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ABSTRACT

Intended to serve as a manual for the developmental and evaluative activities of Project ABLE, this report presents the management and evaluation plan for instructional system development. Major emphasis of the plan is the formation of evaluative procedures drawing on student performance data as the primary source of feedback. To insure continuous program and product improvement, the system is designed around a test/revise/retest process which should continue as long as the program is in operation. Job and task descriptions, followed by specification of behaviorally stated performance objectives, are the basis of the primary evaluation instruments. Procedures for the design and application of developmental and evaluative instruments along with sample materials, flow charts, various system control documents, and sample instruments for formative and summative evaluation are included. (Author/SP)

FIFTEENTH TECHNICAL REPORT

Project ABLE

DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL CURRICULUM FOR THE NEW QUINCY (MASS.) VOCATIONAL-TECHNICAL SCHOOL

Management and Evaluation Plan for Instructional Systems Development for Vocational-Technical Education

Project No. 5-0009
Contract No. OE-5-85-019

by

J. William Ullery

April 1970

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.

American Institutes for Research
Pittsburgh, Pennsylvania

and

Quincy Public Schools
Quincy, Massachusetts

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FOREWORD

This report is intended to serve as a manual for the developmental and evaluative activities of Project ABLE instructional systems development. The plan was evolved from: (1) the research and development activities of Project ABLE and (2) a review of current literature. System performance evaluation and review procedures (i.e. PERT) are given careful attention because of the interface of various project activities and functions. For example, data collected during the field tests have important implications for project review and evaluation, especially in those cases where man-hour projections may be underestimated due to the unanticipated need for recycling (test/revise/retest) of certain modules or lessons. In another instance, failure to evaluate instructor performance may result in inappropriate data collection relative to student evaluation activities.

Some reduncancy will be necessary in order to relieve the reader of the necessity for reviewing the voluminous ABLE technical reports. A number of documents from the Twelfth Quarterly Technical Report were included at the suggestion of those persons who reviewed the initial drafts.

Major factors influencing the design of the management and evaluation plan include the following:

(1) The initial proposal prepared in 1964 by Robert M. Gagné, Robert E. Pruitt, James Altman, and others.
(2) The initial series of ABLE Quarterly Technical Reports.
(3) The engineering-management procedures evolved through the development of a pilot model program as reported in the Twelfth Quarterly Technical Report on the Power Mechanics Curriculum.
(4) Criticisms of current practices used in evaluating educational research. For example--six major areas of weakness in current policies and practices of evaluating research were cited in a recent report submitted to the President and the Congress by the National Advisory Council on Education

Professions Development according to the Phi Delta Kappan, October 1969. The six areas of weakness are:

a. Premature evaluation of a project or venture, made before it is fully operational.
b. Preoccupation with so-called "hard data" developed by mass use of standardized tests.
c. Too much concern with final results alone, leading to lack of effort to determine why project objectives were or were not met.
d. Lack of imagination in selecting types of evaluation policies that are applicable to the special nature, purposes, or stage of development of an educational activity.
e. Requirements that all projects in a program make financial provisions for project evaluation.
f. A tendency to construe tentative findings as "proof".

(5) The recent AERA (American Educational Research Association) monograph series on curriculum evaluation and the wide agreement found on; (a) the application of the behavioral sciences to curriculum development and evaluation; and (b) the degree of emphasis which should be given to the formative* kinds of curriculum evaluation.

(6) The recommendations of a USOE sponsored project review panel under the chairmanship of Dr. Melvin L. [illegible]low.

(7) The recommendations of Dr. Robert Fitzpatrick, Director of Measurement and Evaluation Studies, AIR, and other AIR staff members who reviewed the document during the early draft stages.

(8) A general review of the literature in related areas of research and development.

* Scriven (1967) defines formative evaluation as a kind of process research or outcome evaluation at an intermediate stage of development for the purpose of discovering deficiencies and successes in the intermediate versions. Cronbach (1963) emphasized the importance of research, and stated, "Evaluation, used to improve the course while it is still fluid, contributes more to improvement of education than evaluation used to appraise a product already placed on the market".

ACKNOWLEDGMENT

Many persons, over a period of several years, have made significant contributions to the project effort. The authors of the initial proposal and the early technical reports set the mold for development and evaluation. Mr. Glen E. Neifing, an AIR Research Scientist, has spent hours critiquing report drafts. Mr. Joseph S. Nicastro, Quincy Project Coordinator, provided much assistance in public school operation and procedures. Quincy curriculum coordinators, Mr. Patrick W. Crozier, Mr. Richard W. Forsyth, and Mr. Frank E. Leporini, were technical writers and teachers of ABLE instructional materials. Several AIR behavioral psychologists, including Miss Vivian Hudak and Mr. Boyd Kowal, served as consultants during the early stages of program development. Dr. Christopher W. Flizak, AIR Director of Vocational Studies, and Dr. Robert Fitzpatrick, AIR Director of Measurement and Evaluation Studies, reviewed and critiqued early drafts of the evaluation plan. Mr. David R. Craig provided editorial assistance on several sections of this document.

Many other researchers and key administrative personnel of both Quincy and AIR have been involved and have contributed in many ways through services, assistance, and guidance in the preparation of this document. Special recognition must be given to Mrs. Barbara Colp, Mrs. Nancy Knudsen, and Mrs. Alice Hutchison for the hours of report preparation, typing, and proofing. Where possible, charts and documents include the initials of principal author(s).

ABSTRACT: Project ABLE

USOE Project No. 5-0009
Contract No. OE-5-85-019

A Joint Research Project of: Public Schools of Quincy, Massachusetts and American Institutes for Research

Title: DEVELOPMENT AND EVALUATION OF AN EXPERIMENTAL CURRICULUM FOR THE NEW QUINCY (MASS.) VOCATIONAL-TECHNICAL SCHOOL

Objectives: The principal goal of the project is to demonstrate increased effectiveness of instruction whose content is explicitly derived from analysis of desired behavior after graduation and which, in addition, attempts to apply newly developed educational technology to the design, conduct, and evaluation of vocational education. Included in this new technology are methods of defining educational objectives, deriving topical content for courses, preparation of students in prerequisite knowledges and attitudes, individualizing instruction, measuring student achievement, and establishing a system for evaluating program results in terms of outcomes following graduation.

Procedure: The procedure begins with the collection of vocational information for representative jobs in eleven different vocational areas. Analysis will then be made of the performances required for job execution, resulting in descriptions of essential classes of performance which need to be learned. On the basis of this information, a panel of educational and vocational scholars will develop recommended objectives for a vocational curriculum which incorporates the goals of (1) vocational competence; (2) responsible citizenship; and (3) individual self-fulfillment. A curriculum will then be designed in topic form to provide for comprehensiveness and also flexibility of coverage for each of the vocational areas. Guidance programs and prerequisite instruction to prepare junior high students will also be designed. Selection of instructional materials, methods, and aids, and design of materials, when required, will also be undertaken. An important step will be the development of performance measures tied to the objectives of instruction. Methods of instruction will be devised to make possible individualized student progression and selection of alternative programs, and teacher-training materials will be developed to accomplish inservice teacher education of Quincy School personnel A plan will be developed for conducting program evaluation not only in terms of end-of-year examinations, but also in terms of continuing follow-up of outcomes after graduation.

REPORT SUMMARY

The report presents the Project ABLE management and evaluation plan for the implementation of experimental vocational curricula. A brief review of the goals and objectives of the project is included. A review of the literature is provided for the purpose of defining and clarifying the rationale for the management and evaluation plan for instructional system development. Major emphasis in the plan is given to formative evaluative procedures drawing on student performance data as the primary source of corrective feedback. The system is designed around an iterative process with the major goal of continuous program and product improvement. It is felt that such an approach would provide a regenerative element with self-renewal and updating taking place as a result of the evaluation, validation and follow-up activities. It is shown how test/revise/retest cycles can and should be perpetuated for as long as the program is in operation.

The primary evaluation instruments are derived from job and task descriptions and the subsequent specification of behaviorally stated performance objectives. This entails a detailed breakdown of the task activities and an identification of the "critical incidents" which are then translated into criterion checklist instruments. Criterion instruments, called "performance evaluation modules", are also developed from the task descriptions for the purpose of structuring replicable and reliable assessment situations. The performance evaluation modules are also designed to permit effective class management. While such instruments incorporate objective paper-pencil items, the emphasis is on the more important "hands-on" or practical performance skill test activities. Self-scoring response and feedback techniques with numerous simulators, mock-ups, samples, and other aids are emphasized in recognition of the critical role such devices play in a functional instructional system.

The entire developmental effort is characterized by a system approach centered around successive tryouts and systematic testing. Procedures for the design and application of developmental and evaluative instruments are presented in considerable detail. Sample materials are included along with flow charts, work sheets and various system control documents. Management procedures are defined and the entire process carefully documented. A plan for summative evaluation is outlined and guidelines suggested for appropriate application. Sample instruments for both formative and summative evaluation are included.

INTRODUCTION

The principal goal of Project ABLE is to demonstrate the increased effectiveness obtainable with instruction that derives its content from explicit analysis of desired behavior after graduation, rather than from a selection of excerpts from a total body of knowledge. Each curriculum is defined by what technology and industry need for job success. Subordinate objectives embodied in this approach are the following:

(1) Development of educational objectives. The intent here is to identify the behaviors which are desired of the student when he has completed a particular course of instruction. Education has no meaning in the abstract--objectives need to be stated in specific operational terms. While emphasizing the vocational area of educational goals, the goals also include the development of individual attitudes toward work, habits of work, and standards of excellence.

(2) Derivation of curriculum requirements. Curriculum needs are described in terms of topics within each "subject" and are placed in an instructional sequence which takes prerequisite knowledges systematically into account. Each learning sequence is in the curriculum because it must be there if the student is to be competent, and because the justification for its presence can be demonstrated on the basis of relevance to an occupationally-oriented educational goal. Project ABLE, by analyzing the requirements of many jobs within each vocational area for common and related skills, attempts to provide education in the skills and knowledges which are common to a variety of occupations. This should minimize the amount of "new" training required by a change in job technology or by a desire to take advantage of opportunities opening up in related areas. This should also provide the flexibility needed to accomodate to changes

in the demands of the technology.

(3) Description of needs for prerequisite learning. The elaboration of a new curriculum is intended to make possible the specification of prerequisiste knowledges to be acquired in junior high years of schooling, including the kinds of student preparation which might be gained in industrial arts and other basic areas of instruction. The aim is the development of broad exploratory programs in the junior high grades to prepare students for productive educational and vocational careers.

(4) Effecting changes in student viewpoints. A most difficult task facing any student and his family is that of choosing realistic life goals and the educational path to those goals. The pressures of our society have been directed toward college attendance, while trade school courses have often been relegated to second-class status. Project ABLE includes preparation of an organized program for assessing each student's abilities and interests and for helping him and his family evaluate them over a wide range of occupations. This involves the inservice training of junior high school guidance counselors and the provision of materials and information for junior high students.

(5) Individualizing instruction. It has been demonstrated repeatedly that individuals differ with respect to their abilities. The traditional classroom has not made sufficient provision for these individual differences, but with increasing frequency, especially at the elementary level, schools are changing to individualized study programs. Project ABLE incorporates the concepts of individualized instruction by providing a framework which will allow for maximum flexibility of student progression through a course. Learning is a process aided by the teacher, rather than a schedule (or process) of forcing facts into students. A student's achievement

paces his progress and, at the same time, constitutes a primary source of his motivation. The student is given a set of objectives which tell him all the things he is expected to be able to do after completing an assignment. The key feature is, however, that students do the learning largely on their own. Student-teacher interactions do not take place during lectures and group demonstrations, but rather are emphasized while the teacher gives attention to individual student needs during the learning of new skills.

(6) Student evaluation. Appropriately derived topic objectives lead directly to measures of student performance. It is desired here that all "units" of instruction have performance measures which are available to the student, to instructors, and to guidance counselors. These proficiency tests are an essential and integral part of individualized instruction, and they contribute to making the student evaluation file a clear history of learning achievement. Emphasis in this testing is on attainment of goals, rather than upon differentiation of students into "good" or "poor", and on providing directions for future effort on the part of the student.

(7) Program evaluation. A comprehensive program of evaluation includes objective measures of immediate outcomes, as well as the means for systematic assessment of long-range effects. Student evaluations yield many of the basic data for program evaluation; this requires systematic recording and storing of indicators of student experience and performance. Establishment of techniques for following up the student at periodic intervals after graduation to collect information on employment, job success, and career progression constitutes the basis for program evaluation in terms of its long-range effects.

(8) Development of multiple exit flexibility. The development includes a planned set of training levels of specific education within each technical area, requiring a range of preparation times designated by jobs (or job clusters). The domain of jobs in an occupational group has been structured to reflect the progression of skills inherent in those jobs. Selection of jobs to represent the area reflects the levels involved so that there are clear points of demarcation whereby students can attain certified competence up to different levels commensurate with their individual abilities. This concept of multiple exits at various training levels also will provide specific usable skills for each student regardless of the point at which he chooses to terminate his full-time school activity.

The flow chart depicted in Figure 1 is a graphic presentation of some major goals of Project ABLE. A more detailed listing of suggested goals is provided in Appendix A. The second chart, Figure 2, portrays the major requirements of an individualized instructional system of the type conceived for Project ABLE. It is doubtful that any school system at this time is at the operational stage of "individualized instruction". However, progress toward such goals is rapidly taking place. The third chart, Figure 3, plots the learner activity process within an individualized instructional system (and an operational component of present ABLE programs). Note the flexibility available to individual schools, teachers, and students in the choice of instruction--methods and materials--available through the student-instructor contract options. Such an approach may well be the only effective means of meeting the problems associated with the wide variance in individual learning styles and preferences while maintaining local control over the instructional process.

At the time of the preparation of this report, the major goals and objectives as depicted in Figure 1, had not yet, of course, been achieved. In fact, as the developmental problems became evident in this new and ambitious undertaking, steps were taken, with the cooperation of USOE, to scale down the size of the commitment. Over a period of two years, pilot programs emerged as a result of steps taken to place problem solving and development on a more manageable basis. A number of curricula were prepared and implemented. Others are now nearing completion. (See paper presented at the American Vocational Association Convention in Boston, entitled "Progress and Problems", Ullery 1969.) Thus, Project ABLE has concentrated on building various critical components--components which must be operationalized if the total system is ever to become a reality. And the major components are the learner-centered instructional systems.

GOALS FOR VOCATIONAL – TECHNICAL EDUCATION

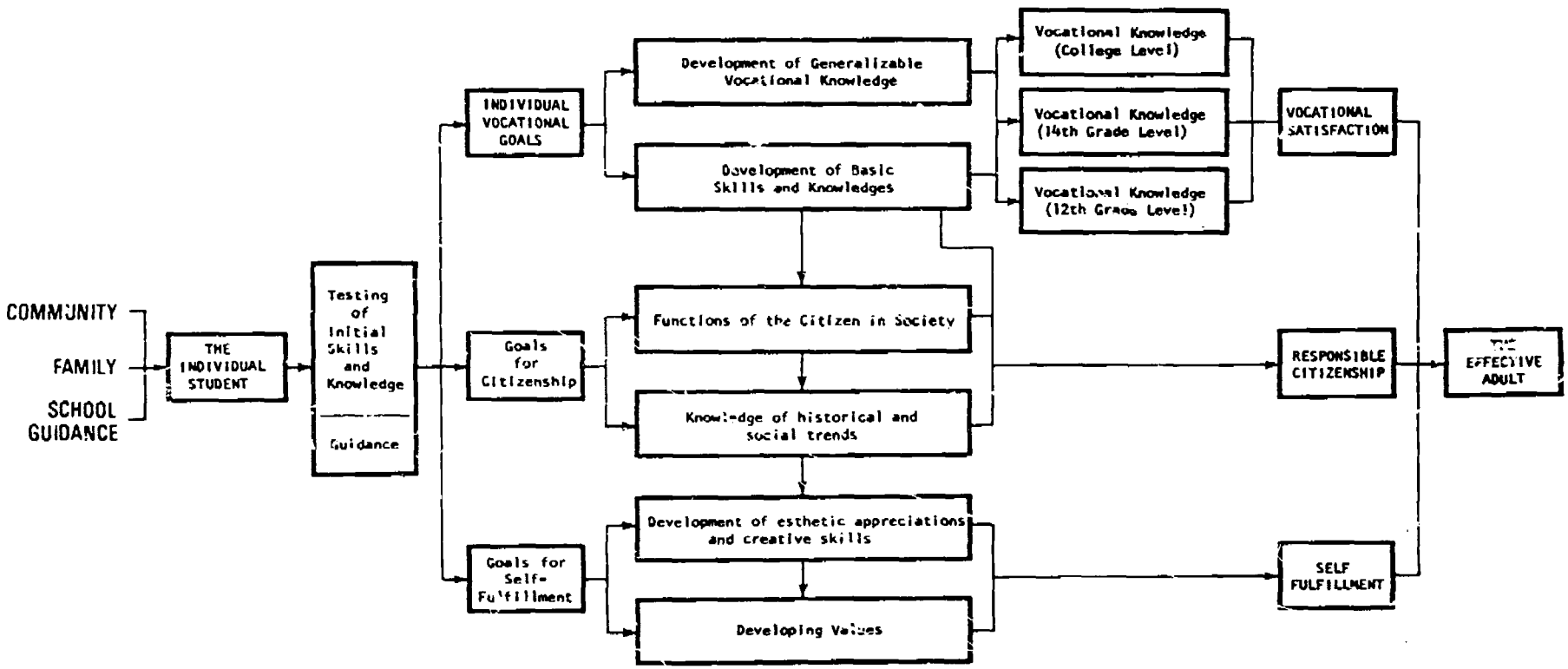

Figure 1.

DO YOU HAVE A LEARNER-CENTERED INSTRUCTIONAL SYSTEM FOR VOCATIONAL AND TECHNICAL EDUCATION?

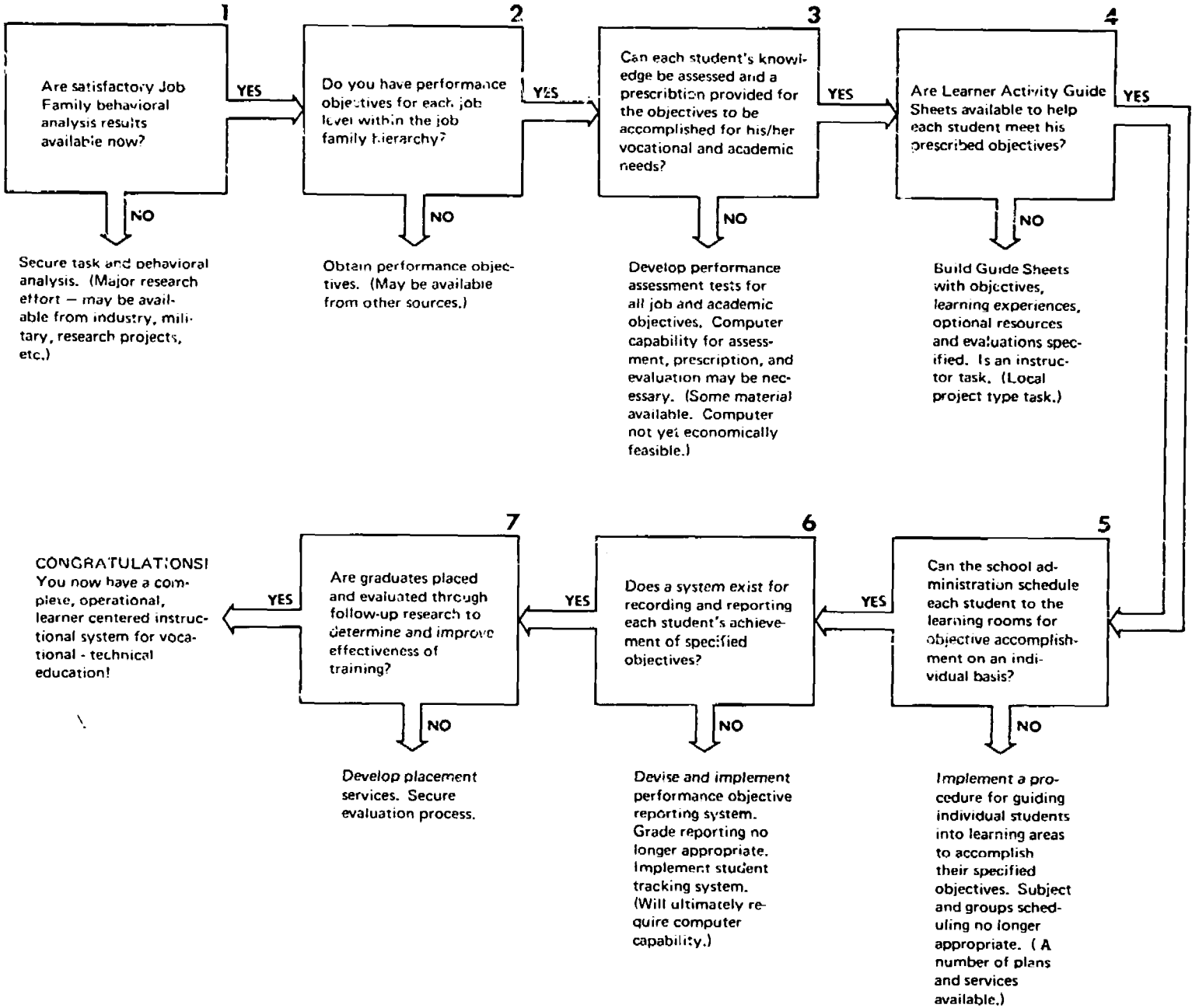

Figure 2.

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INDIVIDUALIZED LEARNER ACTIVITY PROCESS

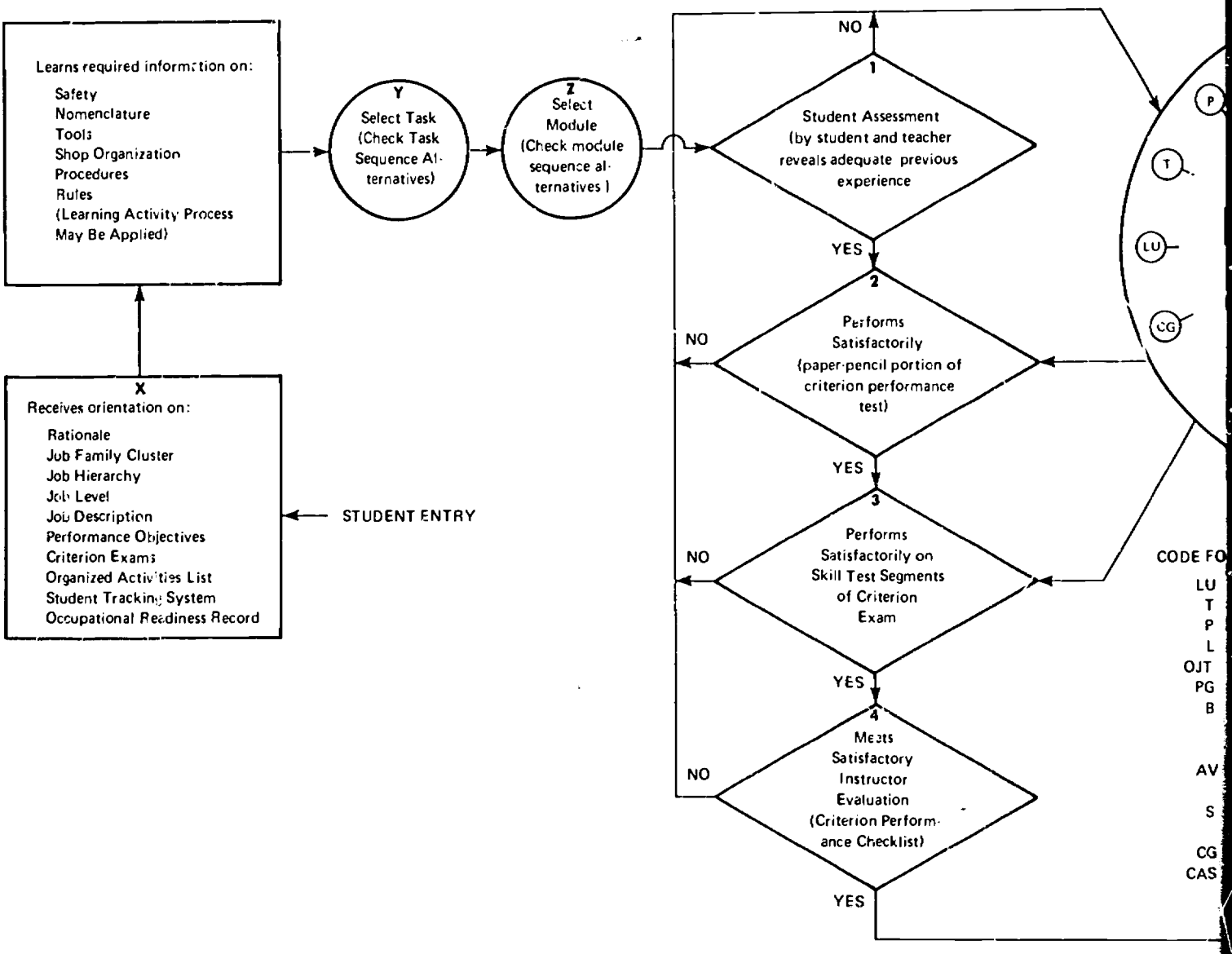
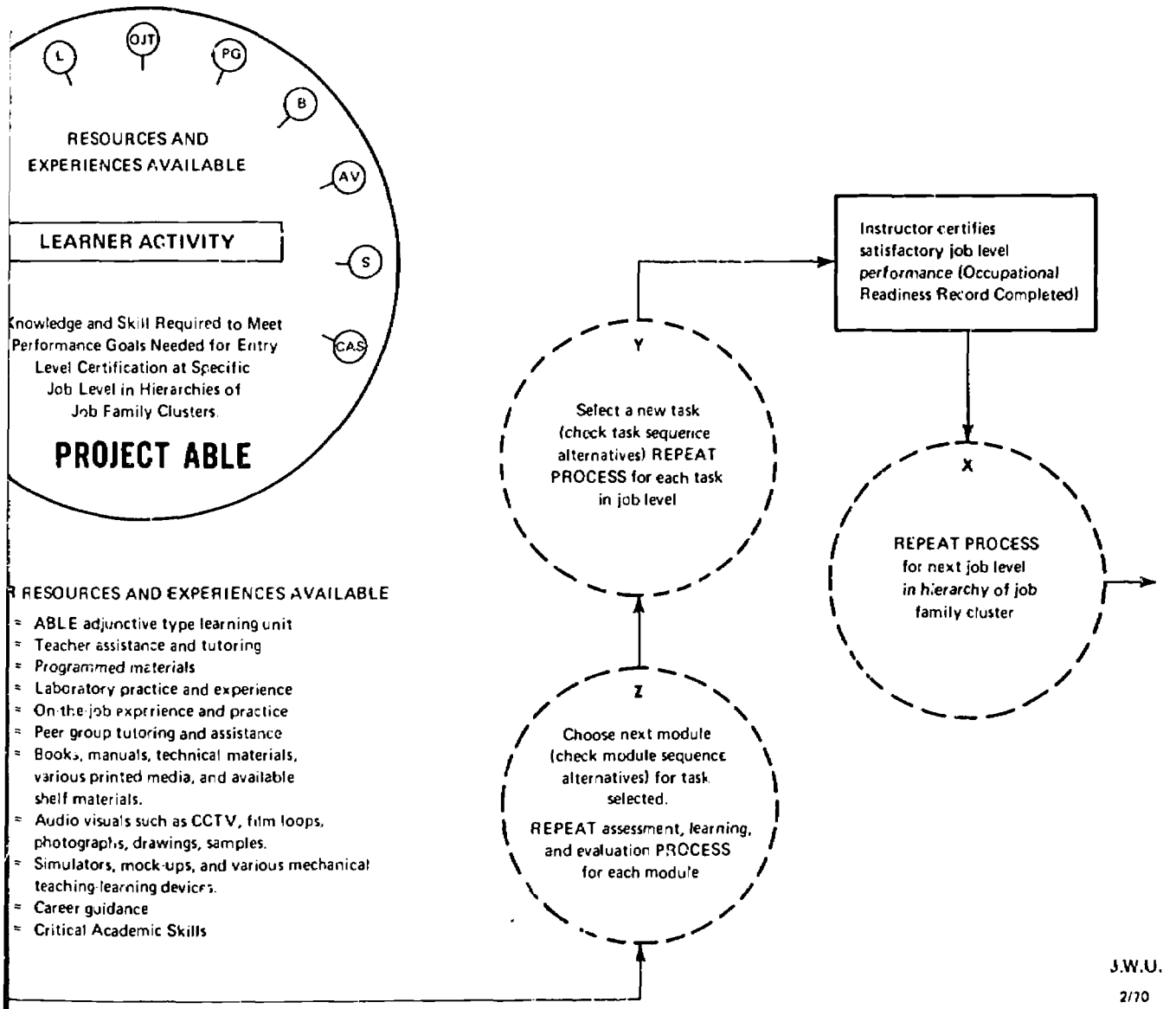


Figure 3.

