E. Selecting proper heat for type and thickness of metal being welded.
F. Positioning work to be welded in the most advantageous position for gravitational effects on appearance of bead.
G. Applying different electrode angles in relation to type and thickness of metal being welded.
H. Identifying flux for removal with chipping hammer.
I. Selecting proper type of file for task.
J. Selecting proper abrasive cloth for task.
K. Practicing proper safety precautions: (wearing goggles or face shield, wearing appropriate apparel, maintaining equipment regularly, shielding welding area).

(Maley, 1966, P. 202)

Suggested Student Activities

All student activities should be made as practical and meaningful as possible. The production of articles to industrial specifications may assist in this process.

A. Reading blueprints to determine characteristics of work piece and the steps of procedure which would be most economical.
B. Welding specific scrap metal with different electrodes and heats checking welding specifications against your results.
C. Measuring and cutting stock to length.
D. Welding joints using different thickness metals.

INSTRUCTIONAL MATERIALS FOR WELDING

TYPE	TITLE	DESCTIPTION	SOURCE
Book	Modern Welding by Andrew A. Althouse, Carl H. Turnquist and William A. Bowditch	A well illustrated text covering practically all the modern welding practices	Goodheart-Willcox Co.
Book	Welding Skills and Practices by J.W. Giachino, Willeam Weeks and Elmer Brune	A basic text on many of the modern welding practices	American Technical Society
Book	New Lessons in Arc Welding by Lincoln Electric Company	The text covers the area of arc-welding using an up-to date approach.	Lincoln Electric Co.
Film	Aluminum Welding Is Different	Film shows that aluminum is easy to join by welding, brazing or soldering. 33 min. free, color.	Reynolds Metals Co.

(Maley, 1966, Pp. 203 & 215)

Film	Arc Welding	Film shows metal-arc, carbon-arc and atomic-hydrogen processes for welding aluminum. 10 min. free, color.	Aluminum Company of America
Film	Consumable Insert Welding	Film shows a special E-B weld insert to join pipe on one side only. 20 min. free, B & W.	Arcos Corporation
Film	Introduction to Oxy-Acetylene Welding	Film shows tools and equipment, obtaining correct flame, manipulation and running beads. 2 reels, $78.00, B & W.	Jam Handy
Film	Modern Methods of Joining Metals	Film explains how gas shielded and magnetic flux methods are used in industry. 22 min. $100.00, color.	Linde Company
Pamphlet	Arc Welding	A pocket manual on how arc welding is used in industry. Purchase.	Industrial Book Co.
Pamphlet	Fusion Facts	Phamphlet gives facts on how welding can increase the life of metals.	Stoody Company
Pamphlet	Welding and Oxygen Cutters	Occupational Outlook Handbook, Bulletin No. 1215-65. Purchase.	U.S. Department of Labor

(Maley, 1966, Pp. 215 & 216)

APPENDIX F

AN EXAMPLE OF AN INSTRUCTIONAL PLAN--PLAN FOR TASK NO. 4 IN CARPENTRY IN THE CONSTRUCTION CLUSTER

TASK NO. 4: ERECTING WOODEN GIRDERS AND COLUMNS

AREA OF HUMAN REQUIREMENT	SUGGESTED TEACHING METHODS	SUGGESTED INSTRUCTIONAL MATERIALS	SUGGESTED STUDENT ACTIVITIES	SUGGESTED EVALUATION PROCEDURES
Reading plans to determine size and location of girders and columns.	Class Discussion Explain why members are placed in certain places.	Textbook: <u>Practical Carpentry</u>, p. 57.	Review Plans. Study text assignment on girders and columns.	Oral or written test.
Selecting proper wood to make up girders and columns.	Explain what types of wood are best to use for columns. Overlay Presentation	Textbook: Practical Carpentry, pp. 32a-32p. Overhead Projector Teacher Made Transparencies	Sort out proper wood to use in making girders and columns.	Quiz students on wood identification and selection.
Measuring girders and columns to accuracy of 1/16 of an inch.	Demonstration of use of steel tape and rule	2 X 8 X 12 Fir Lumber 4 X 4 Columns Steel Tape Folding Rule	Measure girders and columns to accuracy of 1/16 of an inch. Assignment: <u>Carpentry for the Building Trades</u>, pp. 18-28. Assignment: Written report on the woods used in carpentry.	Simple test in adding, subtracting measurements. Oral presentation of written report.
Bevel and cut ends of girders to accuracy of 1/16 of an inch.	Direct group activity	Framing Square Hand Saw Electric Saw	Bevel and cut ends of girders using electric, saw and hand saw.	Performance.
Fastening joints with hammer and nails to the accuracy of 1/16 of an inch.	Explain why joints should be staggered and material should be crowned.	Hammer 16D Nails 2 X 8 X 12 Fir Lumber 4 X 4 Columns	Fasten joints of members of girder with hammer and nails. Staggering joints and nails.	Performance
Placing bearing plates with screws and screw-driver on girders to an accuracy of 1/16 of an inch.	Direct activity of group	Screws Screwdriver Bearing Plates	Place and fasten bearing plates with screws and screwdriver.	Performance
Placing girders in place and leveling. Nailing temporary supports to hold in place while plumbing columns.	Demonstration on use of level and use of temporary supports on erecting girders.	Dry Line Level 2 X 4 Braces	Place girders in place. Level and nail temporary supports until columns are fastened and plumbed.	Performance
Placing and plumbing 4 X 4 columns in place at the bearing plates.	Assist group in use of level to plumb columns	Level 4 X 4 Columns	Practice using step ladders and other devices safely.	Performance
Using step ladders and other devices safely while erecting girders and columns	Observe and direct group in safe use of step ladder and other devices.	6' Step Ladder Saw Horses	Listing safety rules in using electrical equipment.	Oral and written test.