WITHIN AN INSTRUCTIONAL SYSTEM



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CONSTRAINTS

A management and evaluation plan for the overall goals and objectives of Project ABLE, and the conceptionalized educational system planned as a result of Project ABLE research and development, cannot, and should not, be provided at this time. However, an effective regenerative evaluation plan with iterative feedback loops* for the formative stages of curriculum development must become the prime requisite to any further project activity. Of course, this must include effective project performance evaluation and review procedures for instructional system development. The management and evaluation process to be presented in this report will, therefore, focus on the major component of any total educational system--the operating instructional programs. More specifically, this report will center on the formative and summative** evaluative processes involved in the research and development required to operationalize specific courses in job family or occupationally oriented curriculum areas. And here, the major emphasis will be on formative or "pay-off" evaluation using student performance data as the primary source of corrective feedback.

Constraints which must be faced with relative certainty are those related to inadequate funding. It will not be possible to replicate the type of sophisticated training studies or procedures evolved through military training research (and the foundation for much of the current literature) for highly technical programs such as pilot training. Funding

*Johnson (1970) holds that evaluation is the feedback loop. He states, "Evaluation information triggers modifications in the developing system over and over again until reasonable equilibrium is achieved."

**Summative evaluation according to Scriven (1967) is, as one example, used to appraise a product already on the market. Typically, a comparison is made against other products or methodologies through experimental control group testing.

will also limit the number of test subjects available for validation activities. Adequate staffing with behavioral psychologists experienced in clinical procedures will be difficult. With such limitations in mind, the ABLE management and evaluation plan for instructional system development was evolved, not as a model for the experts in programmed learning and instructional systems development, but for practical application in the field of occupational education. Here, it is assumed that programmed materials will not be the objective of the behavioral analyses and that instructional materials development will seldom take place. Available shelf materials are to be identified and applied wherever possible. It is suggested that commercial publishers be contracted where materials must be newly developed.

It will be virtually impossible for vocational and technical educators to prepare programmed materials, textbooks, and instructional materials, in general, for all of their course needs. And, it was not intended that Project ABLE prepare instructional materials--this was to be done only in those areas where no commercial, industrial, or shelf materials were available. It was intended that the project identify appropriate objectives in terms of observable and measurable behaviors. A flexible individualized instructional system utilizing a variety of materials and media was a goal. Rigorous requirements in terms of the kind of micro-task analyses necessary for programmed materials development should, therefore, not be imposed on Project ABLE (where the major concern is on terminal performance specification at a job entry level in a hierarchy of multiple levels). Furthermore, the physical characteristics of the criterion assessment instruments should be different from that incorporated into typical programmed instructional packages. This is necessary since student-instructor contract options will permit a great deal of flexibility in the selection of instructional methods, materials and media.

Summative kinds of evaluation of programs under development will face a number of constraints. For example:

1. Limited financial support in view of the current national emphasis on "pay-off" research and development.
2. Time -- including that required to perform the collection, analysis, and reporting of data.
3. Time -- the lag from implementation to the point where graduates can be compared against other groups, and products compared against other products.
4. Incomplete educational system components such as those listed in Figure 2, in addition to supporting academic programs for the vocational areas (programs consistent with the philosophy and methodologies established for Project ABLE).
5. Institutional characteristics of schools which antagonize and alienate many clients with testing.
6. Institutional characteristics which make cost effectiveness and cost efficiency comparisons difficult if not impossible.
7. Law, regulations and customs which do not allow those students completing requirements, or demonstrating performance and capability to predetermined criteria, to enter the work force and/or other educational institutions.
8. Course objectives, content sequencing and methodologies which differ from comparable traditional programs to such a degree as to make "experimental-control" testing nearly impossible.

Summative evaluation for vocational programs presents other obstacles. For example:

> The problems involved in arriving at a valid numerical estimate of success are too difficult to solve without vast expense and without overcoming a number of social and political barriers. In other words, for any one vocational program to prove that it has been successful in attaining these objectives, the evaluator would have to expend an inordinate amount of effort even to obtain a roughly reliable measure. (Hawkridge, 1970)

In another example, George H. Johnson (1970) reported studies of computer-assisted instruction programs in which statistical evaluation was not attempted for the first two years because of the changes occuring in the curriculum and system as the programs developed. The problems related to formative and summative evaluation are discussed throughout the following sections.

Studies of the feasibility of proposed vocational programs (employment opportunities, future supply and demand, implementation and operational costs, length of training, services available, etc.) must be considered a part of the total developmental and evaluative process. However, vocational education has at its disposal well-established techniques for such research. A recent study completed for the state of Pennsylvania by Walter M. Arnold and associates (1969) and the procedures spelled out in the first two Project ABLE quarterly technical reports (June 1965, September 1965) should be considered valuable resources. The Project ABLE Twelfth Quarterly Technical Report (1969) presents such an example application of a feasibility study. The evaluation plan for the Greene Joint Vocational School prepared by AIR (Rosenfeld 1967) includes procedures, information-gathering forms, and evaluation instruments relative to the establishment and evaluation of a vocational school and its total operating program. Other such reports and studies can be identified for various facets of school and classroom evaluation which need not be explored in detail in this document.

REVIEW OF LITERATURE AND RATIONALE

The initial Project ABLE proposal was prepared in 1964. Reference to validation and evaluation activities were limited, since the parameters of a total educational system were to be explored. Subsequent quarterly technical reports dealt with a number of topics including behavioral objectives, sequencing of units, problems of curriculum development, and others. The fifth report, "The Roles, Characteristics, and Development Procedures for Measures of Individual Achievement" (Morrison and Lecznar, 1966) was concerned with achievement measures. The report reviewed the proposed curriculum structure and instructional methods (not operational at that time) and identified a number of roles for which achievement measures were needed. The technical requirements for measures employed in those roles were briefly examined and the procedures for developing such measures were discussed. For the most part, the report was addressed to paper-pencil type test items. Because of the time interval and brevity of early ABLE documents in the broader area of instructional system evaluation and the extent of the recent activity throughout the nation in curriculum evaluation (in addition to the many operational changes in Project ABLE), a review of the current literature and the development of this manual was deemed essential.

The overview presented in this section should establish, without any doubt, the particular bias Project ABLE has taken in curriculum development and evaluation (which, again, may not involve the writing of new learning materials). In later sections of the report, the reader will likely have difficulty distinguishing between the two processes (curriculum development and curriculum evaluation) since the meanings have become nearly synonymous through the systematic testing procedures being established.

The recently released AERA monograph series on curriculum evaluation provides an excellent and current review of the research in this area. Extensive references are listed throughout the series. Another major resource is the series of papers presented at the USOE sponsored seminar on Research and Curriculum Evaluation in Vocational Education at the University of Illinois in 1966. A more recent source of information is the "AIR Seminar on Evaluative Research: Strategies and Methods" held in Washington, D.C., January 1970. The REFERENCE section lists several papers from the AERA, University of Illinois, and AIR published works. The REFERENCE section also provides an extensive listing of resources related to the specialized topics dealt with in this report.

Curriculum

Definitions of curriculum, for the purposes of this report, should be helpful in establishing the baseline of communication. Robert M. Gagńe (1969) reviewed recent developments, methods, approaches and definitions in curriculum. While he found merit in the descriptions offered by various contributors to the AERA monograph series on curriculum evaluation, he preferred the more specific definitions included in his 1965 book. He stated that;

> A curriculum is a sequence of content units arranged in such a way that the learning of each unit may be accomplished as a single act, provided the capabilities described by specified prior units (in the sequence) have already been mastered by the learner.

Gagńe further clarified his definition by stating that;

> A curriculum is specified when (1) the terminal objectives are stated; (2) the sequence of prerequisite capabilities is described; and (3) the initial capabilities assumed to be possessed by the student are identified.

Relevant, also, to the Project ABLE design and reflected in recent reports on curriculum development (Ullery 1969) is the emphasis Gagné has placed on well engineered and well managed development. Gagné (1969) states that;

> Curriculum design can be, and probably should be, based firmly upon the kind of empirical evidence that can come from successive tryouts and systematic testing.

The importance of this statement and the impact such an approach has had on systems type curriculum development and evaluation must be understood. It is the keystone not only to the developmental process but the evaluative process.

(Again, for the formative stages as prescribed for Project ABLE, the developmental processes and the evaluative processes will frequently be indistinguishable.)

Hilda Taba (1962) defines curriculum development in a fairly broad way by including:

> (1) diagnosing educational needs; (2) formulating objectives; (3) selection of content; (4) organization of content; (5) selection of learning experiences; (6) organization of learning experiences; and (7) determining the ways and means of evaluating effectiveness of what is taught.

Taba seems to be in general agreement with Gagné.

F. Coit Butler (1967) referred to Gagné frequently in a manual prepared for Job Corps instructional systems development. Butler defined training systems as:

> ...a series of interrelated, interacting, precisely controlled learning experiences that are designed to achieve specific training objectives; but organized into a unified, dynamic whole which is responsive and adaptive to the individual trainee while fulfilling specific job-relevant training criteria.

Butler went on to describe the process of curriculum development as a vigorous measurement of results in comparison to the specific performance objectives.

Again, the emphasis on formative evaluation and the congruence between evaluation and development is one in which ABLE has attempted to focus and pattern its operation. It is, in short, an empirical methodology for the analysis, design, and evaluation of instructional programs.

Objectives

J. Stanley Ahmann (1967) in his discussion of curriculum evaluation states that;

> As a first step, we certainly need a clear concept of that which is to be evaluated; more specifically, the curriculum. Secondly, we need clarification, at least in a general way, of the methodological approaches available to us as we face various evaluation problems.

Ahmann then cited the importance of Gagné's works in the specification of curriculum and objectives. H. J. Sullivan, in his review of curriculum evaluation research, appears to be in agreement with Gagné and Ahmann. He states:

> Assessment based upon instructional objectives is a crucial part of well-designed formative evaluation. (1969)

Sullivan also placed emphasis on instructional objectives formulated as behavioral statements.

Robert E. Stake (1967) points out that measurement consultants usually recommend specification of objectives in behavioral terms. On the other hand, J. Myron Atkin (1963) and Elliot Eisner (1966) state that the behaviorist approach can misguide evaluation efforts and disembody an educator's purpose. However, such theorists, through their criticisms, are most likely not thinking in terms of vocational education but of the academic arena. There is little doubt that the theorists from the academic community are strongly influenced by, and speaking directly to, the college preparatory curricula. The pragmatic focus of vocational and technical education might well elicit a different response from many of the critics of the behavioral sciences (or at least the way behaviorists would formulate educational objectives and organize curricula).

Since there is broad agreement that objectives must be stated in order to define curricula and evaluate programs, two major classification frameworks should be briefly reviewed. Robert F. Mager (1962), Gagné and others place emphasis on observable and measurable behavior. Furthermore, Gagné (1965), in his book "Conditions of Learning", provides a classifica-

tion system for the kinds of learning (or prerequisite levels of capability).

Benjamin S. Bloom, et al. (1956) and D. R. Krathwohl, et al. (1964), classified objectives in terms of the cognitive domain (knowledge and intellectual skills relevent to use of knowledge), the affective domain (attitudes and values), and within each of these domains developed a taxonomy or hierarchy of levels. Other publications have been provided in the psychomotor domain (manipulative and motor skills). H. Grobman (1968), in analyzing the various classification methods, has stated that, "While these approaches are not deliberately juxtaposed by their authors, use of one may preclude extensive use of the other".

Sullivan (1969) was more critical in his analysis of the Taxonomy (provided by Bloom, Krathwohl and others) and stated that;

> Any attempt to use the Taxonomy in the formulation of objectives must take into account its lack of precision in indicating either specific overt behaviors to be performed by the learner, or the conditions under which they will be performed.

Sullivan further elaborated by stating;

> Thus, Krathwohl's (1964) statement that curriculum analysis using the Taxonomy "aids in placing the material in the program sequence and in planning the overall development of the skill or ability" simply is not correct. The Taxonomy's lack of specificity in dealing with task analysis and task description renders it useless for the purpose of sequencing instruction. At best, the Taxonomy serves as a guide for describing very general desired outcomes of educational programs and for suggesting objectives which then must be stated in terms of observable learner behavior to be useful for evaluation and instructional purposes. Perhaps the most serious problems with the Taxonomy are related to the lack of evidence that there is any generalizability of the imputed mental processes across subject-matter content.

Lester J. Briggs (1968) in examining factors related to the sequencing of instruction referred also to the cognitive theories:

> If it is correct to recommend that behavioral objectives should be stated for all courses, the apparent implication is that the kind of theory and procedure employed by Gagné in regard to the nature and sequencing of instruction would then appear more precise and useful than the cognitive theory underlying the utilization of advance organizers.

An important aspect of ABLE development is the relationship of the job hierarchy to the specific kinds of learning as defined by Gagné, required at each particular level within the job family hierarchy. Gagné (1965) identified eight major classes of capabilities which he linked to corresponding kinds of learning, each of which begins with a different state of the organism and ends with a different capability for performance. The prerequisite for a type of learning is what distinguishes one type of learning from another. The internal conditions for chaining, for example, require that the individual has previously learned stimulus response connections available to him, so that they can be chained. The generalizations applied to the varieties of learning may be briefly stated as follows (types indicate kinds of learning):

Problem solving (type 8), required as prerequisites,
Principles (type 7), required as prerequisites,
Concepts (type 6), required as prerequisites,
Multiple discriminations (type 5), required as prerequisites,
Verbal associations (type 4), or other chains (type 3),
required as prerequisites,
Stimulus - response connections (type 2)

Action verbs (see Appendices B and C) which describe the major tasks of lower level jobs such as identify, indicate, hold, locate, pick-up, repeat, etc., also correlate with the action verbs related to specific kinds of learning indicative of type 1 and 2 learning as described by Gagné. On the other hand, action verbs which describe the major behaviors of high level jobs (analyze, contrive, develop, diagnose, troubleshoot, etc.) are more likely to correlate with the action verbs related to the type 7 or 8 kinds of learning. If the

type 2 learning is prerequisite to type 3 and 3 to 4, etc., then most of the skills and knowledges basic to the lower level jobs are prerequisite to effective and functional performance at the higher and more sophisticated job levels.

The application of behavioral objectives and the categorization of job clusters on a hierarchy of skills and knowledges in the manner recommended in this manual is congruent with the theory and procedures advocated by Gagné. However, this is not to imply that formative evaluation activities would be restricted to the behavioral objectives and criterion assessment measures. As Grobman (1969) points out;

> ...even the projects most concerned with behavioral statements do not ignore formative evidence simply because it is not germaine to their lists of behavioral objectives.

This plan will also deal with the broader problems of instructional system development and evaluation. The focus will center, though, on a program of successive tryouts and systematic testing. And as Gagné (1967) writes, "One can select textbooks, motion pictures, laboratory equipment, even teachers, but one does not select content. It is derived from objectives."

Formative and Summative Evaluation

J. Stanley Ahmann (1967), in his synopsis of the various aspects of curriculum evaluation, found little comfort in the general progress shown to date. He concluded that "from any angle that it is to be viewed, the problem of curriculum evaluation is enormous. Indeed, perhaps in the minds of some it is better described as horrendous."

John Easley, Jr. (1966), in his review of research for the seminar at the University of Illinois, stated that;

> Efforts made in the direction of summative evaluation, teacher variables, psychological studies of a teaching method, and follow-up studies have raised serious problems of research methodology which await further investigation before generally useful results can hope to be obtained.

Robert E. Stake (1966), in a paper also presented at the University of Illinois seminar, made reference to the disagreements evident among the accepted leaders in the field of curriculum evaluation. For example;

> As to which kind of evaluation -- absolute or relative -- to encourage, Scriven and Cronbach have disagreed. Cronbach (1963) suggests that generalizations to the local school from curriculum-comparing studies are sufficiently hazardous (even when massive, well-designed, and properly controlled) to make them poor research investments. Moreover, the difference in purpose of the two programs is likely to be sufficiently great enough to render uninterpretable any outcome other than across-the-board superiority of one of them. Expecting that rarely, Cronbach urges fewer comparisons, more intensive process studies, and more curriculum "case studies" with extensive measurement and thorough description. Scriven, on the other hand, indicates that what the educator wants to know is whether or not one program is better than another, and that the best way to answer his question is directly.

Scriven (1967), however, in his more recent AERA monograph paper on curriculum evaluation, seems to find a broader area of agreement with Cronbach.

> Thus, it may even be true that "the greatest service evaluation can perform is to identify aspects of the course where revision is desirable (Cronbach,[2] p.236), though it is not clear how one would establish this, but it is certainly also true that there are other extremely important evaluation services which must be done for almost any given curriculum project or other educational innovation."

Scriven also concluded in a similar reference to formative evaluation;

> One role that has often and sensibly been assigned to evaluation is as an important part of the process of curriculum development (another is teacher self-improvement). Obviously such a role does not preclude evaluation of the final product of this process. Evaluation can and usually should play several roles.

Note that in each case, Scriven qualified his recognition of the important role of process evaluation with references to the "other important evaluation services."

It is intended that the plan presented in this document meet the broader role where appropriate, practical, and economical. However, even in those cases where summative type techniques are proposed, every effort will be made to apply the information to program improvement. Scriven has stated that Cronbach is not clear as to how one would identify, through evaluation, aspects of a course where revision is desirable. Perhaps Project ABLE can make some contribution in this area.

Instructional systems development, especially that in which "products" such as programmed instruction packages are not the outcome, should rightly heavily emphasize the formative types of curriculum evaluation. Grobman (1968), states that the two best adjectives to describe curriculum project evaluation are "emergent and dynamic" (for the service functions to be performed). "... regenerative components of the management and evaluation plan for instructional system development with the iterative feedback loops should be applicable not only to the initial development but to the ongoing operational system. This then, should fit the Grobman definition and will be, primarily, formative kinds of evaluation.

Learner Activity Devices

Previous ABLE quarterly technical reports provide a framework for curriculum development. The Twelfth Quarterly Technical Report includes examples of how such procedures were applied and modified to enable the establishment of operational programs. The development and evaluation process contained in the present report evolved as a part of the systematic attempts to meet revised project objectives.

The instructional system development process is initiated by a careful analysis of occupations which form what is termed a job family. The occupations are analyzed for common skills and knowledges. Also considered are job requirements, conditions, trends, and other factors. The jobs are then categorized by hierarchies of skills and knowledges. Training vehicles or representative jobs are then identified and a flow chart for the job family developed. Job descriptions and task enumerations are followed by task descriptions. Behaviorally stated performance objectives are then derived from the task description and translated into criterion referenced assessment instruments called performance evaluation modules. In short, this process enables the specification of the terminal objectives, the sequencing of prerequisite capabilities, and the detailing of initial capabilities assumed (or typically required) by the entering trainees or employees. The appendices include a number of documents and student materials evolved as a result of such research.

The behaviorally stated performance objectives provide standards upon which judgments and decisions can be made. Criterion tests, in the form of performance evaluation modules (See Appendix D), are intended to support that function--judgments and decisions on the behaviors of trainees measured against a predetermined set of absolute criteria. Without such aids and instruments, teachers would not be able to use, in any effective way,

behavioral objectives. (Dr. W. James Popham spoke of such problems at a recent ES'70 conference in Quincy, October of 1969.) The form of the criterion test or performance evaluation was suggested by the emphasis on what can be described in simple terms as "hands-on" activity. This is a situation in which realistic job performance activity is provided--both for instructional purposes and assessment purposes. Thus, the major emphasis is on the laboratory activity work in which the student "handles" the tools, equipment or materials with which he must gain proficiency, or operates under the conditions (simulation possible) and in the kind of environment which he has selected for future employment.

The decision to place emphasis on the "hands-on" approach was reached very early. The attitudes of students (typical of those electing vocational school curricula) toward academic and classroom-type school functions, the nature of their vocational goals and choices, the rationale for the program, and the objectives of the Project, clearly established such an orientation. Furthermore, the identification and selection of jobs, the job descriptions, and the task descriptions, produced behavioral statements which require the student to "do" something to prove or demonstrate his ability to perform the tasks required for entry employment in the job family he has selected for training.

Learner Activity Guide. The Learner Activity Guide sheets which precede the performance assessment instruments incorporate a number of features which should be explained in some detail. For example, the guides include

1. a summary statement of the objective (or objectives, since the units are designed around managed activities).
2. a brief overview which usually contains some information on the activity, the importance of the job standards, and the consequences of malpractice. The overview should emphasize the importance of the objective.
3. prerequisite requirements.

4. alternative learning experiences in the form of student-instructor contract options. Note here that any one of a number of instructional activities can be utilized. Few constraints are made on the methods and materials and herein lies a critically important area of flexibility not typically available in the more traditional group approach or programmed kinds of instruction. Time required for instruction is primarily dependent on student capabilities and past experience (and to some degree, the efficiency of the instructional package if it is needed). Note again that each module (Learner Activity Guide and Performance Evaluation Set) can be used as a pre-test. It is simply not necessary that all students be forced through identical learning experiences when the only question to be answered is whether or not an individual can perform to the minimum standards established for a particular task. This may or may not require instruction. For some students, the process will become a certification activity which will enable rapid advancement to higher level tasks.
5. optional readings and references which offer considerably more breadth and information than the basic ABLE adjunctive type learning units. Through such options, related science and math or various enrichment activities are available to those students wishing to take advantage of the opportunity. The ABLE learning units (See Appendix E) by design, have been prepared in the briefest form possible and include only that essential information needed to achieve the unit objectives. It should be noted here that the learning units and performance evaluation modules are not intended to be the sole source of student experiences. Other educational resources and activities must be utilized if one is to effectively meet the needs of individuals and to take advantage of the many opportunities within the local community.

6. a list of tools, supplies and, in some instances, training aids as required for each unit or activity. Such devices are often stored in a tray which includes an inventory list attached to the front of the tray. (Again, such items are essential to the program as designed.) This system was evolved after early attempts to utilize central toolrooms proved unmanageable. Pilferage, time and effort required to locate tools and supplies, lost or misplaced essential items, and similar factors which hindered progress and created student discipline problems, simply proved unacceptably disruptive to the instructional program. Most shop management problems were effectively solved through the establishment of complete training stations. The cost was minor in view of the efficiency and effectiveness gained, not to mention the control over pilferage and the control over misuse of tools and equipment.

Performance Evaluation Set. After reading and completing necessary activities as outlined on the guide sheet, the student should complete and discuss with the instructor, the written portion of the performance assessment. Note that the Criterion Checklist (last page of the evaluation set) states that the student must attain a minimum score of 85%. Discretion should be exercised here. The 85% figure is intended only as a guideline. The individual items within the written test should be analyzed--especially those related to safety. The analysis may indicate that additional instruction (e.g. a learning unit) is necessary before the student can be allowed to complete the certification process. On the other hand, the discussion and review of test items may clear up some minor problems which could enable the student to progress, without further delay, in his lab evaluation. However, care must be taken in this type of diagnostic testing to insure that students do not jeopardize the safety of themselves and others or cause damage to tools and equipment. Note that most test items are keyed to a self-scoring response card (described in detail in a following section).

The next part of the evaluation set incorporates the "hands-on" performance activities. Carefully engineered and managed procedures developed through systematic testing of all such instruments, guide the student through the entire sequence. Note that additional instructor checkpoints are provided throughout the laboratory activity. Most such checkpoints are related to safety, supervision, and critical evaluation activities. (Students must not be allowed to advance past stop-points without the services of the instructor as indicated.) Checkpoints may also reveal areas in which additional instruction and practice are necessary. Also the instructor should, as a part of such supervisory activities, complete appropriate sections of the Criterion Checklist. After the master progress record is marked, the student is presented the Criterion Checklist as evidence of job task competency certification. A new assignment can then be determined.

Two additional features of the process should be emphasized:

1. Certain key training aids must be in place and properly identified. For example, students in one course are required to identify common defects and deposits on spark plugs. The sample in this case must be organized and labeled to enable an assessment of student capability on a major course objective. Similar items are included with nearly every project or activity.
2. Most such training aids or evaluation devices must be labeled and identified in such a way to enable use of a self-scoring response card. Note that the test questions (preceding the shop activities) are keyed to the self-scoring response cards. Note in the sample evaluation units that various types of test questions and responses, interspaced throughout the "hands-on" activity section, are also keyed to the self-scoring cards. (See Figure 14 and the discussion presented in that section.)

Without such aids and feedback devices, evaluation and instruction in a program of individualized instruction incorporating the objectives set forth for Project ABLE, would not be possible.

Furthermore, formative and summative curriculum evaluation activities would be severely hampered.

Other considerations critical to the learner activity process include

1. appropriate reading levels. In general, the reading difficulty will likely be dictated by the technical terminology, the service and repair manuals, and the industrial literature typically read by personnel in the job for which the instruction is being offered. However, ease of reading can greatly affect student attitudes toward the instructional and evaluative materials. (Format, color, and quality of printing are other important factors.)
2. availability of mock-ups, bench and simulated equipment. Here, the modules should be designed so that, for example, an ignition repair job could be performed on a shop engine or bench unit rather than on a live vehicle furnished by some "customer". An electronics instructor, as another example, who must wait for a particular type of circuit malfunction to come through the front door, will find not only his evaluation system but his instructional system in shambles. In a third example, the only way to assess each students' capability to properly identify a defective cell in an auto storage battery, is to have such a device available--available and ready at the time it is needed by the student.
3. short activities which will enable students to successfully complete evaluation or instructional units during a day's activity. One should attempt to establish a behavioral pattern of success for each student each day, if at all possible. Interest spans and time available for instruction (length of daily periods) should be considered in module construction. Here, successive and systematic testing and tryouts will be necessary to engineer a manageable program.

In some ways, the performance evaluations are similar to end-of-course exams where both written tests and practical applications are required. End-of-course exams, however, have not been developed for ABLE courses and would be considered unnecessarily redundant in a continuous progress program where evaluation is a part of every day's activity. Furthermore, the type of skill and knowledge which can be measured by the typical end-of-course exams and the time limitations involved, make other alternatives more practical and functional. By design, much time is allocated to testing and evaluation in the ABLE curriculum. This must be considered a major dynamic feature of the new instructional system.

Retention is assessed after instruction has taken place when evaluation modules are used in conjunction with ABLE learning units (or other instructional materials). There is usually a time interval of one or more weeks before an evaluation module (or set) is administered. Of course, if the evaluation module is used as a pre-test for the purpose of "certification", then no follow-up may occur. Retention can also be assessed and reinforcement structured through OJT (on-the-job-training) and cooperative work-study programs. Retention assessment and reinforcement activity usually takes place when a student graduates into the next higher training level within the job family hierarchy. Here, most basic tasks are repeated--usually with more stringent standards and under more rigorous conditions. Retention can also be assessed once the trainee is in the work force. And, of course, the repetition of on-the-job performance may be the only effective means of gaining productivity, proficiency, and lasting retention. Again, Project ABLE programs are geared to entry level skills and knowledges for each particular step in a job family hierarchy. Employer supervision, on-the-job instruction, practice, repetition, upgrading, break-in periods, salary reviews (performance assessment), etc., are a functional part of the real work-a-day world--and probably the major source of real and relevant learning.

A carefully designed set of criterion-referenced performance evaluation instruments should enable the instructor to utilize a variety of activities, methods and materials to assist students in the accomplishment of the objectives. However, the availability of a well-written set of supporting curriculum materials will, in reality, support a practical and manageable program in which a large number of diverse activities can take place. Given this basic structure, the instructor can then provide for alternative learning experiences more appropriate to individual learning styles and capabilities. Therefore, little need be said about the instructional methods and materials. We can leave this to the ingenuity of the teacher, the student, private industry, or various curriculum materials development projects.

The important point to be recognized in the evolution of the type of regenerative developmental and evaluative process presented herein is that:

> Such a process, oriented toward criterion testing, if properly engineered and operated, will nearly completely control the content of the instruction irrespective of the means by which instruction is given.

Obviously, the teacher will be forced to teach toward the criterion test. However, let's consider the nature of the evaluation plan, the built-in features for review (and evaluation of the evaluation system) and the ease with which modifications and up-dating can take place. The degree of flexibility in structuring learning activities must be given careful thought along with the options available in materials, media, and mode of instruction. Many advantages are to be gained--with highly desirable, practical and philosophical implications. (See article prepared by AIR in 1967 entitled, "TALENT + PLAN = A NEW HUMANISM.")

To summarize briefly, the evaluation modules or sets include information which describes for the student exactly what he is

expected to do. It also describes the function or use of the new knowledge or skills. The goals are presented in a way which make them attainable and attempts are made to convince the student that the goals are desirable and necessary. Instruction, if needed, is identified and suggested options made available. Realism and practicality are major objectives throughout the design. The methodology insures reinforcement and anticipated early use of skills and knowledges learned as a result of the course experiences. (For example, the first level job tasks will likely be required of most persons entering any of the phases or levels of the job family.) Knowledge of progress is also very important to student attitudes, cooperation and achievement. To this end, statements of objectives and means of evaluating the objectives, the feedback devices, and other features place heavy emphasis on the assessment and reporting of student progress. And, more important, in all such aspects of the program design, active student participation is unavoidable. He is responsible for his own learning, a major part of his own evaluation, and much of his own program management.

Student Tracking Device. The progress board shown in Figure 4 as an information feedback mechanism, can provide the type of guidance presently included in many of the available computer support programs. This is a low cost student operated mechanical system which will offer interim relief to the inordinately high costs of present day computer systems. Furthermore, the information is available at a glance at all times. Student location and the job task he is practicing is always identified. As indicated, red tags show location (absent, office, nurse, etc.) or task being performed by each student. Green tags indicate completion of performance evaluation and task certification. Yellow tags show that instruction has taken place and been completed on any one module or job task. Students applying the performance evaluation as a pre-test in order to certify competency and bypass instructional activity, will have only green tags on such tasks. Masking tape under each tag provides a written record should the tags become scrambled.

Again, each student maintains his own tracking and progress recording. Of course, the instructor keeps his own grade-book record as Criterion Checklists are completed. A quick glance will reveal work completed, options remaining, and rate of progress.

The approach has had interesting effects on student motivation. The application of such a system (along with other system modifications) resulted in a nearly 50% increase in student productivity --more work accomplished in a shorter period of time with a marked reduction in recorded discipline cases. The teacher was freed of unnecessary clerical chores which enabled an increase in tutorial interactions with individual students. Teacher anxiety was reduced with the better managed instructional environment. Graduation into the next higher job level became a visable fact and an accomplishable goal. Such a graphic presentation of individual progress in a flexible program of learner-centered instruction, has had a marked effect on students, teachers and visitors.

Occupational Readiness Record. A sample progress and certification reporting card or record is included in Figure 5. The device is straight-forward and self-explanatory. With such functional reporting methods (a condensation of information from the Criterion Checklist--Appendix D) little practical value would be gained by a continuation of traditional letter grades (i.e. A, B, C, D, F). Note that the reporting method does allow for an exercise of the instructor's expert judgment, task-by-task through the L-M-S ranking. Note also that failures are not recordable. The student is certified on only those tasks in which a minimum leve of competency can be demonstrated. In a sense, there are no failures. Some students will simply take longer than others to reach the various criterion levels task-by-task and job-by-job within the occupational hierarchy.

System Control Documents

Flow Chart of Instructional System Development Process. The Project ABLE Flow Chart of Instructional System Development Process is presented in Figure 6. A second flow chart, Figure 7 (from a recent journal article depicting a "typical" instruction-

al system), is presented for purposes of contrast and emphasis. Note that the ABLE plan calls for the successive tryout and systematic testing (test/revise/retest cycles) of individual modules before ANY attempt is made to implement a course or operating program. Note that the criterion instruments are cycled and validated before instructional materials or learner guides are developed. Note that in the ABLE system, Learner Activity Guides are called for which may frequently not involve the development of new instructional materials. In the ABLE approach, each instructional module or learner activity set is, in itself, a kind of operating system which can, in many cases, stand independent of other activities. The test of the curriculum then, is more of a test of the management capabilities of a wide variety of concurrent student activities. The instructor must be able to organize the class activities, interact with the students in the manner intended, make the necessary evaluation checks and safety checks without interference to his tutorial roles and without loss of productive learning time for the students through "bottlenecks". As can be attested by the ABLE staff, attempts at implementing a total system without the benefit of pre-engineered modules results in chaos. Furthermore, under a "typical" system, effective testing of individual units becomes a nearly impossible chore due to conflict, confusion, negative attitudes, shop management problems and various other interference factors to appropriate evaluation.

The task analysis, the performance objectives, the development of the criterion instruments, and the development of the Learner Activity Guides will suggest an instructional strategy module-by-module. The aids required to support evaluation and the materials, tools, and equipment which will be necessary for the student to be able to demonstrate his competency will be a direct outgrowth of the behavioral analysis. Therefore, the major vehicles for the instructional system will be directly related to, and greatly influenced by, the evaluation process requirements. Instructional Strategy, then, follows "Develop Criteria" and these are not parallel activities as suggested in the "typical" system. The use

of the term "Lesson Plan" also seems out-of-phase with current emphasis on learner-centered instruction (in contrast to the more traditional teacher-centered approach).

PERT. Planning and management control of the instructional system development process through performance evaluation and review techniques and critical path method will be necessary to insure the quality and replicability of the evolved systems and products. Planning, scheduling and controlling of research projects and activities, while not widely practiced in the educational profession, have been eagerly embraced by the government, industry, the armed forces and particularly the aerospace industries where designers and manufacturers have found such procedures invaluable in controlling the complex sequence of operations involved in developing and producing rockets, weaponry and training programs. Appendix F includes charts for the Application of PERT to Instructional System Development for Multiple Job Family Projects in Vocational and Technical Education. Included also are the Work Sheets for estimating and computing duration, early start, early finish, latest start, and latest finish for each activity. From such information, slack time can be calculated and the critical path identified.

The chart shows the many complex interrelationships not possible through the block diagram flow chart provided in Figure 6. Activities which can begin before previous activities are completed are easily shown. Dependencies are graphically presented as are concurrent activities and operations. Man-hour projections and cost projections are more easily computed and controlled. Such an approach sets the stage for accountability and performance contracting procedures. Assessment of project, programs, products, research staff, teachers, (not to mention students) will be possible through multiple iterative corrective feedback mechanisms. So, if the establishment of criteria for the students along with performance measures and procedures for assessing and reporting their competency and performance of stated tasks is so great and good, then why not apply the same quality control processes to

JOB FAMILY: Auto Mechanics and Related Occupations
EXIT LEVEL: Service Station Attendant (915.867) and Related Occupations

OCCUPATIONAL READINESS RECORD

PROJECT ABLE

Name _____

Soc. Sec. No. _____ Date _____

Length of Training _____

Certified by _____
Director

School _____

Address _____

_____

OCCUPATIONAL READINESS RECORD

TO THE EMPLOYER:

This occupational readiness record is both an inventory of the training course content and level of proficiency or achievement demonstrated by the graduate. Graduates can provide potential employers with more complete performance check lists which itemize in great detail the skills and knowledge in which he has demonstrated proficiency. *It is recognized that persons working at the specified occupational* level will function with direction and assistance from superiors. As a part of his training, the graduate has learned to expect appropriate instructions with each assigned task. Furthermore, the graduate should understand that he lacks the authority and training to perform certain functions and operations. He will expect and seek, supervision, assistance and direction where appropriate. Note that the job tasks as identified, are basic to the next higher or more sophisticated job level. *Work experience and further training may qualify the graduate for* more complicated tasks, a new job title, and higher pay.

KEY TO PROFICIENCY CODE:

Level L: Limited Skill-does simple parts of task using required tools, but requires instruction and supervision to do most parts of the job. Identifies parts by name, knows simple facts about the job.

Level M: Moderate Skill-requires help on *some parts*, but can use most tools and special equipment needed. Knows work procedures but may not meet minimum demands for speed or accuracy.

Level S: Skilled-understands operating principles and accomplishes all parts of task with only spot checks of finished work. Meets *minimum demands for speed and accuracy.*

All graduates receiving this document have satisfactorily demonstrated to the training staff their ability to work safely, understand and carry out instructions, and cooperate with other employees. This document also attests to their punctuality, reliability, and general work habits.

Project ABLE/Quincy Public Schools/American Institutes for Research

JOB FAMILY: Auto Mechanics and Related Occupations
EXIT LEVEL: Service Station Attendant (915.867) and Related Occupations.

Name _____ Date _____

Soc. Sec. No. _____ Length of Training _____

Certified by _____ Title _____

Comments _____

LMS	
☐☐☐ Shop Safety	☐☐☐ Services Miniature Bulbs and Sockets
☐☐☐ Fire Safety	☐☐☐ Removes and Replaces Headlamps
☐☐☐ Basic Mechanic's Handtools	☐☐☐ Identifies Common Spark Plug Deposits
☐☐☐ *Automotive Terminology*	☐☐☐ Cleans, Gaps and Tests Spark Plugs
☐☐☐ Identifies Customer Needs	☐☐☐ Removes and Replaces Spark Plugs
☐☐☐ Cleans Service Area and Equipment	☐☐☐ Tests and Adjusts Tire Pressure
☐☐☐ Raises Cars With Floor Jacks and Combination Bumper-Frame Jacks	☐☐☐ Removes and Rotates Wheels
☐☐☐ Raises Cars With Twin-Post Hydraulic Lift	☐☐☐ Inspects Tires and Identifies Common Defects and Wear
☐☐☐ Identifies and Replaces Defective Drive Belts	☐☐☐ Mounts and Demounts Tubless and Tube-Type Tires on Tire Machine
☐☐☐ Inspects Vehicle Lighting Circuit	☐☐☐ Repairs Tubeless and Tube-Type Tires

LMS	LMS
☐☐☐ Washes and Polishes Vehicles	☐☐☐ Visually Inspects Cooling System Identifies Common Defects and Leak Points
☐☐☐ Tests Battery With Battery Hydrometer	☐☐☐ Flushes and Fills Cooling Systems
☐☐☐ Inspects Batteries and Performs Minor Repairs	☐☐☐ Tests Thermostats
☐☐☐ Cleans Batteries, Posts and Cables	☐☐☐ Removes and Replaces Thermostats
☐☐☐ Removes and Replaces Batteries	☐☐☐ Lubricates Body—Doors, Hinges, etc.
☐☐☐ Charges Batteries With Fast and Slow Charger	☐☐☐ Identifies Specified Engine Oil, ATF and Lube Grease
☐☐☐ Inspects and Tests Radiator Pressure Caps	☐☐☐ Checks Engine Oil and ATF and *Fills* to Proper Level
☐☐☐ Pressure Tests Cooling Systems	☐☐☐ Determines Oil Lubrication and Filter Service Requirements
☐☐☐ Tests Antifreeze	☐☐☐ Services Air and Gas Filters
☐☐☐ Identifies Common Hose Defects	☐☐☐ Changes Oil and Oil Filter
☐☐☐ Removes and Replaces Hoses	☐☐☐ Lubricates Chassis

The trainee has had limited experience in dispensing fuel, receiving credit and cash payments, and keeping records and inventory. On-the-job training required in these and other areas.

+4

PROJECT ABLE

FLOW CHART OF INSTRUCTIONAL SYSTEM DEVELOPMENT PROCESS

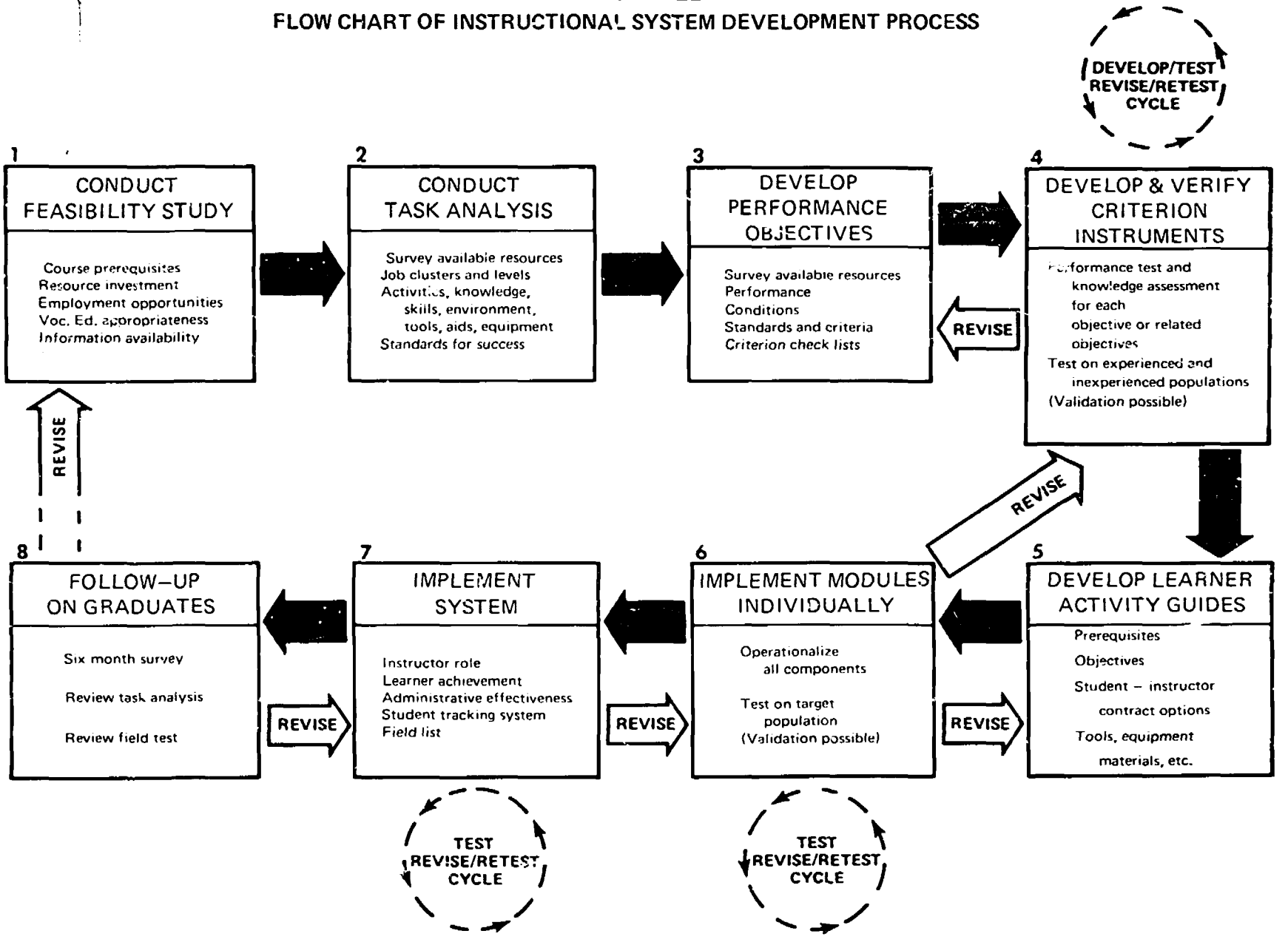


Figure 6.

JW.U. / G.E.N. 4/70

Typical Instructional System

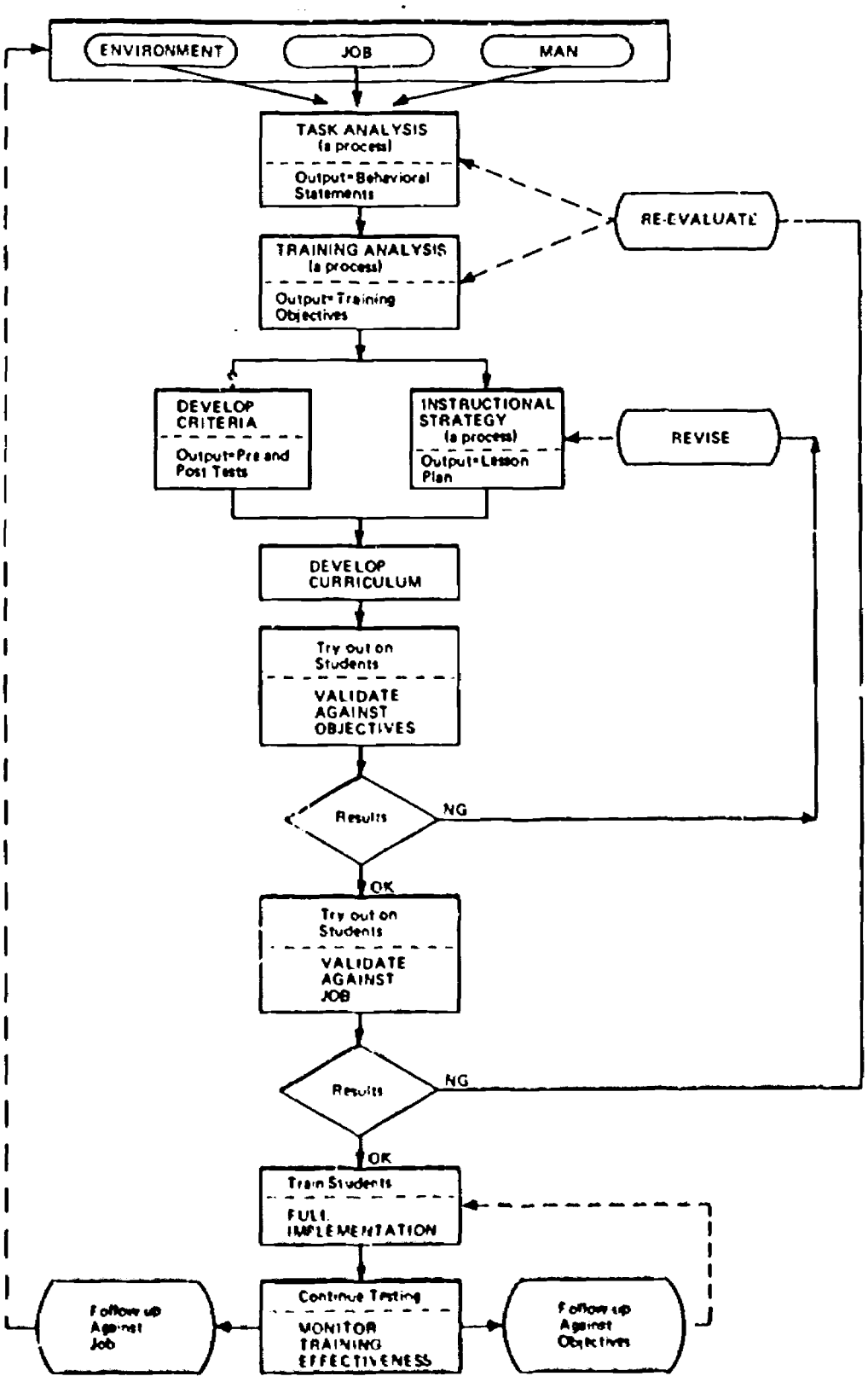


Figure 7.

the project managers, research staff, and instructional staff? Why not?

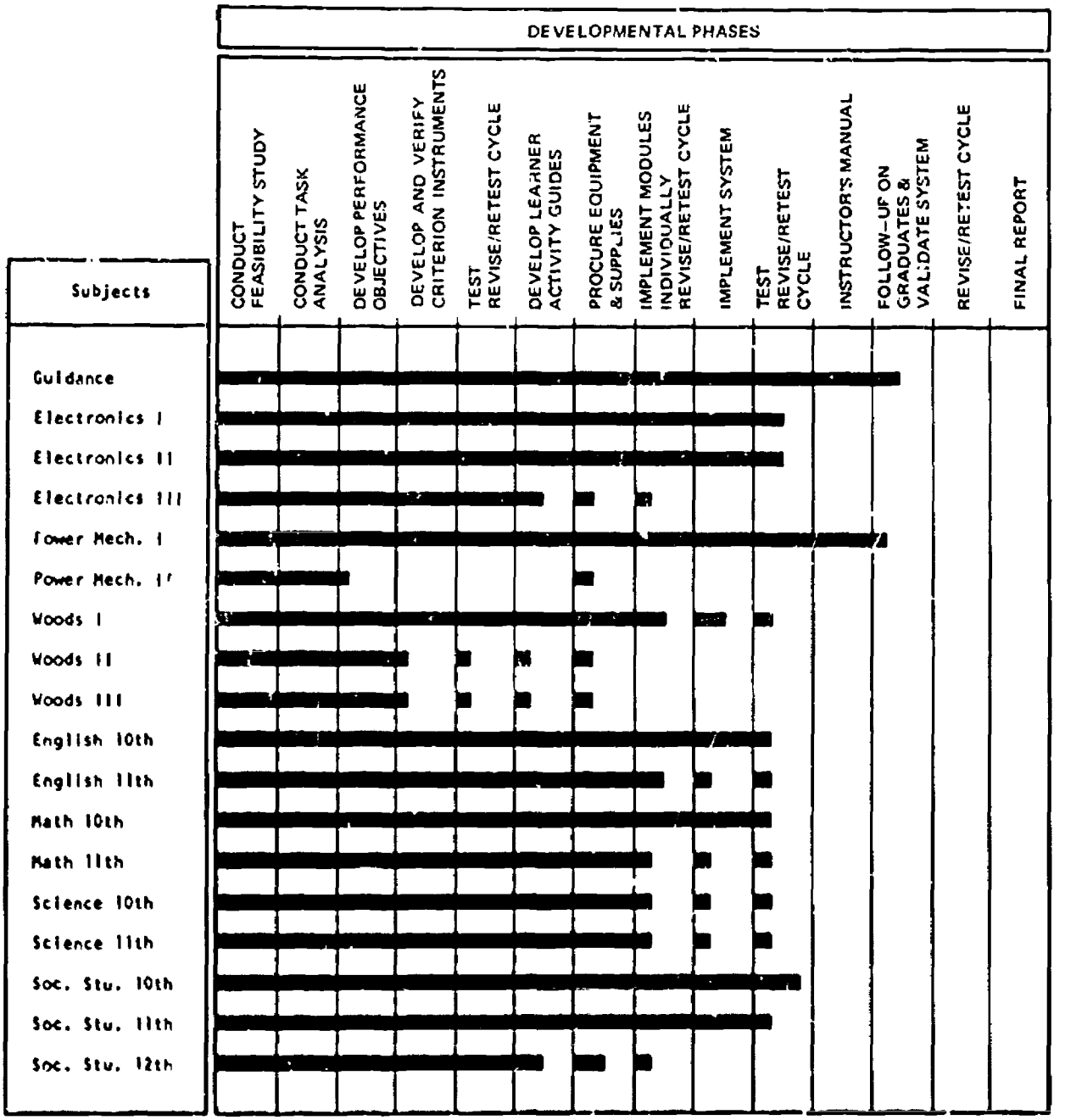
Accountability Checklist. Appendix G includes the Accountability Checklist--Performance Contract for Instructional System Development Process for vocational and technical education. Note that certification of tasks completed takes place at three levels. Of course, such control instruments are keyed to the PERT chart and flow chart (Appendix F and Figure 6). An Instructor Performance Checklist and Task Scheduling Sheet are related key control documents (Figures 8 and 9) and are discussed in a following section.

Project Progress Chart. Figure 8 is a sample project progress chart. Course area and level by developmental phase are in bar graph form.

Progress Chart: Job Tasks by Developmental Phase. Another bar graph type control and reporting document is included as Figure 9. Here, progress can be charted for each job task (derived from the job analysis) by developmental phase. Note that while job tasks are listed in frequency performed, actual development need not follow that sequence. It would be advisable to select an apparent easy-to-develop task and complete all phases of development for purposes of staff training. This process or task could be replicated until quality and product standards are acceptable. From that point, any one of a number of practical criteria could be applied in the selection of job tasks to be developed. Of course, a number of concurrent activities could be under way at any one time.

Matrix of Man-Hour Estimates by Job Tasks and Developmental Phase. The chart labeled Figure 10 should be of considerable value in completing the PERT Work Sheets (Appendix F). It is possible by using such methods, to estimate, by job tasks, the probable number of hours of instruction required (for those students needing such instruction) the number of performance objectives, and the number of modules (Learner Activity Guide and Performance Evaluation Set). The matrix to the right of the job tasks shows man-hours (in each cell) for the completion of a specific devel-

PROJECT ABLE PROGRESS CHART *



* Status as of December 1969

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Figure 8.

PROGRESS CHART

JOB TASKS	DEVELOPMENTAL PHASES										
	DEVELOP PERFORMANCE OBJECTIVES	DEVELOP & VERIFY CRITERION INSTRUMENT	TEST REVISE/RETEST CYCLE	DEVELOP LEARNER ACTIVITY GUIDES	PROCURE EQUIPMENT AND SUPPLIES	IMPLEMENT MODULES INDIVIDUALLY REVISE/RETEST CYCLE	IMPLEMENT SYSTEM	TEST REVISE/RETEST CYCLE	FOLLOW UP ON GRADUATES AND VALIDATE	REVISE/RETEST CYCLE
1. Perform minor engine tuneups.										
2. Check or inspect wheel bearings.										
3. Inspect exhaust systems.										
4. Service and adjust brake systems.										
5. Lubricate universal joints.										
6. Replace windshield wiper blades.										
7. Remove, install, and adjust carburetors.										
8. Perform operational brake inspections.										
9. Lubricate front wheel bearings.										
10. Perform operational engine inspections.										
11. Remove and install starters.										
12. Replace brake shoes.										
13. Replace flasher units.										
14. Install gaskets and seals.										
15. Replace exhaust system components.										
16. Replace fuel pumps.										
17. Remove and install generators or alternators.										
18. Perform operational checks of windshield wiper systems.										
19. Perform operational inspections of propeller shafts, u-joints, and center bearings.										
20. Remove and install radiators.										
21. Adjust or replace emergency brake controls.										
22. Repair or replace master cylinders.										
23. Remove, install, and adjust distributors.										
24. Repair or replace master or wheel cylinders.										
25. Replace shock absorbers.										
26. Repair or replace switches.										
27. Perform operational inspections on manual transmissions.										
28. Adjust, repair, or replace backup light switches.										
29. Perform operational inspections of electrical systems.										
30. Replace thermostats.										
31. Replace fuel filters.										
32. Inspect seat belts.										
33. Perform inspections of vehicle condition.										
34. Perform operational inspections of fuel systems.										
35. Check or replace exhaust manifolds.										
36. Replace brake hoses and lines.										
37. Perform visual inspections of suspension systems.										
38. Repair or replace windshield wiper units.										
39. Inspect vehicles for compliance with local laws.										
40. Perform operational inspections of positive crank-										

Figure 9.

case ventilation systems.
41. Repair or replace instruments and sending units.
42. Install seat belts.
43. Repair distributors.
44. Repair or replace relays.
45. Maintain service station lifts and lubrication equipment.
46. Replace heater water control units.
47. Balance wheels and tires.
48. Maintain tire removal equipment.
49. Inspect or resurface brake drums.
50. Initiate and complete work orders.
51. Service or replace manifold heat controls.
52. Control flow of work.
53. Initiate requests for parts.
54. Repair or replace hydraulic lines and fittings.
55. Service or replace heater components.
56. Retrieve disabled vehicles.
57. Perform operational inspections of exhaust emission control systems.
58. Install emergency warning devices.
59. Maintain washrack equipment.
60. Repair or fabricate hydraulic hoses.
61. Perform operational automatic transmission inspections.
62. Review procured parts for installation on proper vehicles.
63. Repair or maintain power lawn mowers.
64. Repair locks and latches.
65. Determine actual cost of vehicle repairs.
66. Inspect, fabricate, or repair hydraulic lines.
67. Perform operational inspections of air conditioning systems.

b. ADVANCED TASKS

1. Repair or service carburetors.
2. Analyze causes of vehicle failures.
3. Repair starters.
4. Analyze or adjust engine performance using engine analyzer.
5. Repair generators or alternators.
6. Repair or replace hydraulic power brake units.
7. Repair or replace electrical motors.
8. Repair or replace power steering pumps.
9. Repair or service air-conditioning systems.
10. Install air-conditioners in vehicles.

c. SPECIALTY TASKS

1. Radiator repair.
2. Transmission repair.
3. Front end alignment.

PROJECT ABLE

POWER MECHANICS CURRICULUM SECOND LEVEL
PROJECTED DEVELOPMENT IN MAN-HOURS*

Figure 10.