(Maley, 1967. P. 5)

VOCATIONAL INFORMATION UNIT FOR CARPENTRY

[illegible]	[illegible]	[illegible] MATERIALS	[illegible]	
The employment outlook: 1. Local 2. National	Lecture.	Publication: Occupational Outlook Report Series, Bulletin #1450, 1966-67 edition, Occupational Outlook Handbook, Department of Labor, Government Printing Office, Washington, D.C., p. 9. Teacher-developed occupational information.	Visiting local consturction sites to determine outlook for carpentry jobs.	Oral questions. Review student notes on field trip. Written questions.
The wage scales: 1. Local a. union (1) apprentice (2) journeyman (3) master b. non-union (1) entry wage (2) experienced 2. National a. union (1) apprentice (2) journeyman (3) master b. non-union (1) entry wage (2) experienced	Lecture. Chalkboard. Overhead projector.	Teacher-made visuals showing union and non-union wage scales. Overhead projector. Teacher-developed occupational information. Publication: Occupational Outlook Report Series, Bulletin #1450-14, 1966-67 edition, Occupational Outlook Handbook, Department of Labor, Government Printing Office, Washington, D.C., p. 10.	Inquiring from local builders for information on wages for carpenters. Calling or writing union officials and getting information on wages. Developing a table showing the union and non-union wage scale.	Reviewing the information received from the local builders and union officials. Checking student notebooks for information on union and non-union wage scale.
Types of training available: 1. Apprenticeship 2. Technical, trade or high school program 3. On-the-job 4. Military	Lecture. Field trip to a training school.	Chalkboard. Brochures from apprenticeship or trade school courses.	Giving reports on various programs of training.	Written test on types of training available. Review reports of students on results of field trip to the training schools.
Working conditions experienced in occupation.	Lecture. Overhead projector. Guest speaker - local carpenter.	Publication: Occupational Outlook Report Series, Bulletin #1450-14, 1966-67 edition, Occupational Outlook Handbook, Department of Labor, Government Printing Office, Washington, D.C. Chalkboard. Teacher-made charts and visuals.	Writing a unit for the notebook on working conditions in the occupation.	Checking the student notebook.

(Maley, 1967. P. 41)

OCCUPATIONAL INFORMATION UNIT FOR CARPENTRY (continued)