NO. OF UNITS OR PHASES	SUB TASKS (BEHAVIORAL OBJECTIVES)	HOURS OF INSTRUCTION	BASIC JOB TASKS **	
2	6	6	1. Perform minor engine tuneups.	1.
2	6	6	2. Check or inspect wheel bearings.	2.
1	3	1	3. Inspect exhaust systems.	3.
1	2	3	4. Service and adjust brake systems.	4.
1	6	6	5. Lubricate universal joints.	5.
1	2	1	6. Replace windshield wiper blades.	6.
2	6	3	7. Remove, install, and adjust carburetors.	7.
1	1	3	8. Perform operational brake inspections.	8.
1	1	1	9. Lubricate front wheel bearings.	9.
2	4	10	10. Perform operational engine inspections.	10.
1	1	2	11. Remove and install starters.	11.
1	2	4	12. Replace brake shoes.	12.
1	1	1	13. Replace flasher units.	13.
1	5	6	14. Install gaskets and seals.	14.
1	2	6	15. Replace exhaust system components.	15.
1	2	3	16. Replace fuel pumps.	16.
2	4	6	17. Remove and install generators or alternators.	17.
1	2	1	18. Perform operational checks of windshield wiper system.	18.
1	3	3	19. Perform operational inspections of propeller shafts, u-joints, and center bearings.	19.
1	3	3	20. Remove and install radiators.	20.
1	3	4	21. Adjust or replace emergency brake controls.	21.
1	2	4	22. Repair or replace master cylinders.	22.
1	3	3	23. Remove, install, and adjust distributors.	23.
1	3	3	24. Repair or replace master or wheel cylinders.	24.
1	1	2	25. Replace shock absorbers.	25.
1	2	1	26. Repair or replace switches.	26.
1	3	2	27. Perform operational inspections on manual transmissions.	27.
1	2	2	28. Adjust, repair, or replace backup light switches.	28.
1	5	2	29. Perform operational inspections of electrical systems.	29.
1	2	4	30. Replace thermostats.	30.
1	3	2	31. Replace fuel filters.	31.
1	1	1	32. Inspect seat belts.	32.
2	8	4	33. Perform inspections of vehicle condition.	33.
2	6	3	34. Perform operational inspections of fuel systems.	34.
1	2	4	35. Check or replace exhaust manifolds.	35.
1	3	2	36. Replace brake hoses and lines.	36.
1	6	3	37. Perform visual inspections of suspension systems.	37.
1	2	3	38. Repair or replace windshield wiper units.	38.
1	6	4	39. Inspect vehicles for compliance with local laws.	39.
1	2	2	40. Perform operational inspections of positive crankcase ventilation systems.	40.
			Repair or replace instruments and sending units.	41.
				42.

DEVELOPMENTAL PHASES															
CONDUCT FEASIBILITY STUDY	CONDUCT TASK ANALYSIS	DEVELOP PERFORMANCE OBJECTIVES	DEVELOP & VERIFY CRITERION INSTRUMENTS (PERFORMANCE EVALUATION MODULES)	TEST REVISE/RETEST CYCLE	DEVELOP LEARNER ACTIVITY GUIDES	PROCURE EQUIPMENT AND SUPPLIES	IMPLEMENT MODULES INDIVIDUAL REVISE/ RETEST CYCLE	IMPLEMENT SYSTEM	TEST REVISE/RETEST CYCLE	INSTRUCTOR'S MANUAL	FOLLOW-UP ON GRADUATES AND VALIDATE SYSTEM	REVISE/RETEST CYCLE	FINAL REPORT	TOTALS	
		12	102	61	140	2.5	80	1	63		10	36.3		507.8	1.
		12	42	25	56	1.0	32	.40	25.5		4	14.7		212.6	2.
		2	12	7	14	.25	8	.10	6.75		1	3.9		55.0	3.
		4	30	18	42	.75	24	.30	18.75		3	10.8		151.6	4.
		8	39	23.5	56	1.0	32	.40	24.75		4	14.25		202.9	5.
		4	12	7	14	.25	8	.10	6.75		1	3.9		57.0	6.
		8	33	19.5	42	.75	24	.30	19.5		3	11.25		161.3	7.
		2	30	18	42	.75	24	.30	18.75		3	10.8		149.6	8.
		2	12	7	14	.25	8	.10	6.75		1	3.9		55.0	9.
		4	96	58	140	2.5	80	1.0	61.5		10	35.4		488.4	10.
		2	21	12.5	28	.50	16	.20	12.75		2	7.35		102.3	11.
		4	39	23.5	56	1.0	32	.40	24.75		4	14.25		198.9	12.
		2	12	7	14	.25	8	.10	6.75		1	3.9		55.0	13.
		10	57	34.5	84	1.5	48	.60	36.75		6	21.15		299.5	14.
		4	57	34.5	84	1.5	48	.60	36.75		6	21.15		293.5	15.
		4	30	18	42	.75	24	.30	18.75		3	10.8		151.6	16.
		8	51	30.5	70	1.25	40	.50	31.5		5	18.15		255.9	17.
		4	12	7	14	.25	8	.10	6.75		1	3.9		57.0	18.
		6	30	18	42	.75	24	.30	18.75		3	10.8		153.6	19.
		6	30	18	42	.75	24	.30	18.75		3	10.8		153.6	20.
		6	39	23.5	56	1.0	32	.40	24.75		4	14.25		200.9	21.
		4	39	23.5	56	1.0	32	.40	24.75		4	14.25		198.9	22.
		6	30	18	42	.75	24	.30	18.75		3	10.8		153.6	23.
		6	30	18	42	.75	24	.30	18.75		3	10.8		153.6	24.
		2	21	12.5	28	.50	16	.20	12.75		2	7.35		102.3	25.
		1	12	7	14	.25	8	.10	6.75		1	3.9		57.0	26.
		6	21	12.5	28	.50	16	.20	12.75		2	7.35		102.3	27.
		4	21	12.5	28	.50	16	.20	12.75		2	7.35		102.3	28.
		10	21	12.5	28	.50	16	.20	12.75		2	7.35		110.3	29.
		4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3	30.
		6	21	12.5	28	.50	16	.20	12.75		2	7.35		106.3	31.
		2	12	7	14	.25	8	.10	6.75		1	3.9		55.0	32.
		16	42	25	56	1.0	32	.40	25.5		4	14.7		216.6	33.
		8	33	19.5	42	.75	24	.30	19.5		3	11.25		161.3	34.
		4	39	23.5	56	1.0	32	.40	24.75		4	14.25		198.9	35.
		6	21	12.5	28	.50	16	.20	12.75		2	7.35		106.3	36.
		12	30	18	42	.75	24	.30	18.75		3	10.8		159.6	37.
		4	30	18	42	.75	24	.30	18.75		3	10.8		161.6	38.
		12	39	23.5	56	1.0	32	.40	24.75		4	14.25		206.9	39.
		4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3	40.
		8	96	58	140	2.5	80	1.0	61.5		10	35.4		492.4	41.
		4	30	18	42	.75	24	.30	18.75		3	10.8		151.6	42.

COMPLETED

COMPLETED

[illegible]	[illegible]	[illegible]	37.	[illegible]															
1	2	3	38.	Repair or replace windshield wiper units.	38.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	6	4	39.	Inspect vehicles for compliance with local laws.	39.			12	39	23.5	56	1.0	32	.40	24.75		4	19.25		206.9
1	2	2	40.	Perform operational inspections of positive crankcase ventilation systems.	40.			4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3
3	4	10	41.	Repair or replace instruments and sending units.	41.			5	96	58	140	2.5	80	1.0	61.5		10	35.4		492.5
1	2	3	42.	Install seat belts.	42.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	4	6	43.	Repair distributors.	43.			8	57	34.5	84	1.5	48	.60	36.75		6	21.15		297.5
1	1	1	44.	Repair or replace relays.	44.			2	12	7	14	.25	8	.10	6.75		1	3.9		55.0
2	4	5	45.	Maintain service station lifts and lubrication equipment.	45.			8	51	30.5	70	1.25	47	.50	81.5		5	18.15		255.9
1	3	6	46.	Replace heater water control units.	46.			6	57	34.5	84	1.5	48	.60	36.75		6	21.15		295.5
1	3	9	47.	Balance wheels and tires.	47.			6	84	51	126	2.25	72	.90	54.75		9	31.5		437.4
1	2	2	48.	Maintain tire removal equipment.	48.			4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3
2	4	6	49.	Inspect or resurface brake drums.	49.			8	60	36	84	1.5	48	.60	37.5		6	21.6		303.2
1	3	2	50.	Initiate and complete work orders.	50.			6	21	12.5	28	.50	16	.20	12.75		2	7.35		106.3
1	2	3	51.	Service or replace manifold heat controls.	51.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	6	1	52.	Control flow of work.	52.			12	12	7	14	.25	8	.10	6.75		1	3.9		65.0
1	1	2	53.	Initiate requests for parts.	53.			2	21	12.5	28	.50	16	.20	12.75		2	7.35		102.5
1	2	3	54.	Repair or replace hydraulic lines and fittings.	54.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	3	5	55.	Service or replace heater components.	55.			6	48	29	70	1.25	40	.50	30.75		5	17.7		248.2
1	4	5	56.	Retrieve disabled vehicles.	56.			8	48	29	70	1.25	40	.50	30.75		5	17.7		250.2
1	2	3	57.	Perform operational inspections of exhaust emission control systems.	57.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	4	4	58.	Install emergency warning devices.	58.			8	34	23.5	56	1.0	32	.40	24.75		4	14.25		202.9
1	1	2	59.	Maintain washrack equipment.	59.			2	21	12.5	28	.50	16	.20	12.75		2	7.35		102.3
1	2	2	60.	Repair or fabricate hydraulic hoses.	60.			4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3
1	3	5	61.	Perform operational automatic transmission inspections.	61.			6	48	29	70	1.25	40	.50	30.75		5	17.7		248.2
1	3	1	62.	Review procured parts for installation on proper vehicles.	62.			6	12	7	14	.25	8	.10	6.75		1	3.9		59.0
5	7	20	63.	Repair or maintain power lawn mowers.	63.			14	195	117.5	280	5.0	160	2.0	123.15		20	71.25		988.5
1	5	7	64.	Repair locks and latches.	64.			10	66	40	98	1.75	56	.70	42.75		7	24.6		346.8
1	2	3	65.	Determine actual cost of vehicle repairs.	65.			4	30	18	42	.75	24	.30	18.75		3	10.8		151.6
1	2	2	66.	Inspect, fabricate, or repair hydraulic lines.	66.			4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3
1	2	2	67.	Perform operational inspections of air conditioning systems.	67.			4	21	12.5	28	.50	16	.20	12.75		2	7.35		104.3
83	198	247		SUB TOTAL				396	2472	1483.0	3459	617.5	1976	24.70	1544.25		247	889.50		12552.2

ADVANCED JOB TASKS

3	6	11	1.	Repair or service carburetors.	1.			12	108	62	154	2.75	88	1.1	68.25		11	37.30		549.4
3	5	8	2.	Analyze causes of vehicle failures.	2.			10	81	48.5	112	2	64	.80	50.25		8	28.95		405.5
1	3	5	3.	Repair starters.	3.			6	48	29	70	1.25	40	.50	30.75		5	17.7		249.2
4	8	15	4.	Analyze or adjust engine performance using engine analyzer.	4.			16	147	88.5	210	3.75	120	1.5	93		15	53.55		743.3
3	7	10	5.	Repair generators or alternators.	5.			14	99	59.5	140	2.5	80	1	62.25		10	35.85		504.1
1	3	5	6.	Repair or replace hydraulic power brake units.	6.			6	48	29	70	1.25	40	.50	30.75		5	17.7		248.2
2	4	6	7.	Repair or replace electrical motors.	7.			8	60	36	84	1.5	48	.60	37.5		6	21.6		303.2
1	3	5	8.	Repair or replace power steering pumps.	8.			6	48	29	70	1.25	40	.50	30.75		5	17.7		248.2
2	6	8	9.	Repair or service air-conditioning systems.	9.			12	78	47	112	2	64	.80	49.5		8	28.5		401.8
4	8	12	10.	Install air-conditioners in vehicles.	10.			16	120	72	168	3	96	1.2	75		12	43.2		606.4
24	53	85		TOTALS				502	5309	1986.5	4648	83.00	2656	33.20	2072.25	100	352	1193.55	50	16165.5

* Man-hours shown do not reflect administrative personnel requirements.

** Job tasks are listed insofar as possible, in order of frequency performed.

J.W.U.

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TASK SCHEDULING CHART FOR VOCATIONAL-TE

TASKS / MODULES	IV DEVELOP CRITERION INSTRUMENT							V DEVELOP LEARNER ACTIVITY GUIDE								VI VERI	
	CONSTRUCT PERFORMANCE ACTIVITY SECTION 4-1	PREPARE SPECS FOR PHYSICAL DEVICES 4-2	PREPARE PAPER-PENCIL TEST ITEMS 4-3	SPECIFY TOOLS & EQUIPMENT FOR EACH OBJECTIVE 4-4	BUILD MODULE PERFORMANCE EVALUATION SETS 4-5	OPERATIONALIZE ALL MODULE MATERIALS 4-6	SUBMIT INSTRUMENT FOR PANEL REVIEW	SPECIFY PREREQUISITE PERFORMANCE CERTIFICATION 5-1	ENTER EACH OBJECTIVE IN BRIEF FORMAT 5-2	WRITE BRIEF OVERVIEW 5-3	SPECIFY STUDENT INSTRUCTOR CONTRACTS 5-4	LIST ALL MATERIALS TO BE USED FOR EVALUATION 5-5	SPECIFY OPTIONAL RESOURCES 5-6	PRINT & DETERMINE NEED FOR NEW MATERIALS 5-7 5-8	SUBMIT INSTRUMENT FOR PANEL REVIEW	PLACE ALL AIDS INTO OPERATION 6-1	ASSEMBLE ALL MODULE EQUIPMENT 6-2
	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp

Y INDIVIDUAL MODULES				VII IMPLEMENT SYSTEM									VIII FOLLOW-UP GRADUATES						
ASSEMBLE ALL MODULE REFERENCES 6.3	ACQUIRE TRAINER-TESTER CARDS 6.4	REVIEW & TEST MODULES 6.6	SUBMIT INSTRUMENT FOR PANEL REVIEW	DEFINE INSTRUCTOR ROLE 7.1	DEVELOP & PRINT OCCUPATIONAL READINESS RECORD 7.2	BUILD STUDENT TRACKING SYSTEM 7.3	ORGANIZE MATERIALS HANDLING SYSTEM 7.4	SECURE SETS OF STUDENT MATERIALS 7.5	COMPLETE ALL FORMAL REQUIREMENTS 7.6	CONDUCT FORMAL TEST OF OPERATIONAL SYSTEM 7.7	CONDUCT REVIEW OF CHECKLIST 7.15	TEST/REVISE/ RETEST 7.17	SUBMIT INSTRUMENT FOR PANEL REVIEW	CONDUCT SIX MONTH SURVEY 8.1	AID IN ESTABLISHMENT OF FOLLOW-UP PROCEDURES 8.5	AID IN COMPLETION OF INSTRUCTOR'S MANUAL 8.6	COMPLETE DISSEMINATION REQUIREMENT 8.7	PREPARE FOR NEXT JOB LEVEL DEVELOPMENT 8.8	SECURE TASK ANALYSIS & OBJECTIVE REVIEW 8.8.1	SUBMIT INSTRUMENT
Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / Comp	Due / C

opmental phase for each job task. Through an analysis of such documents, it has been possible to make an estimate of four to six man-years of work required per course-year of instructional system development of the initial type (excluding extensive follow-up and field testing activity) described in this report for vocational and technical education. In other words, it would take six men, one full year to complete one course of the normal school year (nine months) variety using the recommended techniques and processes for instructional system development. Compared to the developmental costs of several academic courses in the mathematics and science areas--estimated from two or three to seven-million dollars per course--such an effort for vocational and technical education would seem quite reasonable and appropriate.

Task Scheduling Sheets. A series of task scheduling sheets similar to that labeled Figure 11, are available for the instructional systems development specialist, team leader, and project director. Such devices are also correlated to the PERT materials, flow charts, and performance checklists. In a sense, such devices become a sort of "contract" between developer or writer and project director. Due dates and completion dates provide a means of monitoring individual, team and project progress. Problem areas are more easily pinpointed, and adjustments without serious disruption become possible.

System Development Team

In too many instances, the tasks of instructional system development are relegated to a teacher or group of teachers. To relegate, in one sense of the word, is to submit for execution. In another sense, the dictionary defines the word in terms of "to consign to insignificance or oblivion". The latter definition is usually the outcome of such short-sighted planning, staffing and project management. The situation could hardly be any better if the teachers are excluded or not involved in such a way as to capitalize on those inputs which are critical to the demands of the system development techniques. Competent learning psychologists, instructional technologists, media experts, researchers for the various information collecting stages, clerks

and secretaries, editors, printers, evaluation experts, project managers, teachers and others, when matched with realistic well-defined goals and adequate funds, can do the job. Project ABLE has attempted to establish the proper "mix". Limited success has been achieved (in spite of inadequate funding) and that has come as a direct result of a functional team effort. (The Project staff has provided documentation in the Eighth Quarterly Technical Report on the problems encountered while designing, developing, and implementing an experimental curriculum.)

The author of this report, in an unpublished paper (1967) reviewed some 200 references in the area of junior college staffing (with a focus on occupational education). Staffing innovations and trends related to staffing played a part in the subsequent recommendations of the author. Important also were the emphases being placed on learner-centered instruction and the systems approach to both development and operation of educational programs. A basic assumption for the implementation of such instructional systems as described in this report, was that persons from the skilled trades technical occupations (and competent in the job area to be taught) without professional teacher training (or degrees), could be of valuable service to vocational and technical education in a tutorial role if given the proper support, supervision, and inservice training. Once the instructional program has had proper research and development, and placed into operation in a learner-centered environment (where students can and do assume a great deal of initiative for their own learning, evaluation, and progress management), a different kind of instructor behavior and set of job tasks is required.

W. James Popham (1969) has conducted a teaching proficiency experiment in vocational education. The results of his study show little statistical difference between test scores of groups of students taught by professional teachers and by non-teachers. Both teachers and non-teachers were furnished the objectives and materials to be mastered by the students and were free to teach the material by any means which they chose.

The conclusion reached in the study is that teachers have not been trained to cause behavioral changes in their students. Because teachers do not know how to modify behavior in their students, non-teachers can present material to students which causes them to achieve post-test results not significantly different from teacher-trained students. Popham feels that enough evidence presently exists to justify the immediate establishment of performance test measures of teacher proficiency without engaging in further experimental studies.

During the month of February 1970, Project ABLE conducted an instructor training program for persons from the Baltimore and Philadelphia school systems. The purpose of the training was to insure proper implementation, operation and evaluation of field test activities for the power mechanics instructional system. The instructor training program was designed as a "hands-on", individualized, self-paced experience. The trainees (after receiving a brief overview of project programs, techniques, processes, etc.) entered the power mechanics course playing the role of novice students. They were required to successfully perform as students in the accomplishment of learning materials, performance evaluation modules, and operation of the system components. This included use of the research instruments and information forms which the instructor would ultimately administer. Proper operation of the student tracking system and the various training aids were included. Of course, the trainees were evaluated against program criteria by experienced staff.

The instructor-trainees were then placed in the role of course instructors and allowed to practice that job under live conditions. This included the administration of various research instruments intended for validation purposes during the field test activities. The trainees were also evaluated in their activities against the Instructor Performance Checklist (see Appendix H). Note here, that three levels of certification are again required. (A supervisor from each of the field test schools received the same training.) Additional practice was structured as an inservice

program in which the course modules would be operationalized and implemented one-at-a-time at the test site. Precise procedures have been specified which will enable a standardized replicable process to be followed in the implementation and testing of course materials module-by-module. Supplementary documents and optional reading materials were provided each trainee along with optional "enrichment" resources (theory and philosophy related to individualized instruction, systems development, behavioral sciences, etc.). Such training was accomplished in less than three days. More important, the same process will be replicable at each of the field test sites when general dissemination is undertaken.

A similar training program is recommended for system development team members. Of course the next logical step in the progression from instructor to novice develcper (systems team member) would be to select simple job tasks from the occupational analysis and repeat the various phases of the developmental process until quality products are available and proper procedures demonstrated. This involves a simple test/revise/retest cycling of all steps until adequate performance is attained. Additional information and recommendations on the systems development team are included in the section on RECOMMENDATIONS.

JOB DESCRIPTION AND ANALYSIS

Job Description

A job description has been prepared for each of the representative occupations. One purpose of the job description is to provide information which is useful in detailing the performance required of an incumbent. A job description and task enumeration document for the first level of training in those occupations related to automotive mechanics, is included in Appendix L. A job description and task enumeration for the second level of training is also included in Appendix L. Job title enumerations and occupational flow charts with selected lists of occupations by clusters are included in Appendices J and K.

The First Quarterly Technical Report (June 1965) defined the procedures and major steps for the job family analysis. For example, in Appendix L, the initial section (for Service Station Attendant) Definition of the Population, attempts to distinguish the jobs to be included from the excluded jobs of a similar title. A brief general description is given of formal characteristics of job incumbents along with information about the industry. This helps to delineate the tasks. The Statement of Mission identifies the different purposes and modes of operation which influence performance of the job. It can define alternative objectives, operational modes and hierarchies of goals. It sets the criteria by which one can judge performance and sets the objective toward which all tasks are aimed. The Segments identify sub-operations of the mission and serve as important organizational aids for the tasks. They indicate sequences, time phases and categories of operations. They are the major steps in the regular sequence of job performance. The section Functions lists general activities performed on the job focusing on the categories of things, data, and people. The section Contingencies identifies conditions under which the job is to be performed--the usual and the unusual.

Task Enumeration and Classification

The intent here is to provide a list of specific statements of action. A task is the smallest convenient unit of job activity having a separate purpose. Tasks are suggested throughout the process of preparing general job descriptions. The tasks are classified into Basic, Specialty, Advanced, Auxiliary, and Redundant categories. Only the basic tasks are analyzed in detail. The basic tasks are those closely related to the central purpose of the occupation and typically performed by new employees. The specialty tasks are typically performed by a small proportion of employees, or only rarely performed, and are not closely related to the central purposes of the occupation. The advanced tasks require specialized training and are usually performed by the more experienced personnel. Auxiliary tasks usually require no special training and are not critical to satisfactory job performance. Redundant tasks are repetitious activities which require no special training or can be mastered quickly while on the job.

Generally speaking, tasks should be ranked by frequency performed. Furthermore, data collected on personnel performing such tasks should include pay level, job level or title, and length of time on the job. Tasks should also be ranked or grouped, if possible, by degree of importance to job success and performance. This might be related to various human safety factors, potential damage to expensive equipment, high profit margin activities, and others. Such information is often available through military and industrial sources. Project ABLE has, for example, been able to secure an Air Force computer print-out of an extensive analysis of automotive maintenance personnel. As a part of the feasibility study, careful consideration should be given to the availability of such information.

Task Description

Task descriptions suggest the sequencing and form of instruction, provide the substance for the content of instruction, and serve as a statement of the performance criterion which is the backbone of all evaluation. The breakdown of a typical job structure is shown in Figure 12. In some instances, the activities

are broken out into yet more detail.

Robert Miller (1962) in a widely quoted article on task description and analysis has stated:

> It is possible for a task description to be complete simply by denoting and enumerating all the circumstances in the stimuli and responses that can occur in the operational settings in which tasks may have to be performed. Generally speaking, the level of detail for specifying task activities is about that used in a good manual of instructions to a novice. In fact, one of the uses of a good task description is precisely that of a procedural manual for the job.

(Figure 13 presents a sample task description form.) Here, it should be noted that for many occupations, excellent procedural manuals exist for various job tasks. This would indicate, for example, that industry frequently does apply human engineering techniques to the analysis of the man-machine interface in many of its product lines. Of interest to this discussion also, is the recent study performed by AIR for the Air Force on Maintenance Technician's Performance Curves (November 1969). It was found that "...it begins to appear that troubleshooting may be less related to traditional electronics maintenance skills, i.e., soldering, oscilloscope use, and electronics principles, than to effective use of the technical manuals provided for the system." It was also stated that task familiarization may be equivalent to familiarization with the technical manuals.

Again, during the feasibility study, availability of information and materials should have important implications to policy decisions related to instructional system development. The availability of well prepared procedural manuals could result in significant savings of developmental funds at the task description stage. Unnecessary replication is seldom good research and it is, therefore, recommended that decisions on the type and degree of rigor of task description be determined by the analysis of availability of materials--job task by job task. For example, equipment specifications, engineering and maintenance manuals, and procedural information may be quite adequate for the activities under job task X but not for job task Y. And, job task Z may not

DIAGRAM OF SAMPLE JOB STRUCTURE

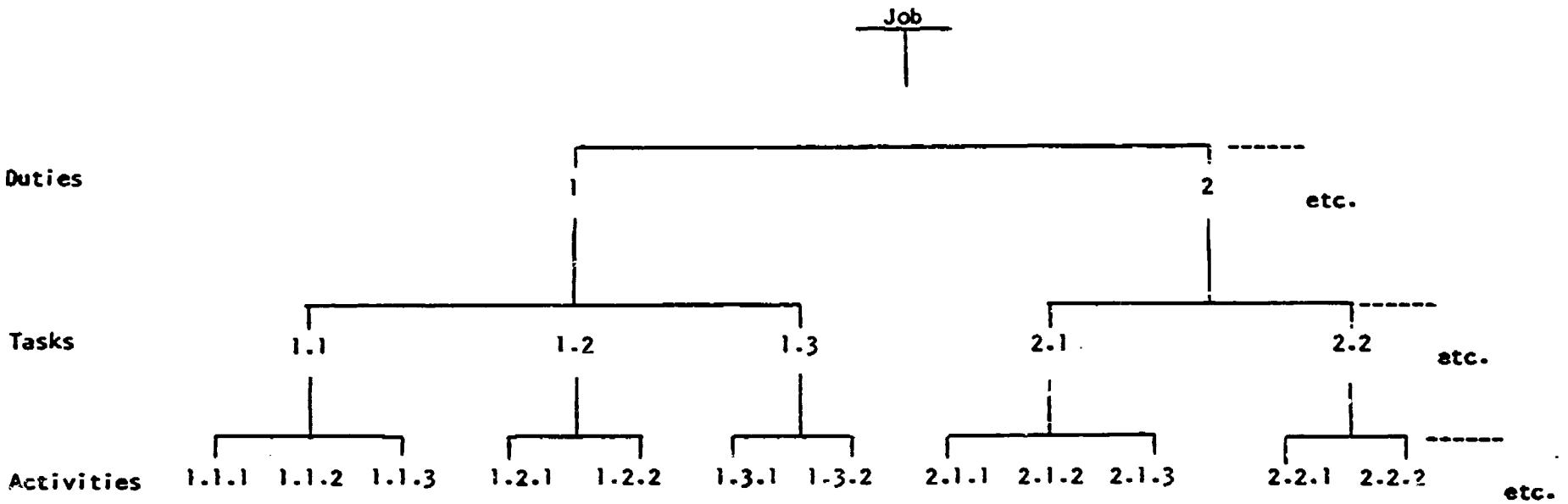

Diagram of a sample job structure showing the breakdown into duties, tasks, and activities.

(Butler 1967)

Figure 12.

JOB: Statistical clerk (Sample Task Description Form) Page 1 of 25 Pages

DUTY: 5 Perform simple arithmetic operations on calculator

TASK 5.1 Add column of positive numbers with decimals ANALYST: F. C. Butler DATE: 6/1/67

INCUMBENT: J. M. Thrasher COPY: 1

ACTIVITY Code + Activity Statement	Time scale (minutes)	ACTION STATEMENT Code + Action + Item Acted Upon + Modifiers	ACTION DETERMINANT(S) Plus Info Needed to Act	INDICATION OF RESPONSE ADEQUACY Plus Info Needed to Determine Adequacy	REMARKS Reference to Alternate or Emergency procedures (AP, EP); Rules and Definitions; Precautions
5.1.1 Set up machine for addition of numbers with decimals		. . . . .	Desire or instruction to perform the task	As indicated below	Assume a prior orientation to machine
		5.1.1.1 Depress DIALS CLEAR and KB CLEAR	SP (= Standard Procedure) to clear keyboard and dials	Zeros appear in all dials. No key is depressed except blank or zero keys	If numbers still appear in MULTIPLIER dials; clear by pressing CLEAR MULT and repeating Element 1
		5.1.1.2 Depress and hold upper CARR SHIFT	SP	Carriage in No. 1 position	If numbers still appear in UPPER or LOWER dials; raise LOCKS for all dials and raise CONSTANT MULTIPLIER lever

(Butler 1967)

Figure 13.

warrant the effort required to undertake a rigorous task description and analysis. In short, it is being suggested that task descriptions can be derived from resource materials in some instances. The adequacy of the resource materials is a matter of judgment subject to influence by the extent of available developmental funds and other factors.

Task Analysis

Robert B. Miller (1962), in his discussion of task description and task analysis, provides little comfort to those field practitioners who must apply the techniques of the behavioral sciences to the development of instructional programs on a budget seldom comparable to many of the military operations. Miller states;

> The step from task analysis to specifications for selection and training cannot be made directly. Instead, the psychologist must first engage in a process of systematic analysis of the behavioral implications posed by the statement of physical task requirements.

Miller also pointed out that;

> Task analysis at present is a heuristic description of activities at the functional interface of the human operator and the objects and environments with which he interacts.

Furthermore, Miller places the clinical psychologists in a rather tenuous position by admitting;

> The source information to the task analysis is task requirements information plus all that is known and much that is conjectured in the full area of experimental psychology. This is a tall order and invites much randomness.

Butler (1967) defined task description as a list of job activities couched in essentially physical terms in contrast to task analysis which determines the knowledge and skill requirements of the job. A systematic analysis of the covert and overt behaviors with a careful charting, as advocated by Gropper (1969) of the stimulus-response connections, may be necessary if programmed type instructional materials is an objective and the major focus of learning activity. (It is said that the consequence of a response acts as feedback and stimulus for the next response in the flow of behavior.) Butler however, points out that there is no clear line dividing the descriptive and behaviorally analytic activities. Where such procedures must be applied, the

AIR Handbook on Training Development (Gropper and Short, 1969) is recommended. Again, any decision to apply such a process should be made on a job task by job task basis after a careful consideration of available information, funding requirements, and other factors.

Application of rigorous task analysis techniques by clinical psychologists is usually performed for the purpose of building programmed instructional materials, frame by frame. Since Project ABLE and similar operations have little need to undertake such programmed instructional materials development, the necessity of micro analyses of behaviors is questionable. Terminal performance kinds of statements of objectives which can be structured in the form of Criterion Checklists have proven to have considerable merit in the type of instructional systems being designed by Project ABLE. Thus, the ABLE Criterion Checklists such as those included in Appendix D are evolved from a task description process.

One major problem confronting researchers in the task description-analysis process is the extent of malpractice in service occupations such as automotive and television repair. The automotive repair and service industry, for example, has been under Congressional investigation for practices considered unethical and dangerous to the safety of the public. Consumer complaints are mounting in many areas. Here, clinical analyses and interviewing techniques may not produce appropriate descriptions of job standards and criteria. Therefore, special emphasis must be given to equipment warranty standards, equipment specifications, repair instructions, and the various technical and service type manuals available during the development of statements of performance.

There are four generally accepted categories of task description and analysis processes. They include:

1. Content
2. Simulated
3. Interview
4. Observation

A content analysis is a process whereby available instructional materials such as textbooks are used as the primary source of information for the derivation of behavioral objectives. Many authorities agree that the content analysis approach is the worst possible way to develop instructional objectives.

A simulation process can be accomplished with the type of procedural manuals described in earlier paragraphs along with equipment instruction documents, repair standards and specifications, etc. Depending on the complexity of the task, the simulation could be performed with or without the replication of the actual situation and environmental conditions

The interview approach frequently involves the use of prestructured instruments with much frequency data collected through a question-answer process. Often times, such instruments are used as mailed questionnaires. Employers, supervisors of persons undergoing investigation, experts, teachers, and others, in addition to the population being analyzed, can be involved at various levels of information collection. This method is often used to validate job tasks, job conditions, or job standards through a frequency count of information collected during simulation or observation.

Observation methods of task description and analysis are usually associated with the more rigorous clinical type of analytical orocess. The technique usually requires the services of trained clinical psychologists. However, Gropper and Short (1969) have a package designed to train personnel in the development of materials through a behavior theory-based training technology.

The methodology of task description and task analysis will be determined by a number of conditions. For example, funding limitations, availability of trained personnel, information availability by job task, nature of the job or job level (i.e., low level versus a high sophisticated technical job or a non-critical versus a critical job where lives of people are to be considered) must be taken into consideration. Furthermore, the intended use of data and information with respect to instructional materials development will be a major determiner of not only the methodology

but the degree of rigor to be applied. Past ABLF development followed use of simulation and interview analysis techniques.

Validation of criterion measures evolved as a result of the task description and analysis process while a subject of earlier sections, remains a concern. Alexander Astin (1964) in his review of criterion-centered research states;

> It should be clear from the preceding discussion that the only method for "validating" a criterion measure is a logical analysis of its relevance to the conceptual criterion. Once the criterion performance is selected, it has, by definition, validity.

Astin then pointed out that;

> In the final analysis, some judge, whether it be the investigator himself or a panel of "experts", must decide how relevant each element is to the conceptual criterion.

The procedures recommended throughout this report should provide for effective review of the relevancy of the criterion measures. Adjustments for errors in the research, and adjustments for changes in the technology of job practices, should be possible through the corrective feedback mechanisms which provide the regenerative or self-renewing features of the instructional systems development process.

FORMATIVE EVALUATION

Formative evaluation should result in program improvement. If this is the case, then much has already been said about such evaluative techniques. The PERT process, the extensive use of test/revise/retest cycles in program development, the various control documents and instruments, the student activity devices and others fall in the realm of formative kinds of development and evaluation. To reiterate, the distinction between the formative evaluative processes and the developmental processes are frequently not identifiable. The Project ABLE approach is more an engineering process in contrast to the usual educational curriculum research or scientific approach typified by experimental-control test groups and elaborate statistical analyses.

Criterion Referenced Assessment Instruments

The criterion tests or "performance evaluation sets" (modules) developed for Project ABLE, are intended to serve a number of important functions, including that of constituting a major instrument for formative curriculum evaluation. The general format of the modules and the method of application was described in previous sections (see also, Appendix D).

Robert Glaser and D. J. Klaus (1962) have provided one of the major works on proficiency measurement. They defined proficiency measurement as the assessment of criterion behavior--the determination of the characteristics of present performance or output in terms of specified absolute standards of quality. They state:

> Measurement is only possible on the basis of specific, observable events. Much as it might be desirable to do so, the covert thinking and planning often assumed to to precede overt actions cannot be investigaged directly. A primary concern in the development of proficiency measures is the development of test instruments which elicit observable responses appropriate to the purposes of measurement.

Glaser and Klaus further point out that criterion-referenced measures involve a comparison between system capabilities

and individual performance. They then contrast norm-referenced measures to criterion referenced measures, and state:

> Norm-reference measures, on the other hand, compare the performance of an individual with a sample of other individuals. The standard for criterion-referenced measures may be either minimum system requirements or maximum system output. The standard used with respect to norm-referenced measures depends on the average and dispersion of the performance of a group of similar individuals.

Related to the minimum and maximum level of standards, according to Glaser and Klaus, is the continuum of skills:

> Underlying the concept of proficiency measurement is a continuum of skill ranging from no proficiency at all to perfect performance. The degree to which his proficiency resembles desired performance at any specified level is assessed by criterion-referenced measures of proficiency.

In the Project ABLE approach, the continuum of skills and the assessment of such skills is keyed to entry levels of the various jobs in the occupational family hierarchy. Undoubtedly, the research of Glaser and Klaus (1962) influenced such a design. They concluded that:

> When used in this way, the term "criterion" does not necessarily refer to final on-the-job behavior. Criterion levels can be established at any point in training where it is necessary to obtain information as to the adequacy of an individual's performance. Many jobs, for example, involve several grades or levels of skill. A machinist can be categorized as an apprentice, a journeyman, or a master at his trade. The specific behaviors implied by each of these levels of proficiency can be identified and used to describe the specific tasks an individual must be capable of performing before he achieves one of these skill levels. It is in this sense that measures of proficiency can be criterion-referenced.

Important also to the ABLE design is the fact that:

> Proficiency measures which reflect a continuum of attainment usually imply cumulative levels of achievement, in that a master machinist is also proficient at the tasks required at the apprentice and journeyman levels. (Glaser and Klaus 1962)

Important then, to the instructor and developer in the design and application of ABLE modules is, as Glaser and Klaus point

out, the fact that:

> Measures which assess performance in terms of a criterion standard thus provide information as to the degree of competence attained which is independent of the performance of others.

Thus, in the ABLE learner-centered programs, particular care must be exercised by the instructor and developer to avoid the kinds of measurement which result in ranking of students, grading or assessment by the "curve" or other such comparisons. It is the specified criteria provided in the Criterion Checklist against which students must be evaluated.

The "backbone" of the ABLE performance evaluation modules is, therefore, the detailed breakout of the behavioral objectives and performance items in the form of a checklist. This has proven to be a practical and functional means of structuring the observations necessary to make the required judgments and decisions. Again, such judgments and decisions must be carefully based on the established standards and criteria--this is a critical aspect of the methodology and program.

It should be noted at this juncture, that probably the two most popular methods for quantifying judgments are by the use of rating scales and checklists. However, the "halo" effect and other forms of contamination have long plagued the use of rating scales. Project ABLE has found the dichotomized checklist items easier to construct and more readily accepted by instructors and students because of ease of use. Sophisticated weightings may be more appropriate at the high level technical occupations but are not likely to be of significance in operational efficiency at the lower job levels typically serviced by vocational education.

The Project ABLE Criterion Checklists were influenced in design and construction by the "critical incidence technique"* pre-

*A critical incident in one sense could be described as an activity or action which was either very effective or very ineffective to the task being performed. It could be some decisive incident which resulted in highly successful performance or perhaps a minor or major disaster on the other end of the dichotomy. In any case, an incident must describe something a person can or must do.

sented by Flanagan (1954). Glaser and Klaus (1962) further elaborated on such procedures:

> A checklist itemizes the specific behaviors which have been found to be "critical", in that they distinguish between effective and ineffective performance of the task (Flanagan 1954). The observer then has the responsibility of detecting the presence or absence of these specified events rather than having the responsibility for judging the overall proficiency level.

The critical incidence technique is frequently applied by A.I.R. researchers and curriculum developers. Detailed procedures for use of this technique are provided in a recent A.I.R. publication by George L. Gropper and J. G. Short (1969).

The Criterion Checklists, as a part of the Performance Evaluation Set, are designed to serve a number of essential instructional and evaluative purposes. (Note the interrelationship of functions in instruction, student evaluation, formative curriculum evaluation, and summative curriculum evaluation.)

The Criterion Checklists

1. provide the basic instruments for evaluating and modifying the behaviorally stated performance objectives. This includes verification of standards, conditions and criteria. It should make easier, the adjustments for periodic changes in the technology and job requirements.
2. serve as the basic research instruments for program validation. Such instruments should also prove valuable in comparing graduates to the general trade employees, comparing graduates to students from traditional or conventional programs, etc.
3. can be used by industry to evaluate employees on the job for any one of a number of purposes.
4. provide an instrument for evaluating and recording data on student performance.
5. provide a set of standards for the student. From these the student can determine what it is he is expected to do and the criteria against which he will be evaluated.

6. provide for the student, a quick means of reviewing (at a later date) the job standards.
7. provide the student with documented evidence of his capabilities and experience. This could be of value in job seeking.
8. provide guides for structuring and organizing learning activities. Furthermore, the checks can pinpoint areas where practice or additional instruction is required.
9. serve as guidance and data collection instruments for the purpose of analyzing individual or group progress and problems.
10. provide an instrument for assessing retention both during the course and after graduation.
11. will be of value in pinpointing revisions required in not only the learning materials but the performance evaluation skill test section.
12. can be used as either a pre or post assessment--with or without the skill test sections (depending on the time available for observation and supervision).
13. becomes a new student progress reporting system which, when used with the Occupational Readiness Record (see Figure 5), will replace traditional grading methods.
14. are compatible with most CSI and CMI systems (computer supported and computer managed instruction.)

In short, the Criterion Checklists became the major instruments for student evaluation, the major instruments for regenerative formative curriculum evaluation and the major instruments for summative curriculum evaluation--irrespective of the form of the instructional package or materials or the teaching-learning methods applied. Such emphasis on student performance measured against the job specifications as the primary source of corrective feedback would seem most crucial to a functional regenerative evaluation process.

Self-Scoring Response and Feedback Devices

The requirements of the regenerative formative curriculum evaluation process necessitates various data gathering procedures for corrective feedback. Much information must be processed quickly, easily, and economically. Furthermore, the nature of the program of individualized instruction for Project ABLE, with its extensive information requirements on student progress and performance, has created a special set of problems for the curriculum developers and instructional staff. As was pointed out in previous sections, much of the data and information requirements for the ABLE instructional and student evaluation program were identical to the data and information needs for formative curriculum evaluation. Again, functional dual-purpose instruments and procedures were found to be critical in the face of budgetary limitations, paper handling problems and staff cooperation. One such instrument, (see Figure 14), when used with the performance evaluation units, was found to be uniquely appropriate and flexible for Project ABLE operations.

Many factors are to be considered in the selection and use of self-scoring response and feedback devices.

1. The evaluation and instructional systems must have devices which provide immediate feedback, item by item, in every instance where feedback is possible on test questions and training aids (i.e. the identification of the defective spark plugs). This becomes not only an essential evaluation aid but a highly efficient and effective learning aid.
2. The system cannot place any out-of-class test grading commitments on the instructional staff. Furthermore, the instructor cannot, and should not, be required to grade any tests during periods of instruction (not possible where written responses, verbal responses, etc. are required). He only views the results and makes recommendations on the basis of his analysis. His professional responsibilities as a director of learning will leave little time for clerical chores. In fact, the number and frequency of evaluations, without self-scoring aids for the student, would

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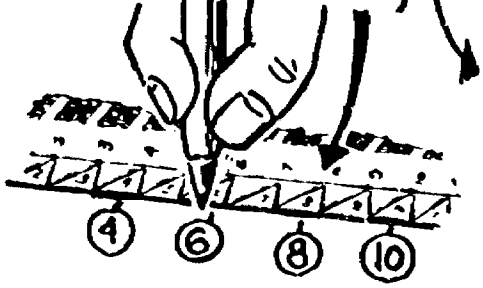
SCORING DONE BY STUDENTS- NOT INSTRUCTORS

MARKS MADE BY STUDENTS ON EDGE OF CARD IDENTIFY ITEMS-OF-DIFFICULTY...



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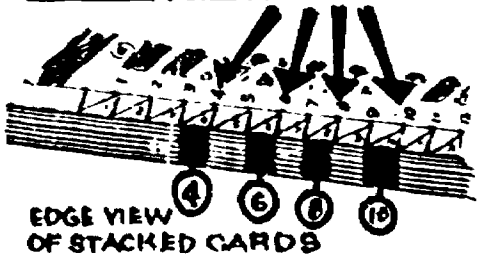

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Item of Difficulty Mark

QUESTION NUMBER	ANSWER OR TUTORIAL FEEDBACK (a)	(b)	(c)	(d)	SCORING POINTS
1					3
2				T	3
3		T			3
4			L	T	2
5	T				3
6		L	T	H	1
7			L		3
8	H	H	E		1
9	T				3
10		E	L	T	1
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					23

QUESTION NUMBER	ANSWER OR TUTORIAL FEEDBACK (a)	(b)	(c)	(d)	SCORING POINTS
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					

P.I. No. 2-11

Item of Difficulty Mark

TTAS-8X

leave the manager with no time for tutoring. Actually, the pilot programs would have been scrapped without such devices.

3. There are definite teaching advantages in giving frequent and short tests rather than the infrequent and longer ones. And, of course, the ABLE system has attempted to incorporate such techniques in both the instructional and evaluative systems.
4. Difficulty levels for each response item must be easily and quickly assessed not only for each student but for group analysis.
5. Ease of item analysis for use with each student is essential.
6. Ease of item analysis for the test groups as a part of formative evaluation.*
7. The device must be easy to use, mobile, and preferably disposable because of the grease and dirt conditions typical to most vocational shops. Again, during the time students are working with equipment, they will also be required to handle the evaluation or instructional module (usually on a clipboard). Computer consoles and various types of multi-media automated equipment (some are available with automatic response and feedback features) may be prohibitively expensive and too cumbersome to handle. Consider, also, the fact that most ABLE instructional and evaluation activities are to be designed for flexible use with either live equipment (e.g. customer vehicles) or shop training aids, mock-ups, and simulators. Also, the variety of instructional materials and methods possible, demand considerable flexibility.

*Traditional indicators of item effectiveness, according to Popham (1969) can be very misleading in mastery type learning situations. It is necessary to examine the raw data and to take into account factors related to safety, group job experience, instruction applied, pre or post test application, etc.

8. The cost must be low and within the means of most public school systems. (The cost of the response card for the various ABLE programs has been estimated at one dollar per student per semester. This cost is small compared to other less beneficial educational expenses.)

In the opinion of the ABLE research staff, the learner-centered programs could not function as designed (and be in keeping with the stated objectives of ABLE) without such aids. Furthermore, effective program and student evaluation at an acceptable cost, could not be possible. Note again, the interrelationships possible through the use of such aids between; student evaluation, instruction and learning, formative curriculum evaluation, summative curriculum evaluation, and overall project evaluation.

Validation of Objectives

Empirical validation of the objectives with the aid of the Criterion Checklist instruments must precede the development of the skill test section. Again, the major guidelines must be the job entry level requirements. Depending on the nature of the occupational family and job level, this could range between 30 days and 6 months. For example, the researcher may establish a guideline of an equivalent set of skills and knowledges common to those exhibited by employees who have been on the job for 30 days, for the lowest level job in a family cluster and a one year (or more) guideline for an occupation at the technical or skilled trade level.

The objectives must be validated against a trained and competent population--and this may present some problems. Some service areas such as TV repair trades and the automotive repair industry have been subjected to severe criticism for malpractice. The automotive repair industry has been under Congressional investigation for service practices which are not only unfair to the consumer but a threat to the public safety. With this in mind, the identification of job standards and conditions become a very important consideration. Therefore, the more valid and reliable resources for validation (or verifica-

tion) of behavioral objectives may be warranty standards, engineering specifications, instruction pamphlets, technical manuals, and service guides for the various kinds of equipment or processes most persons must work with or around. Such an approach must, of course, be related to the guidelines established for entry level skills.

The Criterion Checklists can be used as questionnaires or as instruments for structuring observations. The instruments should be submitted to employers and superiors of those persons typical of the occupational group being analyzed for job standard verification. Of course, the instrument is also tested against persons working successfully at the job entry level designated. Any discrepancies in the data comparisons between the two groups should be given careful scrutiny. Discrepancies with technical specifications should be a special cause of concern. Research techniques and statistical procedures will be dependent upon sample size, complexity of the occupation, and available funds.

Criterion Test Construction

In their present form, the performance evaluation sets or modules incorporate both an objective paper-and-pencil section and the more functional "hands-on" performance or skill test. The skill test requires the employee or trainee to perform specific tasks under the conditions and to the standards specified. (There will be instances where this may be most difficult and inappropriate under training conditions. Other alternatives are available.) Extreme care must be given to the design and testing of such instruments since the entire developmental process can stand or fall on the efficiency and effectiveness of the performance evaluation modules. The paper-pencil items have limited value and their appropriate application is often obvious. Simulators, mock-ups, and other aids have a special place in the programs described since many of the evaluation conditions cannot be left to chance through traditional customer-type repair of service situations typical of the majority of vocational training programs. It is at this stage of development where the developmental methodology of successive tryouts and systematic

testing become critical as research techniques.

The development of the paper-pencil items must follow well established criteria for the preparation of tests using multiple choice, matching, true-false, completion, essay, short-answer, graphic, problem-item, and others (some of which are difficult to key to self-scoring cards). However, validation of such items will not follow those techniques established for norm-referenced test construction.

The ability to structure and manage the skill-test situation will hinge on shop operation and organization, tool control and security, effective training aids (mock-ups, simulators, samples, etc.), the use of self-scoring feedback devices, appropriate instructor stop-checkpoints, and other factors. This is an engineering-management problem in the design of a kind of quality control instrument. Therefore, the criterion-referenced instrument must be comprehensive, valid, reliable, objective (relatively free of bias by the scorer), standardized, economical AND practical to use. In plain, simple terms, it must work. Here, competent technicians, knowledgeable in course content and laboratory practices, will be required to work the "kinks" out of the operational activities.

In general, the skill test should be as realistic and representative as possible. No more structuring than is absolutely necessary need be applied. Some prompting is unavoidable as the student responds to various items keyed to the response card. Furthermore, the Criterion Checklist, against which the student will be evaluated, and the instructor checkpoints, will be a source of cues. Connected sequences within the skill test will present some problems for the test designer. Again, only the essential information should be presented. On the other hand, structure is required to give reliable and standardized instruments. In the more familiar standardized type of paper-pencil tests, each item usually represents a discrete response and has little influence on subsequent responses. However, in the skill test, there will frequently be an interdependence of sequenced responses. A chaining of associations frequently takes place

and this may be difficult to eliminate. For example, if item X is missed, the student may learn the right answer from his response card, his instructor, a fellow student, or just the experience of having made the error. This may give a clue for the next major step or test item. The test/revise/retest cycles will be helpful in the building of instruments which are reasonably free of the effect of the interdependence of sequenced responses.

The mock-ups, simulators, samples, and various aids incorporated in the ABLE programs should be given additional emphasis because of the important role such devices play, not only in skill testing and evaluation, but in instruction and learning. With such aids, it is often easier to isolate for measurement that portion of the behavior basic to success in a specific task. Equipment, cost, management and supervision become major factors. With the use of mock-ups safety and trouble-free operation for consistency and reliability in equipment can be better assured. Malfunctions can be more easily induced or repaired (e.g. a throw of a switch) with certain types of simulators or mock-ups. (Graphic illustrations can sometimes be substituted for portions of skill assessment.) Parts can be eliminated which interfere with the performance or skills critical to the tasks being taught or evaluated. A great deal of time can be saved for both the student and teacher, which will enable more training and evaluation in a shorter period of time (efficiency and cost effectiveness). With the mock-ups and simulators, procedural sequences can be more easily structured and controlled for valid and reliable assessment. Corrective feedback is more easily programmed to the benefit of both the student and the evaluator. Many other advantages could be listed.

A number of factors are to be considered in the construction of performance assessment instruments. For example, Glaser and Klaus (1962) described three major types of sampling errors to be avoided:

> First, is the undue inclusion of test content selected because of ease of measurement--that is, items which are chosen principally on the basis of their simplicity of preparation, presentation or scoring. Basic vocabulary,

definitions, locations, and so forth, are often used in proficiency measurement while the evaluation of involved motor skills and the application of principles to actual system problems may be avoided.

Second, is the error in sampling which occurs when the test instrument is derived from course materials rather than from the objectives of training.

Third, is the error that results from sampling a universe of behaviors which fails to represent the behaviors required on the job. This type of error may result from the inclusion of skills which do not actually contribute to job success or from the exclusion of aspects of job performance not recognized as important in task proficiency. Perhaps the most common example of this type of error is the emphasis usually given to the measurement of job knowledge and theory in instances where this information may not be relevant to actual task performance.

The Job Corps Instructional Systems Development Manual (Butler 1967) includes a skill test construction checklist (as modified below) appropriate for the design of ABLE instruments. In reference to the breakout of behaviors in the Criterion Checklist, such questions must be answered and resolved:

1. Have you stated as accurately as you can, what you want the test to measure?
2. Is the skill being measured representative of that indicated in the training objective?
3. Do you want to use actual equipment or would some modification of the actual equipment be better?
4. Will the tools, equipment, and materials being used in the test, permit the trainee to display the skill being measured?
5. Are you primarily interested in evaluating the result of the trainee's effort, the product; or in how the product was achieved--the process?
6. Considering the skill being measured, what factor (speed, accuracy, or errors) should you use?
7. If the test yields more than one measure of performance, how can these subscores be combined and weighted?

8. If the test yields only a total score, is this score meaningful, or is it composed of inconsistent parts?
9. Is the score compatible to the ABLE system?
10. Will the skill test measure abilities that could be measured as well by a graphic presentation or a written knowledge test?
11. Are there minor activities which can be omitted from the test or from the scoring?
12. Do the directions make it clear to the trainee and the evaluator exactly what is to be done?
13. Will each trainee tested face the same initial situation?
14. Are the demands of the test job-like?
15. Is the trainee told only what he should do, or is he told how he should do it?
16. Are all aspects of recording and scoring performance as objective as they can be made?
17. Do the directions tell the trainee how he will be rated (accuracy, speed, errors)?
18. Can persons from the trained population complete the test satisfactorily?
19. Has the test been tried out to determine the range of scores possible and to determine the minimum passing score?

The test/revise/retest cycles during the formative stages of the ABLE process will provide answers and solutions for many such questions.

Validation of Criterion Tests

Again, it must be emphasized that criterion referenced tests are not used for the purpose of making discriminations between students. Criterion tests are intended as a measure of the effectiveness of the instruction or the capability of an employee or student to perform to a predetermined set of absolute criteria rather than relative to the achievement of other persons. Butler (1967) has pointed out that criterion referenced testing separates the trainees along a time scale while norm-referenced test-

ing separates the trainees along a proficiency scale. Therefore, considerable flexibility may be permitted in the time taken to reach proficiency but little latitude is necessary in the level of proficiency. The criterion test must be designed to treat everyone the same. One must provide the same conditions, the same opportunity, the same givens, and the same set of proficiency standards.

As with the objectives, the criterion tests must be validated against a representative trained population. (Similar problems to those described in the validation of the objectives, will need careful attention.) The entry level guidelines in terms of length-of-time on the job, must be carefully controlled. In some institutions, it will be possible to find subjects from a group of advanced students who have worked in such jobs (preschool, after school, or summer employment) and can adequately meet the entry level guidelines.

Through this stage, it will be necessary to cycle (test/revise/retest) each module several times with groups of two to five persons. A case study method will be necessary with constant observation of student or employee activity and behavior. (It should be understood that during the process of testing and verifying criterion modules, that the objectives will again undergo verification.) From experience, two to three cycles will be required for each module before field testing can take place. However, as Glaser and Klaus (1962) point out:

> The validity of a proficiency test is primarily a function of the accuracy with which the task has been analyzed and the skill with which the items have been selected.

It is recommended that the easiest and shortest modules for the more simple job tasks be tested first. Quick turn-around and an opportunity "to get things moving" will contribute to a more efficient and effective organization. Problem solving can then take place on a small and manageable scale. Staff training can be accomplished under more feasible conditions. Furthermore, a general "debugging" of most operational, management, and research problems will be more easily handled.

To complement the tryout against the experienced groups, the modules should also be tested with an untrained population typical of those entering the instructional program. The comparison will provide much valuable information including that related to reading level, terminology, safety, organization, and of the management of a host of unforeseen difficulties and problems. Of course, the test will likely confirm the need for instruction but it will also reveal areas and items which need not be included in the instructional program. In any case, the criterion exam should discriminate between the trained (or experienced) and the untrained populations. In general, the trained population should do well. However, problems of malpractice (especially in unregulated trade and service occupations), and the acquisition of widely practiced unsafe work habits, will require a careful analysis of all aspects of criterion test results.

Within each module, it is expected that experienced trainees will get approximately 85% of the test items correct on validated instruments. During the validation stage, the instruments should be modified until such a standard can be attained. Furthermore, the same criteria should be applied to each item within each module. (The value, 85%, is a widely accepted standard in criterion test development.)

Test items on which less than 85% of the experienced population score correctly may be poorly written, not relevant to the objective or task, not appropriate for the job level or length of time on the job, an inappropriate type of item or in the wrong form for the key point to be assessed, etc. Failure to reach 85% may indicate some problem areas in the training. On the other hand, the untrained sample would be expected to score below 85% on most items. Since the exam should discriminate between the trained and untrained populations, high scores by the untrained group should indicate the need for a careful analysis of the test items. Care should be exercised when working with items related to safety--a more rigorous standard may be necessary, especially when analyzing results for individual guidance.

The self-scoring response devices, such as the sample included in Figure 14, will also enable the identification of level of difficulty for each item. The card will also allow the keying of many training aids to the self-scoring response device. (For example, a selection of resistors which must be tested in order to identify the defective item. In this case, the various resistors would be labeled a, b, c and d with the correct response being keyed to the coding format for the response card.) This is of critical importance since alternatives to the paper-pencil items become easily managed. Ease of item analysis through the use of these cards is evident. Without the self-scoring devices, evaluation and analysis of results might become impossible due to costs and time constraints.

Student and Instructor Reaction Forms

It should be noted that the instruments included in Appendix I are time consuming to administer and evaluate, and are costly to process. Furthermore, premature evaluation and data collection is to be avoided. Students and teachers alike will resist such paper work and tend not to be careful in the replies being requested. However, if administered appropriately and timely, the information from such forms could be quite helpful during the cycling process. The reaction forms are designed for use with both criterion evaluation modules and instructional materials.

Generally speaking, the reaction forms should not be administered during the early test/revise/retest cycles, but can be used by the researchers for the structuring of observations and interviews. However, when ultimately applied, should any serious problems begin to occur with student attitudes, discipline, learning progress, etc., such paper work tasks must be among the first activities terminated. (In such an event, the only alternative may be through structured interviews and observations--a costly process.) The instructor should complete a reaction form for each module. However, students should not be expected to react to every unit completed. Four or five responses (from a group of 20 students) per unit should be adequate. This can be

structured easily by random assignment.

The field test is intended to gain an adequate N in terms of population size. This should also enable individual module and program analysis under various settings and conditions. It is an important part of the cycling process required for system development. However, it will likely be necessary to pre-test individual modules at each field site for the purposes of training staff, developing the required training aids, structuring course and shop management, etc.

To place evaluation in proper perspective, it must be remembered that the major instruments for evaluation (and validation) have been structured in the form of Criterion Checklists. The skill test sections and the self-scoring feedback devices are important components of the assessment modules. It is felt that such an approach will enable a functional operational regenerative evaluation system with relevant corrective feedback--the emphasis being placed on continuing program improvement.