AREA OF HUMAN REQUIREMENT	SUGGESTED TEACHING METHODS	SUGGESTED INSTRUCTIONAL MATERIALS	SUGGESTED STUDENT ACTIVITIES	[illegible]
Physical and mental characteristics.	Lecture.	Chalkboard. Visual charts showing important physical and mental requirements. Publication: Job Guide for Young Workers, 1963-64 edition, Government Printing Office, Washington, D.C., p. 48.	Reading assignment: Job Guide for Young Workers. Entering the most important information from the reading assignment in the student notebook.	Checking the student notebook.
Geographical location of employment.	Lecture.	An assortment of classified ads from a variety of daily newspapers.	Making a bulletin board display from classified ads of help wanted: carpenters. Making a list of types of construction sites where carpenters would be employed.	Checking student lists of job sites where carpenters are employed.
Opportunities for advancement.	Lecture. Visiting experts from the trade.	Chalkboard. Publication: Guide for Young Workers, 1963-64 edition, Government Printing Office, Washington, D.C., p. 48. Occupational Outlook Report Series, Bulletin #1450-14, 1966-67 edition, Government Printing Office, Washington, D.C., p. 9.	Making a list of opportunities for advancement for the notebook.	Reviewing work in the student notebook.
Advantages and disadvantages of the occupation.	Lecture.	Teacher-made charts, visuals and chalkboard. Overhead projector. Publication: Occupational Outlook Report Series, Bulletin #1450-14, Occupational Outlook Handbook, Government Printing Office, Washington, D.C., pp. 8-9.	Developing a chart showing the advantages and disadvantages of the occupation for the student notebook.	Testing the student on opportunities for advancement and advantages and disadvantages of the occupation.
Nature of work involved in the occupation.	Lecture. Guest speaker.	Publication: Occupational Outlook Report Series, Bulletin #1450-14, Occupational Outlook Handbook, Government Printing Office, Washington, D.C., p. 8.	Interviewing a tradesman to determine the nature of his work.	Reviewing the reports of students' interviews.

OCCUPATIONAL INFORMATION UNIT FOR CARPENTRY (continued)

AREA OF HUMAN REQUIREMENT	SUGGESTED TEACHING METHODS	SUGGESTED INSTRUCTIONAL MATERIALS	SUGGESTED STUDENT ACTIVITIES	[illegible]
Union involvement in the occupation.	Lecture. Guest speaker - union official or member.	Union material such as pamphlets and organizing material from local or national office.	Making a list of the ways the union is involved in the occupation and of the benefit offered the worker.	Checking the student notebook.
Means of entry into the occupation.	Lecture. List various means. Visiting officials from trade school, union, or building firm.	Publication: Occupational Outlook Report Series, Bulletin #1450-14, Occupational Outlook Handbook, Department of Labor, Government Printing Office, Washington, D.C., p. 9.	Interviewing several tradesmen to determine how they gained entry to the occupation. Writing reports of these interviews.	Reviewing students' reports of interviews. Giving an overall test of knowledge of the occupational unit.

(Maley, 1967. Pp. 42-43)

APPENDIX G

LIST OF PRODUCTS AND DEVELOPERS

The following is a list of products for which Product Development Reports have been prepared.

Arithmetic Proficiency Training Program (APTP)
Developer: Science Research Associates, Inc.

The Creative Learning Group Drug Education Program
Developer: The Creative Learning Group
Cambridge, Massachusetts

The Cluster Concept Program
Developer: The University of Maryland,
Industrial Education Department

Developmental Economic Education Program (DEEP)
Developer: Joint Council on Economic Education

Distar Instructional System
Developer: Siegfried Engelmann & Associates

Facilitating Inquiry in the Classroom
Developer: Northwest Regional Educational Laboratory

First Year Communication Skills Program
Developer: Southwest Regional Laboratory for
Educational Research & Development

The Frostig Program for Perceptual-Motor Development
Developer: The Marianne Frostig Center of Educational Therapy

Hawaii English Program
Developer: The Hawaii State Department of Education
and The University of Hawaii

Holt Social Studies Curriculum
Developer: Carnegie Social Studies Curriculum Development Center,
Carnegie-Mellon University

Individually Prescribed Instruction--Mathematics (IPI--Math)
Developer: Learning Research and Development Center,
University of Pittsburgh

Intermediate Science Curriculum Study
Developer: The Florida State University,
Intermediate Science Curriculum Study Project

MATCH--Materials and Activities for Teachers and Children
Developer: The Children's Museum
Boston, Massachusetts

Program for Learning in Accordance With Needs (PLAN)
Developer: American Institutes for Research and
Westinghouse Learning Corporation

Science--A Process Approach
Developer: American Association for the Advancement of Science

Science Curriculum Improvement Study
Developer: Science Curriculum Improvement Study Project
University of California, Berkeley

Sesame Street
Developer: Children's Television Workshop

The Sullivan Reading Program
Developer: Sullivan Associates
Menlo Park, California

The Taba Social Studies Curriculum
Developer: The Taba Social Studies Curriculum Project
San Francisco State College

The Talking Typewriter or
The Edison Responsive Environment Learning System
Developer: Thomas A. Edison Laboratory,
a Subsidiary of McGraw Edison Company

Variable Modular Scheduling Via Computer
Developer: Stanford University and
Educational Coordinates, Inc.