SUMMATIVE EVALUATION

One of the major goals of Project ABLE is to apply newly developed educational technology to the design, conduct, and evaluation of vocational education. The purpose of the research was not the generation of new knowledge but the appropriate application of tested techniques and methods. The major emphasis then, must be on the formative aspects of the developmental and evaluative processes.

The major instruments have been identified and will serve adequately both the functions of formative and summative evaluation. For example, comparisons of ABLE to non-ABLE students through experimental-control group testing would require use of the Criterion Checklists and the performance evaluation modules for performance assessment. These would constitute the major instruments for summative kinds of evaluations. Of course, the same instruments will also be used for the follow-up of ABLE graduates (in the work force) for purposes of validation and corrective feedback for program modification. As stated earlier, summative type evaluation should not take place until the cycling and field testing of programs has advanced to a stage where reasonable success can be assured.

It should be reiterated that the comprehensive educational system envisioned for ABLE may not be operational in a form suitable for summative evaluation, for many years. Project ABLE and other organizations will contribute components of that "Grand Design" which will in turn be validated and evaluated in an appropriate manner.

Carver (1970) recommends the survey of existing measuring instruments to see if any are relevant and to use existing devices, if relevant, to save valuable time and effort. Project PLAN (American Institutes for Research and Westinghouse Learning Corp.) is presently working on the evolvement of a more comprehensive scheme. Dr. John C. Flanagan, Chairman of the Board for AIR, presented a paper entitled, "Evaluating a Comprehensive Educational System" (January 1970) at a recent seminar sponsored by AIR

on Evaluative Research. This has important implications for Project ABLE because of the many similarities between the two projects with respect to the technology to be applied and goals of individualized instruction.

Two major functions of the evaluation activities being conducted by Project PLAN were:

1. The extent to which the project and the system has achieved its goals and intents.
2. The extent to which the individual goals (students) have been achieved.

The steps (overlapping) were:

1. Definition of goals or functions of the system.
2. Design and implementation of the system.
3. Development and application of procedures for collecting relevant information.
4. Analysis and interpretation of the data.

An analysis of the paper will reveal many key elements of the Project PLAN comprehensive evaluation system basic to the process being applied by ABLE.

A recent team review of Project ABLE activities sponsored by USOE and under the chairmanship of Dr. Melvin L. Barlow, made recommendations for comparison of ABLE students to non-ABLE students on the basis of; (1) achievement, (2) attitudes toward school, (3) attitudes toward the subject and method of instruction, (4) attendance, and (5) drop-outs. Also; (1) jobs obtained, (2) jobs held, (3) jobs related to training, (4) job performance, (5) wages, (6) satisfaction with school preparation, (7) enjoyment of life, (8) citizenship, and other appropriate factors. Most such items fall within the realm of summative evaluation and should be treated accordingly. With this in mind, several major instruments have been identified (to serve such functions) for application at an appropriate time.

One of the major bench mark studies of vocational education was reported in the publication, "The Process and Product of T&I High School Level Vocational Education in the United States" (Eninger, 1965). The objectives of this follow-up study were as

follows:

1. To describe the essential dimensions of occupational, educational and other relevant experiences of a nation-wide sample of T&I vocational course graduates from the classes of 1953, 1958, and 1962.
2. To compare vocational and academic course graduates from the same schools and graduating classes in terms of post high school occupational, educational, and other relevant experiences.

In addition, the study provides data for three other objectives:

3. To determine the relationships between (1) school characteristics of curriculum, instructional methods, facilities, teacher personnel, student services and other relevant factors and (2) measures reflecting the post high school occupational and educational experiences of vocational course graduates.
4. To determine the relationships between (1) the characteristics of vocational course graduates as revealed by school records and (2) measures reflecting post high school occupational and educational achievement.
5. To determine the relationships between (1) measures of employment opportunity that characterize the region served by the school and (2) measures reflecting the post high school occupational and educational achievement of vocational course graduates.

Items included in the form used in the AIR Survey (See Appendix M) will provide much of the information related to the review team recommendations (and some of the stated objectives from the original Project ABLE proposal). Furthermore, most of the items have been included in Project TALENT surveys (Flanagan, 1964). The availability of well tested and validated instruments with comparisons of information on ABLE students possible to relevant bench mark data, must be given the utmost consideration when final plans are formulated for summative evaluation and follow-up activities.

An additional Employer Assessment instrument from the "Eval-

uation Plan for the Greene Joint Vocational School" (Rosenfeld, 1967) is recommended (See Appendix M). This instrument is a derivation from the earlier AIR study in vocational education. Several other forms are included which should complete most of the hard data requirements for summative and follow-up evaluation. It should be noted, however, that serious problems exist in follow-up studies of educational programs. Cronbach (1963) states:

> The follow-up study comes closest to observing ultimate educational contributions, but the completion of such a study is so far removed in time from the initial instruction that it is of minor value in improving the course or explaining its effects.

Project PLAN, in a report entitled "Classroom Behavior of PLAN Students Compared with Control Students" (Lipe 1969), describes procedures and data analyses which would be highly relevant to Project ABLE summative evaluation activities. Since some modifications of the instruments will be required, the Project PLAN staff should be retained (when such assessment becomes appropriate) for assistance. Training of classroom observers will also require Project PLAN assistance.

The effective integration of vocational and academic studies will require yet another set of formative and summative evaluative procedures. However, it is felt that little need be said in this manual about such future evaluative activities until; (1) the behavioral objectives and evaluative instruments for several vocational areas are available; and (2) the programs are operational; and (3) similar progress is shown in the tool subjects within the academic areas.

The flow chart provided in Figure 2 has important implications in this critical area of national concern--the effective integration of vocational and academic studies. Project ABLE was to have pioneered development in this area. However, recent cost estimates of 20 to 30 million dollars for the accomplishment of the major project goals will provide some indication of the size of the problem. A restructuring of national priorities with adequate financial support will be required to meet such obligations. In the interim, the completion of critical components

such as indicated in Figure 2, should enable early progress (in limited areas) of our ability to prescribe for individual students, his vocational and academic needs. The ability to prescribe those needs will advance concurrently with our ability to define goals and to evaluate success in achieving stated goals. And progress in this area will, as a natural outgrowth of the new educational technology, operationalize the concept of "accountability for learning results".*

*Independent educational accomplishment auditors, according to the Phi Delta Kappan, January 1970, are being employed by USOE to implement a learning accountability system as required by law. The goal is to make schools and educators responsible for the learning success and failures of their students. It is also hoped that the new concept will also introduce a type of cost effectiveness into the learning system. It is predicted that the accomplishment auditor will become as vital to schools as the fiscal auditor.

RECOMMENDATIONS

What Needs To Be Done?

Vocational and technical education is facing a critical need for instructional system development such as that characterized within the original goals of Project ABLE and groups such as the Council of the Great Cities Schools* and ES'70**. Briefly, the approach is based on the behavioral and related sciences with an emphasis on learner-centered educational processes. However, progress across the nation in the development of individualized instructional systems for vocational and technical education has been disappointing. Several vocational directors of Great Cities schools have cited curricula and curriculum development as their major problem area.

The technology now being applied on a limited scale with considerable success by Project ABLE is said to be of national significance. For example, Dr. Robert M. Gagné (presently president of AERA) found the rationale, training materials and testing procedures of remarkable and unusual excellence. He stated, "I should think the acceptance of this method by teachers and students would be well-nigh universal". Dr. William T. Kelly, Director of Vocational Education in Philadelphia wrote that, "It is imperative that some method be found to reproduce this material at a cost within the reach of school districts". Dr. Karl F. Dutt, Research Coordinator for the Eastern Northhampton County Schools in Pennsylvania, considered the approach to be an "ideal learning experience". Dr. John M. Recklitis, Director of Vocational Education for the Penn Hills School District in Pittsburgh, found one ABLE program to be, "second to none in the nation". Dr. William L. Hull, Research Specialist at the Ohio State Center for Research and Leadership Development in Vocational and Technical Education, stated, "This project

* A consortium of the twenty largest school systems in the country.

** Educational Systems for the 1970's. (Bushnell 1969)

(ABLE) may be one of the few in the nation which provides a living example of an innovative diffusion system in action at the local level". Similar reactions from publishers have stimulated plans for national dissemination of several programs.

Of national significance also, is the field testing of ABLE learner-centered instructional systems with disadvantaged students in Baltimore and Philadelphia. Such pilot programs have been scheduled for predominately all-black schools. Included is one group of 10th grade dropouts who have returned to school. Another program is focused on special education students with reading levels ranging in the low primary grades. Schools such as the Booker T. Washington High School (an ES'70 network member) in Houston and others have yet to be accomodated because of Project ABLE funding limitations.

It is recommended that two major tasks be undertaken with the objective of having a highly structured coordinated effort in operation for the opening of school, fall 1970:

I. Instructional systems (of the ABLE design) for the major job families should be developed, implemented, field tested and nationally disseminated. This development should take place in the major school systems of our metropolitan areas.

II. The application of effective management and evaluation techniques (again of the ABLE design) should be undertaken in the major cities of this country as an integral part of instructional system development and operation.

The need is well documented and of course, accomplishment of each of the tasks is dependent on one another. Naturally, the process must be financially desirable. The process must also result in early operational instructional programs. Indeed, the President, Congress, the profession, and the populace are demanding immediate visible evidence of quality educational products and programs. Accountability features through performance contracting will be a key factor. Assessment of project, programs, products, teachers and students must be an integral part of the process and the emphasis in assessment must be on continuing program improvement--a truly regenerative process with corrective feedback mechanisms.

Related to Tasks I and II is the need to accomplish field testing and dissemination of instructional systems presently under development by Project ABLE. These programs are Power Mechanics, Woods, and Electronics. Since only portions of the three job families have been developed, the advanced levels should be completed. More important, with respect to the needs of the large cities, is the same kind of development in many other job family areas, which should be undertaken immediately in each of the "partner" school systems--development which could, in turn, be field tested by members of the organization. Such demonstration areas should then become centers for the training of curriculum developers and teachers, and the focal point for national dissemination. This may be the only functional way of training curriculum R&D staff. And, this is likely the only way relevant teacher-training programs can be conducted--hands-on, under live conditions, through the kind of procedures advocated for the students (including use of performance standards and learner centered individualized instruction). Obviously, such exemplary demonstration programs would serve many functions, as do the existing ABLE instructional systems.

It should be noted here that the related academic courses may require additional research effort. However, this should not be the central thrust of a new proposal. Hopefully, other research groups will address this problem. However, until the behavioral objectives are properly derived for job family areas, little can be expected in terms of relevant and appropriate academic development. Note that at the present time most attempts at developing behavioral objectives for the academic disciplines focus on a content analysis methodology. This is said to result in the worst possible kind of instructional objective. An analysis of the behaviors derived from ABLE type task analyses should furnish the information needed to specify at least the related math and science needs for adequate job performance.

The guidance component is one other critical item in the "What Needs To Be Done?" category. However, the proposed project could not develop its own guidance program. It is planned that

the materials developed will be integrated within the ongoing guidance program of each school system. The USOE has invested heavily in such development. Organizations such as Project PLAN are working on student guidance programs and placing much emphasis on student career decision-making activities. Individual school systems should, therefore, utilize the best available resources. The job and task analyses possible from the proposed development would be most valuable to the guidance functions.

How Can The Tasks Be Accomplished?

No individual school system, sponsor, agency, industrial or private developer, or research organization could possibly accomplish all of the defined tasks. It is also unlikely that any one school system in cooperation with a research organization (such as the original ABLE operation) could make any sizable contribution of national significance to the curriculum needs in vocational education. The problem in the area of learner-centered vocational curriculum development is simple to define--inadequate resources. This would include the lack of a systematic application and concentration of available funds, and the inefficient use of available trained staff.

Furthermore, on a small and limited basis, the current method of curriculum development (teachers writing for personal classroom use) is not practical because of the lack of assessment, uneven quality, and questionable benefits from the high development cost. We can now accept the fact that a rather high level of funding is necessary for developing instructional systems. Such a level of funding can be justified only if the materials and systems can be used widely. Such replicability requires a high degree of quality control in the developmental process. Quality control cannot occur without proper and effective management and evaluation procedures. This is not possible without the direction of highly structured performance-accountability type contracts. Such contracts require experienced and competent research and management personnel to structure and implement the contracts. Effective policy direction is necessary, and expert technical advisors of national stature are needed to monitor de-

velopment and implementation. In short, the developmental effort must focus on system design analysis, management by objectives, technology of instruction, quality assurance and performance, and accountability contracting.

A proposed solution to these problems is presented in the following pages. The plan is based on the high probability that a cooperative approach by several large school systems with effective research support and management assistance would be able to gather the financial resources (Federal, State, local, industrial) to accomplish the tasks. From this base, each system would sponsor (i.e. with the kinds of funding now available as a result of changes in recent federal legislation) independent development in one or more specific job family areas. This would also enable a concentration of resources within each city and reduce the duplicated effort now taking place within and among such school systems. To illustrate, Quincy could reduce its usual curriculum development efforts in area X (since, for example, Baltimore or Philadelphia or one of the other large cities would be concentrating resources in that area) and divert its resources to the support of additional manpower in area Y. Widespread use, relevancy and applicability in the other cooperating schools, and on a state and national scale as field testing progressed, would be assured through the highly structured management procedures. This would be accomplished under the direction of a Policy Board (with the assistance of a Technical Advisory Board) through its project director and project coordinators. (See proposed organization chart, Figure 15.)

Funding support for the technical management team (project director and one research scientist per job family under development) might be available through one or more Federal agencies. Funding for secretarial services, frequent travel between the participating communities, communications, consultants, support for periodic Policy Board meetings, and support for regularly scheduled Technical Advisory Board services would be an appropriate Federal input. Of course, local and state options are available. On the other hand, vocational administrators from

PROPOSED ORGANIZATIONAL CHART

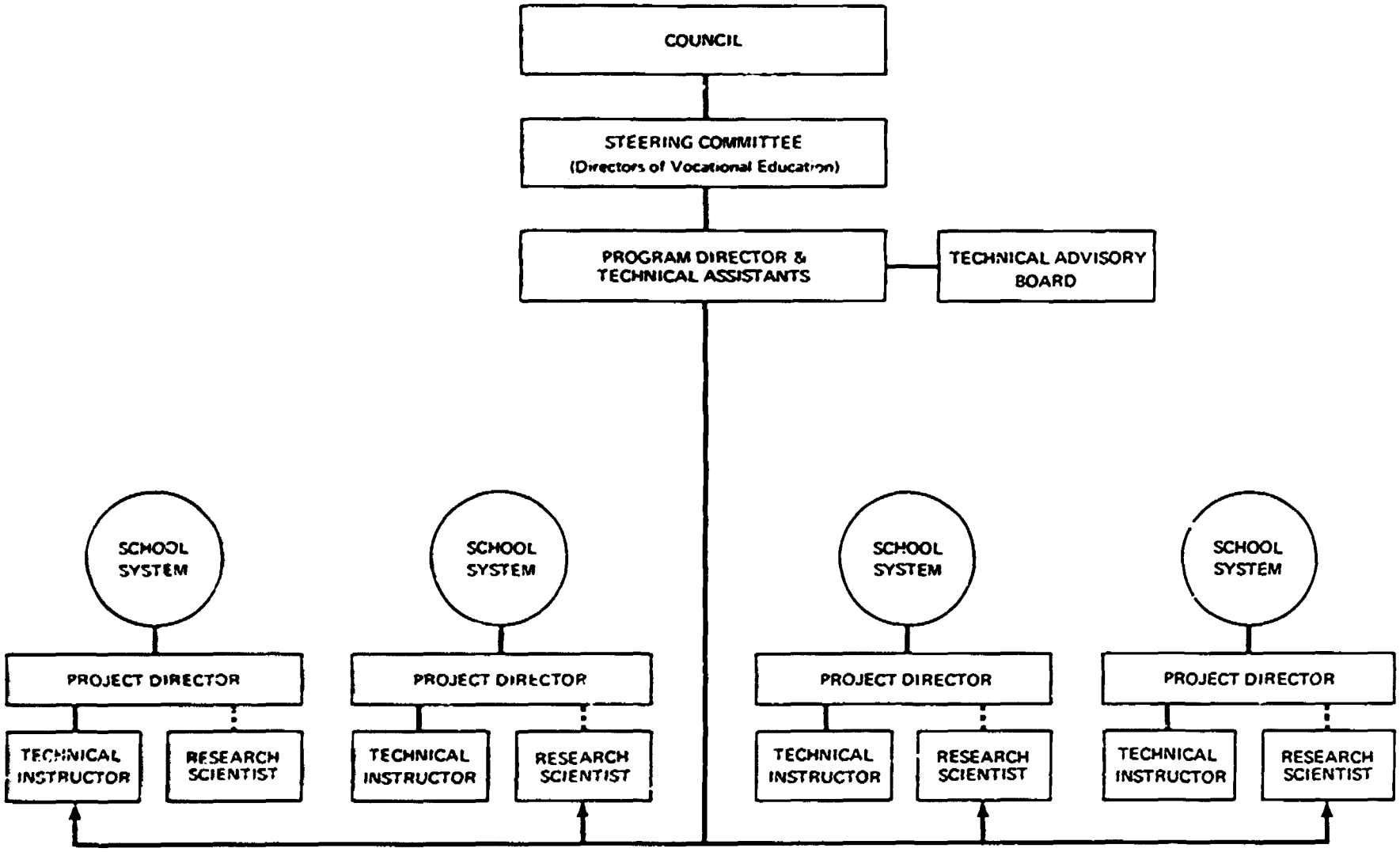


Figure 15

PLAN OF ACTION

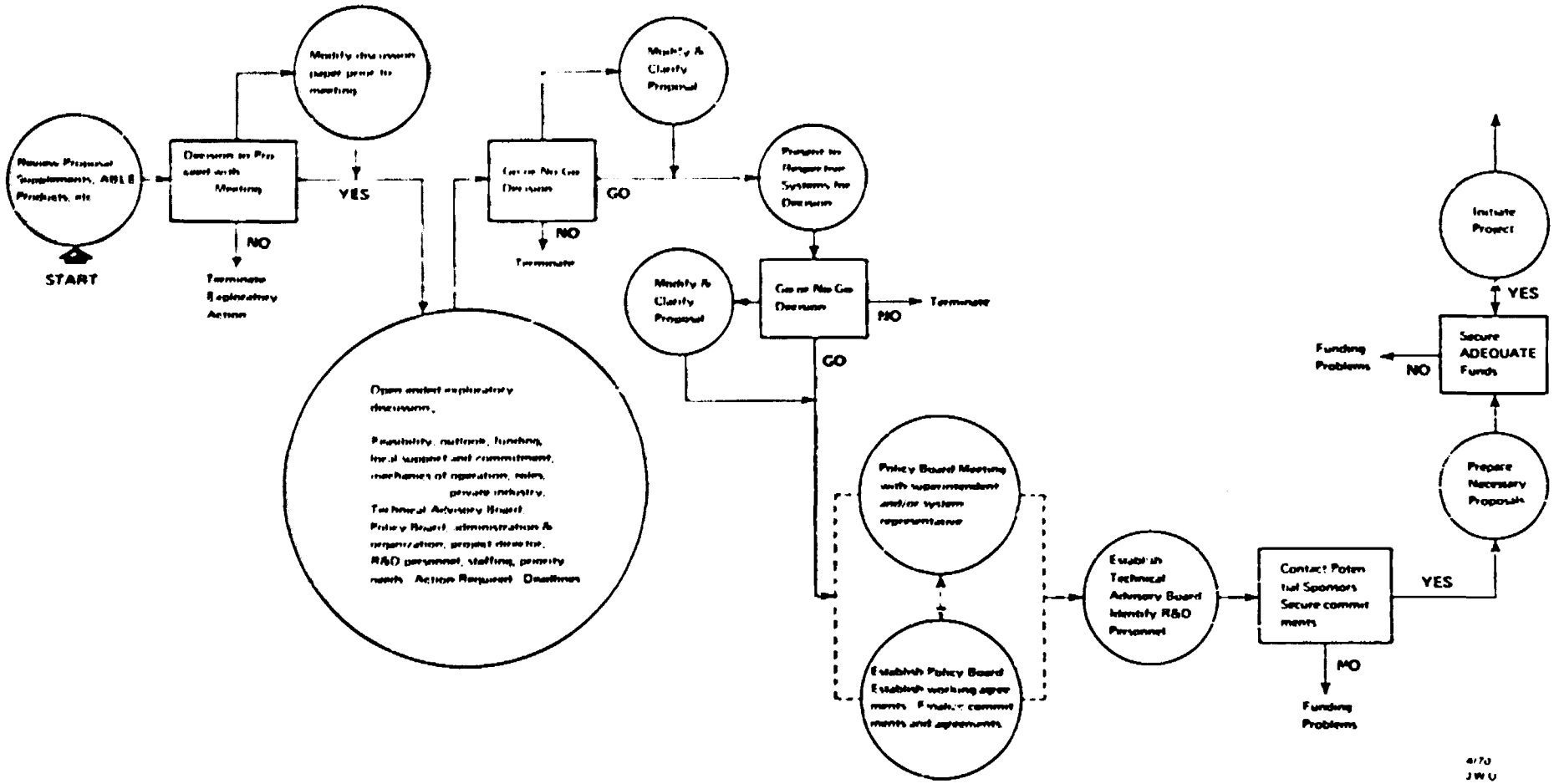


Figure 16.

several of the large cities have suggested sponsorship through a coordinating council. This could be accomplished by applying for funds now available to each member school from the respective states. Should fifteen or twenty of the large cities be involved, "membership" costs to each city would likely fall in the range of salaries listed for a school principal. It was also stated that more stability for long-term efforts could be assured through local and state governments with fewer "strings" attached.

A model proposal for use by each city could easily be prepared for submission to the respective states for the support of development in a specific job family. The partner school systems need not be involved in individual system proposals and no state funds need be shared (with the possible exception of shared support of the central management and coordinating team). However, the developmental and evaluative procedures would be centrally formulated and coordinated. This would be presented in a much more finished form than is the case with most proposals typically received by such states in the areas of curriculum development. The strong points of the proposal would be the system design features, management features, technology of instruction, quality assurance and performance, and accountability contracting with trained staff availabe to assist in the operations. Important also would be the availability of field test systems (other members and partners of the cooperative group of school systems) at no cost to the sponsor. Each participating school system would establish a demonstration center for local, state, and national dissemination for the job family under development. This would also be the center for the training of instructors and curriculum development support personnel. More important, the investment (through reciprocal activity in the other partner systems) would result in the early establishment of additional demonstration centers for other job family areas. This is a kind of "pay for one and get a dozen" bargain, and such proliferation of quality instructional systems at the "grass roots" level is a highly desirable outcome. Again, it is only through centralized coordination and quality control procedures with a numer of locally

initiated and supported developmental units, that the desired results and products would be guaranteed. Actually, the development would be in a way decentralized, in order to gain access to the student target population during the critical develop/test/revise/retest cycles of instructional system development process.

Proposals submitted to states by the respective schools would require local control of funds and the identification of a local project director who could also serve as the coordinator to the technical management team. State or local funding would be required to cover the usual project expenses, including reproduction of materials, communications, travel, etc. Of course, cooperating field test schools would be expected to pay for all materials received. (Project ABLE experience with the teacher-training sessions and material purchases for the Power Mechanics field test has shown a rather small expense for the cooperating schools.)

The effort required to complete the proposed development has been estimated at from four to five man-years per course-year, depending on the availability of job and task analysis information and behavioral objectives from organizations such as the military. In order to maintain a reasonable schedule, it is, therefore, recommended that each job family team include at least three to four members. (Of course, local coordinator-project directors could also function as writing and research team members.) The local director must be willing to share the team leadership with the research scientist in the developmental work. Good rapport and working relationships have been gained under such conditions in Quincy.

System teams for each job family area must include at least one full-time behavioral scientist/instructional technologist experienced in job and task description, derivation of behavioral or performance objectives, development of criterion exams, and program development for vocational-technical education. Since it is not likely that such expertise would be found within a school system (or in a position where adequate time could be diverted

to the proposed development), qualified individuals to fill these positions could be supplied by a research organization. This could also be accomplished through sub-contracting with individuals or organizations. In any event, every effort should be made to recruit such individuals from among the residents of the respective metropolitan areas.

The local system would provide three full-time content experts (trade experienced teachers) for each job family team. Again, state support and reimbursement is available. However, local school system funding should not be a major problem if some activity were curtailed in other areas. Such persons should have a commitment to individualized instruction and the application of the behavioral sciences typified by the goals formulated by ABLE and other groups. Demonstrated proficiency in curriculum development and in the writing of well-structured test instruments and learning materials would be essential. Proficiency in the development of "hands-on" shop instructional materials must be evident. Experience in the development of training aids is also important. Since there are a number of individuals with such capability in vocational and technical education, the problem becomes one of a thorough in-house talent search. Utilizing local talent, teamed with behavioral scientists, given adequate time and funds, under proper supervision, with efficient management techniques, should enable the meeting of conditions of a performance contract--a performance contract incorporating quality control and accountability for specified results.

One secretary per job family area should also be provided by the local school system (and again, state support could be secured). Student typists and clerical help would be necessary.

In Quincy, the housing of R&D teams in school-provided offices has resulted in significant savings on rental space and project overhead. More important, it places the developers near the site of the testing, which is to be accomplished module-by-module through test/revise/retest cycles. Office furniture, telephone service, library services, and various other functions which contribute operational economy, would be provided locally.

In short, the costs to each member system (should no Federal support be available for the central management functions) would be modest. Furthermore, each city would likely face only minor obstacles in securing funding for: (1) one research scientist assigned to the local team, (2) two or three full-time instructors from the local staff, (3) one secretary, and (4) miscellaneous project operating costs, including printing, communications, etc.

In summary, the major advantages of this proposed plan include:

1. The ability to spread costs among agencies, governmental levels, states, cities, and schools.
2. The ability to concentrate resources.
3. The ability to eliminate redundant activity and thus realize needed economies.
4. The ability to insure quality control.
5. The ability, through quality control, to derive disseminable products and replicable instructional systems.
6. The ability to provide many schools, through the dissemination of quality products, the means for dispensing with irrelevant and inappropriate curriculum development.

Additional Considerations

Policy Board. Equal representation among the cooperating schools would seem appropriate. Here, it is recommended that each school system provide one representative--the Director of Vocational and Technical Education. Several such organizations typically operate through similar steering committees. The Policy Board would provide direction and guidance to a Project Director supplied by the research organization. Nominations of individuals for the position of Project Director should be prenegotiated and approved through the Policy Board. Consultation with individual school systems on the hiring of research scientists would be necessary. Since the Federal government requires the identification of an agency for the receiving, disbursing, and approved accounting

under government audit of any Federal funds, the research organization should assume this responsibility as the Executive Agent of the Policy Board. (This is not necessary for Federal funds administered through the State. This can be managed by the city receiving such grants.) The Policy Board through its Project Director, would oversee all expenditures and receive a monthly reporting of all expenditures. (This is possible through a two to three page computer print-out which accounts for all expenditures.) Overhead rates for the administrative services of the research organization should be established by Federal government audit.

Technical Advisory Board:

The Technical Advisory Board should include two to four nationally prominent scientists considered to be among the most knowledgeable persons in the technology to be applied. Persons of diverse backgrounds or from various disciplines would not be needed because of the nature of the performance contracts. (The individual school systems could lend considerable breadth in the various disciplines at little cost to the program.) Regularly scheduled project review and advisory services should be specified as a condition of the basic contract. Such services should also include reports submitted to funding sponsors.

Dissemination. It is an established policy of the USOE to encourage the participation of private industry in the educational enterprise. Most major curriculum efforts have accomplished network or national dissemination through commercial publishers under the procedures established by the government (and very precisely supervised by USOE). In such cases royalties cannot be retained by the commercial producers and must be paid to the government. Only limited copyright privileges are awarded and all materials become public domain after a specified number of years.

Project ABLE has been seriously hampered without the aid of publishing technology in the preparation and printing of its curriculum materials. Furthermore, the cost of duplicating and short-run printing has been very expensive and time consuming.

Requests for materials by various school systems have also been a burden on the project staff and its limited budget. These are the kinds of services and contacts best assigned to commercial publishers. Such involvement of private industry usually results in quality printing, professional illustrations, and more and better multi-media aids. Such cooperation often leads to a considerable investment of private funds. Hopefully, such an involvement could accelerate the developmental process. It is significant to note that these kinds of arrangements are being actively promoted by the Federal government.

Length of Commitment. Short-term commitments would not likely be very attractive to the more competent and established curriculum developers. Some stability must be guaranteed. It is, therefore, recommended that at least three to four years be scheduled for the initial stages of development. Note that present projections from experience, show that four to five man-years of work are required per course-year of instructional system development. (This implies that four men could complete one course in one year.)

Target Date. Commitments, if forthcoming, must be made during the spring of 1970. The program, if it is to be implemented, must be in operation by this summer. A later than summer starting date would likely be very difficult for the public school systems since staffing assignments are already in process for fall classes.

Costs. In addition to office space, materials, some local staff, etc., above normal expenditures must be anticipated during the early phases for each of the job family areas for; various teaching aids, materials, tools, some shop equipment, multi-media materials and equipment, etc. Adequate funds should be set aside for such items. Some loss of local control over curriculum development because of the investments and involvement in shared decision making with other Policy Board members, must also be considered a cost. Another such cost must be found in the fact that the Technical Advisory Board would likely exert some influence over development, testing and implementation. Loss of some

flexibility at the local level with the advent of performance and accountability type contracts under carefully scrutinized cooperative development could be considered a cost.

Budget Projections

State and/or Local Funds	Federal or "Membership" Funds
Full or part-time coordinator --local director.	Project Director
*Two to three full-time instructors.	Assistants (dependent on size of operation)
*One typist per job family area and adequate student help.	One full-time professional curriculum developer--behavioral scientist, per job family area.
*Communications and postage, materials and supplies, consultants and services, travel, etc. (Only limited funding necessary in this area.)	Secretary/Clerical
	Communications and postage, materials and supplies, consultants and services, travel, etc.

*Per job family area under development

REFERENCES

American Institutes for Research. An Experimental Program. Development and Evaluation of an Experimental Curriculum for the New Quincy (Mass.) Vocational-Technical School. Pittsburgh: Institutes for Performance Technology, November 1964.

American Institutes for Research. Development and Evaluation of an Experimental Curriculum for the New Quincy (Mass.) Vocational-Technical School. Pittsburgh: Institute for Performance Technology:
First Quarterly Technical Report, June 1965. Morrison E. J.
Second quarterly technical report, The Problem of Defining Objectives, September 1965. Morrison, E. J.
Third quarterly technical report, Curriculum Implications of the Study of Objectives, December 1965. Gagné, R. M., and Morrison, E. J.
Fifth quarterly technical report, The Roles, Characteristics, and Development Procedures for Measurement of Individual Achievement, June 1966. Lecznar, W. B., Morrison, E. J.
Sixth quarterly technical report, The Development of Learning Units, September 1966. Lecznar, W. B., Morrison E. J.
Seventh quarterly technical report, The Sequencing of Learning Units, December 1966. Lecznar, W. B., Morrison, E. J.
Eighth quarterly technical report, Problems Relating to the Development and Implementation of a Vocational Curriculum, March 1967. Butler, F. C., Hudak, V. M., Kowal, B.
Eleventh quarterly technical report, The Electronics Curriculum, January 1969. Butler, F. C., Crozier, P. W.
Twelfth quarterly technical report, The Power Mechanics Curriculum, July 1969. Ullery, J. W., Forsyth, R. W.

American Institutes for Research. Maintenance Technicians Performance Curves (Monthly Status Report #14) Pittsburgh, November 1969.

American Institutes for Research. Talent + Plan = A New Humanism. Reprint from Greater Pittsburgh Magazine, September 1967.

Ahmann, J. Stanley. Aspects of Curriculum Evaluation: A Synopsis. In Gagné, R., Scriven, M., and Tyler R. Perspectives of Curriculum Evaluation. AERA monograph series on curriculum evaluation, No. 1. Chicago: Rand McNally, 1967.

Altman, J. W. Research on General Vocational Capabilities (Skills and Knowledges). Pittsburgh: American Institutes for Research, March 1966.

Altman, J. W. & Morrison, E. J. School and Community Factors in Employment Success of Trade and Industry Course Graduates. Pittsburgh: American Institutes for Research, August 1966.

Altman, J. W. Toward a Concept of Integrated Vocational Education. Paper read at American Vocational Association Convention, Miami, December 1965.

Arnold, Walter M. Statewide Planning Studies: Pennsylvania. Paper read at American Vocational Association Annual Convention, December 1969.

Astin, Alexander W. Criterion-Centered Research. Educational and Psychological Measurement, No. 24, 807-822.

Atkin, J. Myron. Some Evaluation Problems in a Course Content Improvement Project. Journal of Research in Science Teaching, I, No. 2, 1963, 129-32.

Atkin, J. Myron. Behavioral Objectives in Curriculum Design: Science Teaching, 35, No. 5, May 1968, 27-30.

Ausubel, D. P. Psychological Aspects of Curriculum Evaluation. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education, University of Illinois, 1966.

Baker, Eva. Establishing Performance Standards. Los Angeles: Vimcet Associates, 1966.

Bend, Emil. The Impact of the Social Setting Upon Evaluative Research. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.

Bloom, Benjamin S., et al. Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain. New York: David McKay Co., 1956.

Briggs, L. J. Sequencing of Instruction in Relation to Hierarchies of Competence. Palo Alto, California: American Institutes for Research, October 1967.

Broudy, Harry S. Problems and Prospects in Vocational Education. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.

Bushnell, David S. An Educational System for the '70s. Phi Delta Kappan, December 1969, 199-203.

Butler, F. C. Jr. Job Corps: Instructional Systems Development Manual. Denver: Rocky Mountain Educational Laboratory, Inc., January 1967.

Carver, Ronald P. Special Problems in Measuring Change in Psycometric Devices. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.

Cook, Desmond L. A New Approach to the Planning and Management of Educational Research. The PERT project, School of Education, The Ohio State University, October 27, 1964 (mimeographed).

Cronbach, L. J. Course Improvement Through Evaluation. Teacher's College Record, 64, 1963, 672-683.

Cronbach, L. J. The Logic of Experiments on Discovery. In Schulman, L. M., and Keislar, E. (Eds.), Learning By Discovery. Chicago: Rand McNally, 1966.

Cronbach, L. J. Psychological Issues: Pertinent to Recent American Curriculum Reform. Paper read at the 14th International Congress of Applied Psychology, 1961.

Easley, John Jr. Evaluation Problems of the UICSM Curriculum Project. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.

Eisner, E. W. Educational Objectives: Help or Hindrance. Paper read at the annual meeting of the American Educational Research Association, Chicago, February 1966.

Eisner, E. W. Instructional and Expressive Objectives: Their Formulation and Use in Curriculum. In Popham, W. J., Eisner, E. W., Sullivan, H. S. and Tyler, L. L. Instructional Objectives. AERA monograph series on curriculum evaluation, No. 3, Chicago: Rand McNally, 1969.

Eninger, M. U. The Process and Product of T&I High School Level Vocational Education in the United States. Pittsburgh: American Institutes for Research, September 1965.

Fitzpatrick, Robert. The Selection of Measures for Evaluating Programs. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C. January 1970.

Flanagan, John C. The Critical Incidence Technique. Psychological Bulletin, 51, 327-358.

Flanagan, John C. & Jung, S. M. Evaluating a Comprehensive Educational System. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.

Flanagan, John C. et al. The American High School Student Report to the U. S. Office of Education, Cooperative Research Project No. 635. Pittsburgh: Project TALENT Office, University of Pittsburgh, 1964.

Flanagan, John C. Stability of Career Choice: Ages 14 to 19. Paper read at American Psychological Association, Chicago, September 1965.

Flanagan, John C., The Uses of Educational Evaluation in the Development of Programs, Courses, Instructional Materials and Equipment, Instructional and Learning Procedures, and Administrative Arrangements. In Tyler, R. W. (Ed.) Educational Evaluation: New Roles, New Means. Chicago: University of Chicago Press, 1969, pp. 221, 242.

Frederiksen, N. Proficiency Tests for Training Evaluation. In Glaser, R. (Ed.), Training Research and Education. Pittsburgh: University of Pittsburgh Press, 1962.

Gagné, R. M. The Analysis of Instructional Objectives for the Design of Instruction. In Glaser, R. (Ed.) Teaching Machines and Programmed Learning. II: Data and Directions. Washington, D. C., National Education Association, 1965, 21-65 (a).

Gagné, R. M. The Conditions of Learning. New York: Holt, Rinehart, & Winston, 1965 (a).

Gagné, R. M. Educational Objectives and Human Performance. In Krumboltz, J. D.(Ed.), Learning and the Educational Process. Chicago: Rand McNally, 1965 (b).

Gagné, R. M. (Ed.) Learning and Individual Differences. Columbus: Charles E. Merrill, 1967.

Gagné, R. M. Curriculum Research and the Promotion of Learning. In Tyler, R. W., Gagné, R. M. and Scriven, M. Perspectives of Curriculum Evaluation. AERA monograph series, Chicago: Rand McNally, 1967.

Gerlach, V. S. and Sullivan, H. J. Constructing Statements of Outcomes. Inglewood, California: Southwest Regional Laboratory for Educational Research and Development, 1967.

Glaser, R. L. Instructional Technology and the Measurement of Learning Outcomes. American Psychologist, 18, 1963, 519-522.

Glaser, R. L., Damrin, Dora E., and Gardner, F. M. The TAB Item: a Technique for the Measurement of Proficiency in Diagnostic Problem-Solving Tasks. Urbana: Bureau of Research and Service, College of Education, University of Illinois, 1952.

Glaser, R. L. & Klaus, D. J. Proficiency Measurement: Assessing Human Performance. In Gagné, R. M. (Ed.), Psychological Principles in System Development. New York: Holt, Rinehart, & Winston, 1962, pp. 419-474.

Glaser, R. L. The Program for Individually Prescribed Instruction. Paper read at the annual meeting of the American Educational Research Association, Chicago, February 1966.
Grobman, H. Evaluation Activities of Curriculum Projects. AERA monograph series on curriculum evaluation, No. 2, Chicago: Rand McNally, 1968.
Gropper, George L. & Short, J. G. Handbook for Training Development. Pittsburgh: American Institutes for Research, 1969.
Harrison, G. V. The Instructional Value of Presenting Explicit Versus Vague Objectives. Wilson, J. A. R. (Ed.) California Educational Research Studies, University of California, Santa Barbara, 1967.
Hawkridge, David G. Sr. Designs for Evaluative Studies. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.
Hawkridge, David G. Sr., Campeau, P. L., Trickett, P. K. Preparing Evaluation Reports of Educational Programs: A Guide for Authors. Palo Alto: American Institutes for Research, October 1969.
Horowitz, Joseph. Critical Path Scheduling. New York: Ronald Press Co., 1967.
Johnson, George H. The Purpose of Evaluation and the Role of the Evaluator. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.
Krathwohl, D. R., Bloom, B. S., & Masia, B. B. Taxonomy of Educational Objectives, the Classification of Educational Goals, Handbook II, Affective Domain. New York: David McKay, 1964.
Leton, Donald. Criterion Problems and Curriculum Evaluation. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.
Lipe, Dewey et al. Classroom Behavior of PLAN Students Compared With Control Students. Paper read at the American Psychological Association Meeting in Washington, D. C., September 1969.
Lipham, James M. Administrators and the Educational Program. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.
Lumsdaine, A. A. Assessing the Effectiveness of Instructional Programs. In Glaser, R. (Ed.) Teaching Machines and Programmed Learning II: Data and Directions. Washington: National Education Association, 1965, pp. 267-320.
Mager, Robert F. & McCann, J. Learner-Controlled Instruction. Palo Alto, California: Varian Associates, 1961.
Mager, Robert F. Preparing Objectives for Programmed Instruction. San Francisco: Fearon Press, 1962.
Miller, Robert B. Task Description and Analysis. In Gagné, R. M. (Ed.), Psychological Principles in System Development. New York: Holt, Rinehart, & Winston, 1962.
Nichols, Daryl G. Social and Educational Research Program. Paper read at the American Institutes for Research Seminar on Evaluative Research, Washington, D. C., January 1970.

Phi Delta Kappan. Volume LI, No. 2, October 1969.
Phi Delta Kappan. Volume LI, No. 5, January 1970.
Popham, W. J. Educational Criterion Measures. Inglewood, California: Southwest Regional Laboratory for Educational Research and Development, 1967.
Popham, W. J., and Baker, E. L. Development of Performance Test of Teaching Proficiency. Paper presented at the annual meeting of the American Educational Research Association, New York: February 1966.
Popham, W. J. and Husek, T. R. Implications of Criterion-Referenced Measurement. Journal of Educational Measurement, Volume 6, No. 1, pp. 1-9, Spring, 1969.
Popham, W. J. Objectives of Instruction. In Popham, W. J., Eisner, E. W., Sullivan, H. J. and Tyler, L. L. Instructional Objectives. AERA monograph series on curriculum evaluation, No. 3, Chicago: Rand McNally, 1969.
Popham, W. J. Validation Results: Performance Tests of Teaching Proficiency in Vocational Education. Paper presented at the American Educational Research Association Meeting, Los Angeles: February 1969.
Quirk, C., & Sheehan, C. (Eds.), Research in Vocational and Technical Education. Madison: University of Wisconsin: Center for Studies in Vocational and Technical Education, 1967.
Rahmlow, Harold F. Use of Student Performance Data for Improvement of Individualized Instructional Materials. Paper read at the American Psychological Association meeting in Washington, D. C., September 1969.
Rosenfeld, M., Kowal, B., & Seiler, E. L. Assessing the Progress of Education: Vocational Education--Phase I. Pittsburgh: American Institutes for Reserach, November 1965.
Rosenfeld, Michael. An Evaluation Plan for the Greene Joint Vocational School. Pittsburgh: American Institutes for Research, 1967.
Scriven, Michael. The Methodology of Evaluation. In Tyler, R. W., Gagné, R. M., and Scriven, M. Perspectives of Curriculum Evaluation. AERA monograph series on curriculum evaluation, No. 1. Chicago: Rand McNally, 1967.
Shaw, Marvin E. & Wright, J. W. Scales for the Measurements of Attitudes. New York: McGraw-Hill Book Company, 1967.
Stake, R. E. Toward a Technology for the Evaluation of Educational Evaluation. In Tyler, R., Gagné, R. M., and Scriven, M. Perspectives of Curriculum Evaluation. AERA monograph series on the curriculum evaluation, No. 1. Chicago: Rand McNally, 1967.
Stake, R. E. The Countenance of Education Evaluation. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.
Street, David. Sociological Aspects of Curriculum Evaluation. Paper read at the National Seminar for Research and Curriculum Evaluation in Vocational and Technical Education. University of Illinois, 1966.

Sullivan, H. J. Objectives, Evaluation, and Improved Learner Achievement. In Popham, W. J., Eisner, E. W., Sullivan, H. J., and Tyler, L. L. Instructional Objectives, AERA monograph series on curriculum evaluation, No. 3. Chicago: Rand McNally, 1969.

Taba, Hilda. Curriculum Development: Theory and Practice. New York: Harcourt, Brace, and World, 1962.

Tyler, L. L. A Case History: Formulation of Objectives from a Psychoanalytic Framework. In Popham, W. J., Eisner, E. W., Sullivan, H. J. and Tyler, L. L. Instructional Objectives. AERA monograph series on curriculum evaluation, No. 3. Chicago: Rand McNally, 1969.

Tyler, R. W. Changing Concepts of Educational Evaluation. In Tyler, R. W., Gagné, R. M. and Scriven, M. Perspectives of Curriculum Evaluation. AERA monograph series on curriculum evaluation, No. 1. Chicago: Rand McNally, 1967.

Tyler, R. W. Constructing Achievement Tests. Columbus: Ohio State University, 1964.

Tyler, R. W. Some Persistent Questions on the Designing of Objectives. In Lindvall, C. M. (Ed.), Defining Educational Objectives. Pittsburgh: University of Pittsburgh Press, 1964, pp. 77-83.

Ullery, J. W. Junior Community College Staffing. Unpublished paper, Urbana: University of Illinois, 1967.

Ullery, J. W. Project ABLE: Progress Report. Paper presented at the 63rd annual American Vocational Association Convention, Boston, December 1969.

Ullery, J. W. Performance Evaluation--37 Modules developed for the Project ABLE Power Mechanics Curriculum. Pittsburgh: American Institutes for Research, 1969.

Ullery, J. W. Learning Units--37 Modules developed for the Project ABLE Power Mechanics Curriculum. Pittsburgh: American Institutes for Research, 1969.

Warmbrod, J. R. Review and Synthesis of Research on the Economics of Vocational-Technical Education. Columbus, Ohio: ERIC Clearing House. The Center for Vocational and Technical Education, Ohio State University, November 1969.

APPENDIX A

Some Suggested Goals for Organizations Undertaking Instructional System Development for Learner-Centered Vocational-Technical Education Programs

Some Suggested Goals for Organizations Undertaking Instructional Systems Development for Learner-Centered, Vocational-Technical Education Programs.

Goals for Vocational-Technical Education

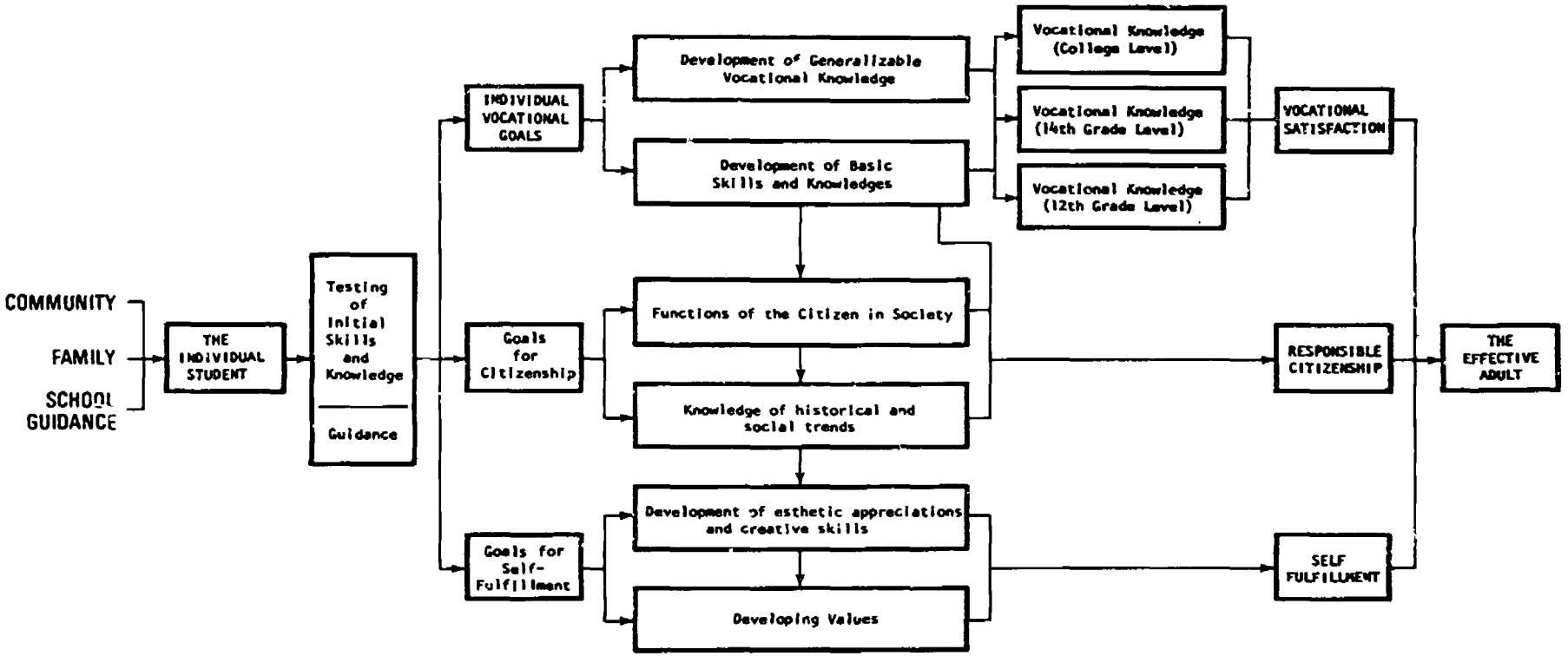
Goals for School System Networks

Goals for Individual School Systems

Goals for Vocational-Technical Divisions of Individual School Systems

J.W.U. 4/70

GOALS FOR VOCATIONAL – TECHNICAL EDUCATION



GOALS FOR SCHOOL SYSTEM NETWORKS

Purposes of the ES'70 network are as follows:

- providing an individualized education for each student,
- highly relevent to the adult roles which he will play,
- economically practical within available public resources,
- based on behavioral and related sciences,
- employing suitable systems of school organization
- utilizing appropriate educationally oriented technology.
- locally planned and directed,
- approved, and implementation assistance provided by the appropriate state department of education,
- financed by Federal, state, local and private funds,
- designed for ultimate availability to all school systems.

In addition, the local superintendents have agreed that programs should be designed for replicability in other schools upon sufficient progress to warrant dissemination.

While it was expected that most of the materials and instructional systems would be developed by outside resource groups (but with the full involvement of the network schools) the procedures and instructional methods could first be assembled and tested within the participating school districts.

The ES'70 network should serve as a sort of umbrella for curriculum development. However, a problem exists for the organization. While it can be said that the "whole is more than its parts", the major parts--functional, replicable, individualized, instructional systems--are not yet operational.

GOALS FOR INDIVIDUAL SCHOOL SYSTEMS

Other goals should include:

Establish an appropriate balance of conceptual to manual skills in vocational and technical training.

Subordinate or related objectives should include activities which would contribute to:

Student acceptance of psychomotor skills and non-college degree kinds of occupations as highly relevant and critical to societal needs.

Student acceptance as legitimate, those experiences designed to promote development of attitudes and psychomotor skills needed for becoming employable.

Student acceptance of occupational instruction as a valid curriculum leading to personal and socially redeeming occupations.

Student acceptance of the value in experiences and learnings that are not strictly cognitive in nature and do not depend on traditional kinds of paper-pencil achievement testing.

Provision of adequate opportunity for students to learn related and relatable skills and subject matter without sacrificing vocational learning.

Establish cooperative arrangements with business and industry that will provide valuable learning experiences which cannot be adequately provided in the school. (It should be expected that 40% to 60% of the students in ABLE type programs be involved in formal or informal cooperative programs. Other kinds of experiences and programs are possible.)

Individualize scheduling. (This would likely require a modular kind of scheduling where, for example, a student could be assigned to extra time in one particular area according to his needs. This would also imply the ability to alter schedules as a student needs change.)

Establish flexible scheduling to permit vertical and horizontal transfers. (This means, for example, the ability to move a student from a 10th grade area to an 11th grade area or from job level one to job level two upon completion of required tasks. This also means the ability to transfer, given a reasonable notice, from one job family to another, for those students who alter their career goals.)

Provide adequate vocational guidance and career decision making experiences in job family selection and long range planning--through individualized student activity.

Acquire the capability to assess and prescribe for each student vocational and academic needs. (This may require computer capability.)

Establish cooperative placement services with outside agencies with procedures to accomplish appropriate follow-up and evaluation on graduates.

.....and others.

GOALS FOR THE VOCATIONAL-TECHNICAL DIVISIONS

OF SCHOOL SYSTEMS

Individualize instruction with flexible and adaptive techniques:

Many educators are describing such systems (and ways of structuring educational programs) in terms of a new humanism. Identification of relevant goals, providing assistance in meeting objectives, and providing frequent and diagnostically oriented evaluations of each student's progress, are key features. In such a system, students usually do not leave one unit until they have attained a predetermined level of proficiency. Furthermore, they are allowed varying amounts of time (and practice) to achieve mastery of specific objectives. The teacher's behavior and role is changed to that of diagnostician, tutor, and special resource person working with learners individually or in small groups. (He must also supervise teacher aids.) Such learner centered environments require resource centers operating as a kind of "supermarket", adequately equipped with many kinds of materials and aids. Student behavior and role change is typically accomplished since the learner is more actively involved in the learning process--he assumes the major responsibility for his own development. This includes activity in learning, self-evaluation, and the management of his own progress. (See Flow Chart on Learner Activity Process and sample student tracking system--which is a sort of student operated equivalent of an instant computer print-out of individual and group progress.)

Suborordinate goals then, must include (not ordered):

Provide student programs which can be structured in terms of both long range and short range relevant performance objectives.

Establish learner-centered programs. Develop techniques and produce materials to facilitate the process.

Identify and adapt available published instructional materials, maintenance manuals, equipment instructions, etc., wherever possible (rather than attempting the development of new materials).

Establish conditions and procedures which permit most students to remain on one unit until they have attained a predetermined level of proficiency.

Establish conditions and procedures which permit for individual students, varying amounts of time (and practice) to achieve mastery of specific objectives.

Establish resource centers equipped with relevant materials (materials identified as a result of analyses of performance objectives and through the selection of various items for student-instructor contract options).

Establish programs which follow various "system" techniques such as suggested in the Flow Chart of Individualized Learner Activity Process Within an Instructional System and provide the materials and techniques to accomplish the objective.

Establish teacher-training programs and provide the necessary materials to assist in bringing about the behaviors required to properly implement and operate the "system".

Effect observable teacher behavior change (different from that which is characterized in traditional programs) to establish the role of diagnostician, tutor, and special resource person working primarily with learners as individuals or through small groups.

Effect observable student behavior (different from that in traditional programs) in which the individual assumes a major responsibility for his own development--learning, self evaluation and management of progress. (It is expected that such behavior would also provide training in decision making and problem solving. Observable student behavior would also include teacher-type activity through peer-group interaction among the class members.)

Produce performance evaluation instruments, materials and aids allow for frequent and diagnostically oriented evaluation of each student's progress.

Establish flexible procedures to provide multiple entry and exit points. (This will require the ability to manage a great variety of activities in a sort of "supermarket" environment through instructional and certification services. This will require school system administrative action to establish programming with sufficient flexibility to permit vertical and horizontal transfers and individualized scheduling based on individual progress. Grade level constraints would require relaxation since the programs would be based on job families, job levels, and specific tasks within job levels to be learned and/or certified. Because of the broad application and generalizability of the system, student age, grade, and sex constraints would require relaxation. Other administrative action would be necessary to enable a program geared to a kind of continuing education capable of servicing, for example; out-of-school youth, youth or adults of any age or grade level, workers who are employed but who need work skills such as those identified in the job and task analysis and provided at the particular job level, workers who need skill and knowledge updating, or persons who simply need job competency certification for various job tasks.)

Development and application of techniques of providing instruction which takes full account of individual differences in ability, interest, prior learning, and learning style.

Verify increased student motivation and achievement as a result of new individualized programs.

Demonstrate the feasibility of highly flexible planning of vocational education for the individual student, incorporating the goals of vocational competence, positive attitudes toward work, effective work habits, and adequate standards of performance.

Demonstrate progress toward improvement in the goals of responsible citizenship and individual self-fulfillment for individuals as a result of individualized instruction.

Demonstrate a high degree of vocational competence and versatility on the part of the graduate of such programs.

Test and validate management and evaluation techniques, procedures, and instruments for instructional system development. (Delineated in the Fifteenth Technical Report.)

Subordinate goals include:

Validate instruments for accountability type performance contracts.

Publish materials which would enable replication of the process and techniques by other agencies and groups in VOTEC education.

Validate procedures which can be applied within realistic fiscal constraints.

Validate evaluation techniques, activities, and instruments designed for both program and student improvement. (This must be a regenerative process with iterative corrective feedback mechanisms. This must be applied to project management, program development, and student and teacher activities.)

Validate teacher-training program for disseminating, implementing and field testing instructional systems.

Identify summative kinds of evaluation for appropriate use (assuming accomplishment of formative kinds of evaluation and adequate progress in the various test/revise/retest cycles).

Derive instructional and performance objectives from an analysis of desired behavior after graduation.

Subordinate goals include:

Identify jobs within a job family through procedures established for feasibility studies.

Enumerate job titles for entire occupational family.

Group and arrange job titles on hierarchy of skills, knowledge and training time.

Cluster job titles by sub-families or groups from an analysis of job tasks horizontally and vertically within the hierarchy.

Select representative jobs for each cluster.

Conduct job and task analysis.

Develop and operationalize (for one or more job families) complete instructional systems, adequately field test and validate, and disseminate.

Subordinate goals include:

Conduct feasibility study, conduct task analysis, develop performance objectives, develop and verify criterion instruments, develop learner activity guides, verify individual modules, implement and test system, and follow-up graduates.

Establish pilot programs in such a way as to permit the testing and validation of management and evaluation techniques, procedures, and instruments for instructional system development.

Establish exemplary demonstration programs as a part of the development for the purpose of training R&D staff and instructors and for the purpose of local, state and national dissemination upon the completion of field testing.

Identify instruction options highly relevant to each student's chosen adult occupational role.

Demonstrate practical and economical advantages including savings in shop equipment purchases as a result of the precise identification of instructional objectives.

Establish a student operated system for tracking individual and group progress as an alternative to inordinately high-cost present day computer instructional support management systems. (This must provide instant observable information on each student by task or unit with respect to instruction and/or certification completed, sequence requirements, tasks remaining, tasks presently being worked on, whereabouts if not in the instructional area at any given time, and other relevant information. Both student and teacher should be able to prescribe new activity from a quick perusal of remaining options.)

.....and others.

APPENDIX B

Action Verbs Related to Specific Kinds of Learning

Action Verbs Related to Specific Kinds of Learning

Specific Responding (producing a single, isolated response)	Motor Chaining (producing a sequence of motions)	Verbal Chaining (producing a sequence of words)	Discriminating (identifying two or more stimuli)
associate	activate	cite	choose
give a word for	adjust	copy	compare
grasp	align	enumerate	contrast
hold	close	letter	couple
identify	copy	list	decide
indicate	(dis)assemble	quote	detect
label	(dis)connect	recite	differentiate
lift	draw	record	discern
locate	duplicate	reiterate	distinguish
loosen	insert	repeat	divide
move	load	reproduce	isolate
name	manipulate	(re)state	judge
pick up	measure	transcribe	pick
place	open	type	recognize
press	operate		select
pull	remove		
push	replace		
recognize	stencil		
repeat	trace		
reply	tune		
respond	turn off - on		
rotate			
say			
set			
slide			
signal			
tighten			
touch			
turn			
twist			

(Butler 1967)

Action Verbs Related to Specific Kinds of Learning (Continued)

Classification	Rule Using	Problem Solving
allocate	anticipate	accommodate
arrange	calculate	adapt
assign	calibrate	adjust to
characterize	check	analyze
categorize	compile	compose
catalogue	compute	contrive
classify	conclude	correlate
collect	construct	create
file	convert	develop
grade	coordinate	devise
group	correct	diagnose
index	deduce	discover
inventory	define	find a way
itemize	demonstrate	invent
match	design	realize
mate	determine	reason
order	diagram	resolve
rank	equate	study
rate	estimate	synthesize
reject	evaluate	think through
screen	examine	trouble-shoot
sort	expect	
specify	explain	
survey	extrapolate	
tabulate	figure	
	forsee	
	generalize	
	illustrate	
	infer	
	interpolate	
	interpret	
	monitor	
	organize	
	plan	
	predict	
	prescribe	
	program	
	project	
	schedule	
	solve	
	translate	
	verify	

APPENDIX C

Types of Learned Performance

Types of Learned Performance

Performance Type	Definition	Example	Inferred Capability
Specific responding	Making a specific response to a specified stimulus	Trainee repeats new word "torque"	Connection, Identification
Motor chaining	Exhibiting a chain of motor responses, each of which is linked to each subsequent response	Using a wrench to remove a sparkplug	Sequence of motions
Verbal chaining	Exhibiting a chain of verbal responses, each of which is linked to each subsequent word	Listing, from memory, the steps for starting a diesel engine	Verbal associations; Verbal sequence
Discriminating	Making different (chained) responses, to two or more physically different stimuli	Pointing out and identifying the ball peen hammer, the carpenter's hammer, and the tack hammer	Discrimination
Classifying	Assigning objects of different physical appearance to classes of like function	Sorting out all the resistors from a pile of spare parts	Concept
Rule using	Performing an action in conformity with a rule which is composed of two or more concepts	Adding more flour for high altitude baking	Principle or rule
Problem solving	Solving a novel problem by combining rules	Trouble-shooting a radio	Principles, plus "problem solving ability"

(Butler 1967)

Summary of Facilitating Conditions

Performance established by learning	Internal (learner) conditions	External Conditions
Specific responding	Certain learned and innate capabilities	Repeated exposure to response-provoking stimuli; immediate confirmation of active response
Motor chaining	Previously learned individual connections	Presented a sequence of external cues that call for a sequence of specific responses; repetition to achieve selection of response-produced stimuli
Verbal chaining	Previously learned individual connections and cues	Presenting a sequence of external verbal cues, effecting a sequence of verbal responses at the same time
Discrimination	Previously learned chains, motor or verbal	Practice providing contrast of correct and incorrect stimuli
Classifying	Previously learned multiple discriminations	Recalling discriminated response chain along with a variety of stimuli differing in appearance, but belonging to a single class; confirmed by successful application
Rule using	Previously learned concepts	Using external cues, usually verbal, effecting the recall of previously learned concepts in a suitable relationship; confirmed by specific applications of the rule
Problem solving	Previously learned rules	Self-arousal and selection of previously learned rules to effect a novel combination which is self-confirming

APPENDIX D

Learner Activity Guide and Performance Evaluation--Sample Modules

PERFORMANCE EVALUATION SET & LEARNER ACTIVITY GUIDE

POWER MECHANICS

FAMILY: AUTO MECHANICS & RELATED OCCUPATIONS

EXIT LEVEL: SERVICE STATION ATTENDANT & RELATED OCCUPATIONS

CHASSIS LUBRICATION
PE 11-6

Project ABLE
Quincy Public Schools
American Institutes for Research

PERFORMANCE EVALUATION SET
& LEARNER ACTIVITY GUIDE

POWER MECHANICS

Family: Auto Mechanics & Related Occupations.
Exit Level: Service Station Attendant & Related Occupations.

(915.867)
LEVEL I

CHASSIS
LUBRICATION
PE 11-6

TASK 12 C.O. 1 & 2

NAME _____

DATE _____

LEARNER ACTIVITY GUIDE

PREREQUISITES: PE 3-1 and PE 11-1 through 11-5

OBJECTIVES: Given an auto to be lubricated, you will:

1. Use a service manual lube chart to locate and clean lubrication points in front suspension, steering linkages, drive and power lines, cables and linkages, etc.

2. Identify the proper tools and adapters and apply the specified type and amount of lubricant without dirt or foreign materials entering the system. Follow the lubrication chart directions for the specific make, model, and year of car.

3. Check lubricant level in differential, manual transmission, manual steering gear, and power steering reservoir. Identify proper lubricant.

4. Identify and lubricate to specifications, various under-the-hood lubrication points.

(Continued)

PROJECT ABLE

OVERVIEW: Most cars and trucks have lube points on the underbody which are exposed to rugged operating conditions. The steering and suspension systems, with ball joints and bearings, are the major underbody lube points. Careful servicing is important. While older vehicles are equipped with grease "fittings" for such joints, most new cars are now sold with pre-packed bearings. The servicing interval for most fitting-equipped points is from 1,000 to 4,000 miles. The recommended servicing interval for pre-packed bearings ranges from 12,000 miles to 36,000 miles (or from 12 months to 36 months). You must know that the method of lubrication is different for the two types. Greasing a pre-packed bearing like those equipped with standard fittings could ruin the bearing seals. Furthermore, a different type of grease is usually required. Chassis lubrication is one job you should not attempt without the careful supervision of the instructor or mechanic.

STUDENT-INSTRUCTOR CONTRACT OPTIONS:

- ☐ 1. Student-instructor conference.
- ☐ 2. Learning Unit #11-6.
- ☐ 3. Chek-Chart's Car Service, Chek-Chart Corporation, pp. 49-54.
- ☐ 4. Other--specify: _____.

EQUIPMENT: Tote-Tray #11-6 with lube chart manual, penetrating fluid, oil can with 10W30 oil, hand lubrication gun, adapters for pre-packed bearings, and assorted wrenches. Get some paper towels.

POWER MECHANICS
Family: Auto Mechanics & Related Occupations.
Exit Level: Service Station Attendant & Related Occupations.
(915.867)
LEVEL I

CHASSIS LUBRICATION
PE 11-6

TASK 12
C. O. 1 & 2

NAME _____

DATE _____

Pre Assessment

Instructions;

(1) Fill in name and date on the last two pages. When you have completed the performance evaluation, you will get one copy, the instructor will file the other.

(2) Do the training check questions below and give answer card to instructor.

(3) Complete the performance evaluation under instructor's supervision. He must see proof of your performance.

TRAINING CHECKS: T-T No. Z-11. The correct answer is **L**. Start with number **17.**

17. Dirt must be removed from fittings and plugs

a. to make a path for excess grease.
b. to prevent foreign materials from entering bearing.
c. to see the bearing.
d. to present a neat appearance.

18. To remove the grease gun from a fitting after greasing the lube point

a. unscrew fitting.
b. pull straight off.
c. break by moving up, down, or sideways.
d. pull trigger and pop out.

19. Limited slip differentials can always be detected by

a. checking drain plug for metal tag.
b. checking manual for specifications.
c. checking special type of grease in differential.
d. rotating a rear wheel and observing opposite wheel.

20. The service interval for bearings with standard fittings and for pre-packed bearings is

a. much longer for pre-packed bearings.
b. determined by the mechanic.
c. longer for the standard fitting equipped bearings.
d. about the same.

21. The pressure gun

a. can be used on pre-packed bearings by changing only the grease.
b. can be used on pre-packed bearings with no modifications.
c. should not be used on pre-packed bearings.
d. should not be used unless the nipples are changed.

22. Limited slip differentials

a. use a different grease than used in standard differentials.
b. use the same grease furnished for standard differentials.
c. are serviced the same as any other differential.
d. require no special care.

23. The lubricant for manifold heat-control valves should be

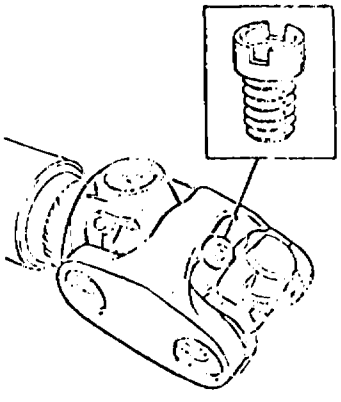
a. Door-Ease or silicon spray.
b. penetrating fluid or similar lubricant.
c. flake graphite.
d. SAE 20 oil.

Identify the following (put a check mark next to the correct letter)

24. Standard nipple plug.

a. _____
b. _____
c. _____

b.



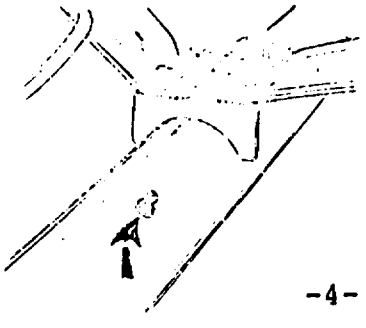
25. Pre-packed bearing plug.

a. _____
b. _____
c. _____

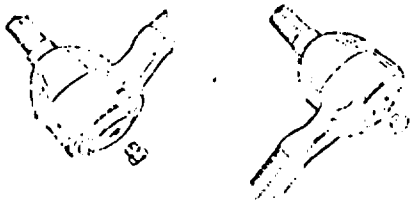
26. Flush type plug.

a. _____
b. _____
c. _____

c.



a.



27. When the lubricant in a differential, steering reservoir, or transmission is very low, you should

    a. recommend the owner return it at a later time for service.
    b. recommend draining and refilling unit with new fluid.
    c. simply fill to proper level with specified lubricant.
    d. add gear grease.

28. Vehicles should be allowed to warm up indoors before greasing when the temperature approaches

    a. 0°F.
    b. -10°F.
    c. +10°F.
    d. +20°F.

29. When attaching grease gun to fitting,

    a. push straight onto fitting.
    b. touch lightly and apply grease.
    c. pull trigger and shove.
    d. place on angle and roll on.

30. Most new cars are sold with

    a. pre-packed bearings for most front-end lube points.
    b. standard grease fittings for most lube points.
    c. standard grease fittings for all lube points.
    d. standard nipple plugs for most lube points.

31. Standard fittings and pre-packed bearings

    a. require the same type of grease.
    b. differ only in the service interval.
    c. are serviced with the same tools and fittings.
    d. require a different type of grease.

32. Greasing either pre-packed bearings or bearings equipped with standard fittings.

    a. is recommended procedure.
    b. could ruin the bearing seals.
    c. requires essentially the same tools but different grease.
    d. requires essentially the same grease but different tools.

STOP _____ INSTRUCTOR CHECK #1
initials

POWER MECHANICS
Family: Auto Mechanics & Related Occupations.
Exit Level: Service Station Attendant & Related Occupations.
(915.867)
LEVEL I

CHASSIS LUBRICATION
PE 11-6

NAME _____
DATE _____

TASK 12 | C. O. 1 & 2

PERFORMANCE ACTIVITY
(Pre and/or Post Assessment)

UNIT OBJECTIVE 1: Using a service manual lube chart, locate and clean lubrication points in front suspension, steering linkages, drive and power lines, cables and linkages, springs, etc.

A. _____ year _____ make _____ model _____ mileage

When was the vehicle last greased? _____ miles _____ date

B. What is the recommended lubrication service interval?

_____ miles _____ months

Does the mileage or time interval indicate the need for greasing? _____

C. How many plugs are listed? _____
How many fittings are listed? _____
What type of plugs or fittings are listed?

_____
_____
_____

#33. Do all plugs and fittings require the same type of lubricant?
a. No b. Yes

D. Complete the following information:

Differential

Type _____

Service Interval _____

Lubricant _____

Is service required? _____

Transmission-Overdrive (or Automatic Transmission)

Type _____

Service Interval _____

Lubricant _____

Is service required? _____.

Steering

Type _____

Service Interval _____

Lubricant _____

Is service required? _____

E. Raise vehicle following procedures listed in unit on lifts and jacks.

F. Prepare the plugs for greasing--do NOT grease until after the instructor check below.

What type plug or fitting is used? _____

Were the plugs changed? _____

Were the plugs originally of the pre-packed type? _____

UNIT OBJECTIVE 2:	Identify the proper tools and adapters and apply the specified type and amount of lubricant without dirt or foreign materials entering the system. Follow the lubrication chart directions for the specific make, model, and year of car.

A. Get the hand gun. It should be filled with the lubricant specified for pre-packed bearings. Is it the type of lubricant specified by the manual? _____ Do NOT grease anything yet.

#34. Get the pressure gun. Does it have the type of lubricant specified for standard nipple-type fittings?

a. No b. Yes

NOTE: The pressure system has the wrong type of grease for pre-packed bearings. NEVER use the pressure gun on sealed pre-packed bearings. The pressure would break the seals--this could void the warranty.

NOTE: No student (10th, 11th, or 12th grade) is allowed to grease fittings without first having the job inspected by the instructor.

STOP _____ initials

INSTRUCTOR CHECK #2: Check written work. Check identification of fittings. Student must be able to identify pre-packed bearings. Make certain he has identified and cleaned all lube points. Check for limited slip differential. Have student identify plugs on differential and transmission. Have student demonstrate use of hand gun and pressure gun. Watch him perform. Make certain he keeps fittings and nozzle VERY clean. Have student demonstrate turning of wheels while greasing ball joints or king pins.

B. Do NOT attempt to grease a universal joint or drive shaft without instructor's assistance. Lubricate the first few points with instructor's help.

C. Lubricate all fittings and plugs as indicated on chart. Use proper lubricant.

UNIT OBJECTIVE 3:	Check lubricant level in differential, manual steering gear, power steering reservoir, and manual transmission-overdrive unit.

Differential

A. What type of lubricant is specified for the standard differential? _____ What type of lubricant is specified for the limited slip differential? _____ (Check the service chart for some other make of car if both are not listed for the vehicle you are servicing.) Does the vehicle have a limited slip differential? _____

B. Find and prepare plug--do NOT remove until checked by instructor.

STOP _____ initials

INSTRUCTOR CHECK #3: Have student remove plug, check level, and replace plug. Did student inspect for leaks and broken seals?

C. Is lubricant required? _____ Fill only by permission of instructor.

NOTE: Do not lower car to ground until instructor checks plug.

Manual Transmission

#35. What type of lubricant is specified?

a. A.T.F.
b. SAE 90-140
c. SAE 10W30
d. SAE 30

A. Find and prepare plug.

NOTE: Do not remove fill plug until checked by instructor. Should the car you have been servicing have an automatic transmission, go to another vehicle for this part of the project.

STOP _____ initials

INSTRUCTOR CHECK #4: Have student remove plug, check level, and replace plug. Did student inspect unit for leaks?

B. Is lubricant required? _____

Fill only by permission of instructor.

Steering Gear (units without power steering)

#36. What type of lubricant is specified?

a. Chassis lube

b. A.T.F.

c. SAE 10W

d. SAE 90-140

A. Find and prepare plug.

STOP _____ INSTRUCTOR CHECK #5:
initials Have student loosen fill plug, check fluid level, and replace plug.

B. Is lubricant required? _____

Do not add lubricant without instructor's or mechanic's permission.

Power Steering Reservoir

#37. What type of lubricant is specified?

a. A.T.F.

b. SAE 10W

c. SAE 10W30

d. SAE 90-140

A. Find and prepare cover or fill cap.

Some older cars with power steering have two separate lube points: (1) the power steering unit reservoir and (2) the steering gear box. In new vehicles, the power steering reservoir supplies the gear box with lubricant. Your instructor can explain this.

B. Remove cap and check level. Is lubricant required? _____

Fill only by permission of instructor.

UNIT OBJECTIVE 4: Identify and lubricate, to specifications, various under-the-hood lubrication points.

Manifold Heat-Control Valve

#38. What is the specified lubricant?

a. SAE 30

b. A.T.F.

c. Penetrating oil

d. SAE 90-140

A. Lubricate.

Throttle Linkage

A. What is the specified lubricant? _____

B. Point out lube points to instructor--from manual.

C. Lubricate.

Other Accessories

A. List four (4) other lubrication points listed in manual. (Points not covered in this project.)

1. _____
2. _____
3. _____
4. _____

STOP _____ initials

INSTRUCTOR CHECK #6: Check steps in power steering, manifold heat-control valve, throttle linkage, and "other accessories".

POWER MECHANICS

Family: Auto Mechanics & Related Occupations.

Exit Level: Service Station Attendant & Related Occupations. (915.867)
LEVEL I

CHASSIS LUBRICATION
PE 11-6

TASK 12 | C. O. 1 & 2

NAME _____
DATE _____
MAN-HOURS _____
INSTRUCTOR _____

CRITERION CHECKLIST

L M S

Lubricates chassis.

U S

☐ ☐ 1. Uses a service manual lube chart to locate and clean lubrication points in front suspension, steering linkages, drive and power lines, cables and linkages, etc.

☐ ☐ a. Identifies the service requirements and interval for the various lube points.

☐ ☐ b. Locates all lubrication points.

☐ ☐ c. Cleans all foreign matter from fittings and/or plugs.

☐ ☐ d. Identifies pre-packed bearings.

☐ ☐ 2. Identifies the proper tools and adapters and applies the specified type and amount of lubricant without dirt or foreign materials entering the system. Follows the lubrication chart directions for the specific make, model, and year of car.

☐ ☐ a. Identifies proper lubricant.

☐ ☐ b. Uses hand gun for pre-packed bearings and universal joints.

☐ ☐ c. Connects and breaks connection properly with both hand and pressure guns.

☐ ☐ d. Lubricates without foreign materials entering system--keeps nozzle and fitting clean.

☐ ☐ e. Follows lubrication chart directions.

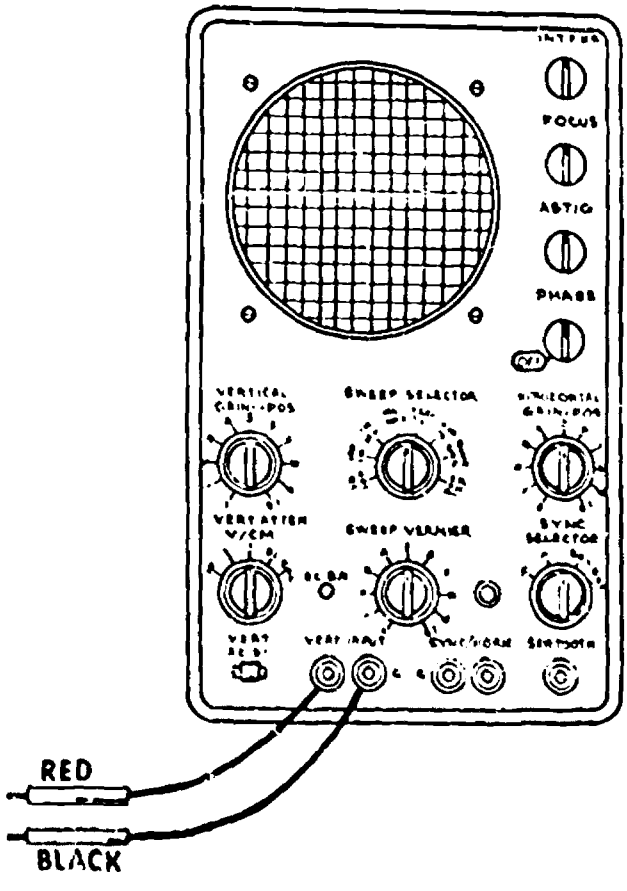
1/70

U	S	
☐	☐	3. Checks lubricant level in differential, manual transmission, manual steering gear, and power steering reservoir. Identifies proper lubricant.
☐	☐	a. Checks for limited slip differential.
☐	☐	b. Checks differential.
☐	☐	c. Checks manual transmission.
☐	☐	d. Checks manual steering gear.
☐	☐	e. Checks power steering reservoir.
☐	☐	4. Identifies and lubricates, to specifications, various under-the-hood lubrication points.
☐	☐	a. Manifold heat-control valve.
☐	☐	b. Throttle linkage.
☐	☐	c. Others.
☐	☐	5. Performs tasks in an appropriate amount of time.

PERFORMANCE EVALUATION SET
& LEARNER ACTIVITY GUIDE

CORE

ELECTRONICS PROGRAM



BASIC OSCILLOSCOPE OPERATION

3/70

13

PERFORMANCE EVALUATION SET
& LEARNER ACTIVITY GUIDE

BASIC OSCILLOSCOPE OPERATION
PE 4-1

OPS/AIR/ABLE ELECTRONICS MECHANIC LEVEL II

TASK	C. O.	T. O.
4	1	2

NAME _____

DATE _____

LEARNER ACTIVITY GUIDE

PREREQUISITES:

OBJECTIVES: Given an oscilloscope, you will measure potential difference.

COMMENTS: An electronics technician must be able to operate the oscilloscope effectively. Naturally, there are differences in scopes, but what you learn or demonstrate in this activity will apply to many different oscilloscopes.

STUDENT-INSTRUCTOR CONTRACT OPTIONS:

- ☐ 1. Student-instructor conference.
- ☐ 2. Experiment: Basic Electricity (3), Zbar Exp. 29.
- ☐ 3. Read text _____.
- ☐ 4. Other--specify _____.

EQUIPMENT, TOOLS, MATERIALS: Oscilloscope, a DC Circuit, Trainer Circuit #1, and a Power Supply.

QPS/AIR/ABLE
ELECTRONICS
MECHANIC
LEVEL II

BASIC OSCILLOSCOPE
OPERATION
PE 4-1

TASK	C.O.	T.O.
4	1	2

NAME _____

DATE _____

PERFORMANCE ACTIVITY

(Pre and/or Post Assessment)

Complete each of the steps below, in order to prove your ability to use the oscilloscope to measure potential difference.

1. Insert jumpers on Trainer Circuit #1 in the positions indicated in column 1, 2, 3, or 4 (selected by instructor).

2. Connect the LVDC power supply + to 1A and - to 1G and adjust it for 5, 10, 15, or 20 v (selected by instructor).

3. Using oscilloscope, measure voltage across the resistors identified in the column selected in Step 1, and record these voltages in column 5.

	1.	2.	3.	4.	5.
Jumper	3bc	4bc	3bc	4bc	
Jumper	3ef	4ef	4ef	3ef	
Measure	3ab	4ab	3ab	4ab	
Measure	3cd	4cd	3cd	4cd	
Measure	3de	4de	4de	3de	
Measure	3fg	4fg	4fg	3fg	

STOP _____ INSTRUCTOR CHECK
initials

4. After measuring the four voltages, record them in column 5, call the instructor, and demonstrate your technique for measuring voltage with the oscilloscope.

NOTE: When finished, turn off LVDC power supply.

OPS/AIR/ABLE ELECTRONICS MECHANIC LEVEL II	BASIC OSCILLOSCOPE OPERATION PE 4-1	NAME _____ DATE _____ MAN-HOURS _____ INSTRUCTOR _____

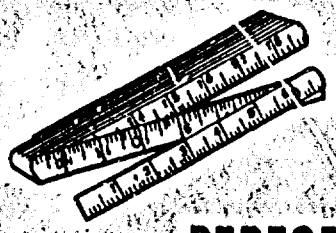
TASK	C. O.	T. O.
4	1	2

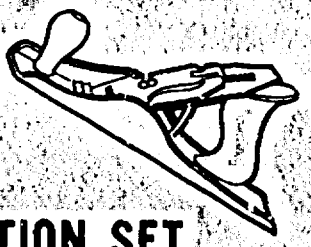
CRITERION CHECKLIST

L	M	S
☐	☐	☐

Measure potential difference with oscilloscope.

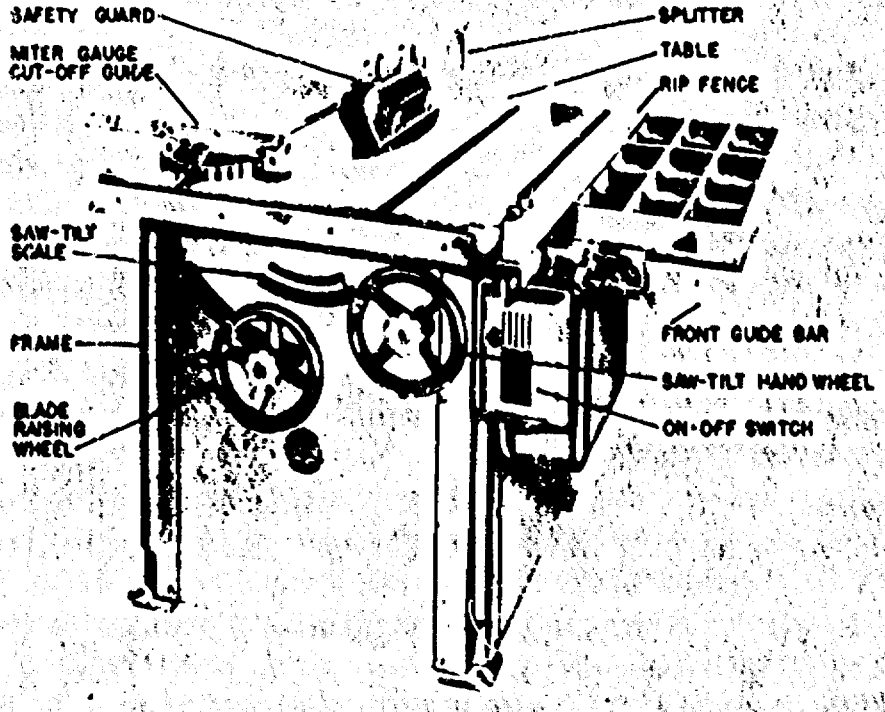
U	S	
☐	☐	1. Uses common control adjustment.
☐	☐	2. Performs scope calibration.
☐	☐	3. Derives correct reading.
☐	☐	4. Measures correct circuit.
☐	☐	5. Observes safe work habits.





PERFORMANCE EVALUATION SET & LEARNER ACTIVITY GUIDE

CORE WOODWORKING PROGRAM



CIRCULAR SAW OPERATION

PERFORMANCE EVALUATION SET
& LEARNER ACTIVITY GUIDE

OPS/AIR/ABLE GENERAL WOODWORKING LEVEL I

CIRCULAR SAW OPERATION PE 5-3

TASK	C.O.	T.O.
18	1	1-6

NAME _____

DATE _____

LEARNER ACTIVITY GUIDE

PREREQUISITES: PE 1-1, 2-1, 2-2, and 2-3.

OBJECTIVES: Given a circular saw, stock, and a blueprint, you will (following correct safety procedures):

1. Tell the difference between circular saws by blade size.
2. Identify the major parts of a circular saw by their appearance and function.
3. Identify circular saw blades by their appearance and function.
4. Choose the correct saw blade for the type of cut needed and install the blade tightly.
5. Cut stock to rough length and width ± 1/16" (or with at least 1/8" allowance where dressing or additional operations are indicated).
6. Cut stock to finish size ± 1/64" (or with at least 1/32" allowance where dressing operations are necessary).

COMMENTS: The circular saw is the most frequently used and one of the most important machine tools in woodworking.

(Continued)

STUDENT-INSTRUCTOR CONTRACT OPTIONS:

- ☐ 1. Student-instructor conference.
- ☐ 2. Follow steps on back of Drawing KD-3.
- ☐ 3. Read text Technical Woodworking, pp. 136-148.
- ☐ 4. Other--specify _____

EQUIPMENT, TOOLS, MATERIALS: Blades: Planer, rip, crosscut and combination. Push stick, miter gage, arbor wrench, square, blueprint or sketch.

QPS/AIR/ABLE GENERAL WOODWORKING LEVEL I	CIRCULAR SAW OPERATION PE 5-3	NAME _____ DATE _____ MAN-HOURS _____

TASK	C.O.	T.O.
18	1	1-6

PERFORMANCE ACTIVITY
(Pre and/or Post Assessment)

NOTE: Use the response card T-T #Z-11 for answering the questions under Steps A, B, and C. Correct answer is T.

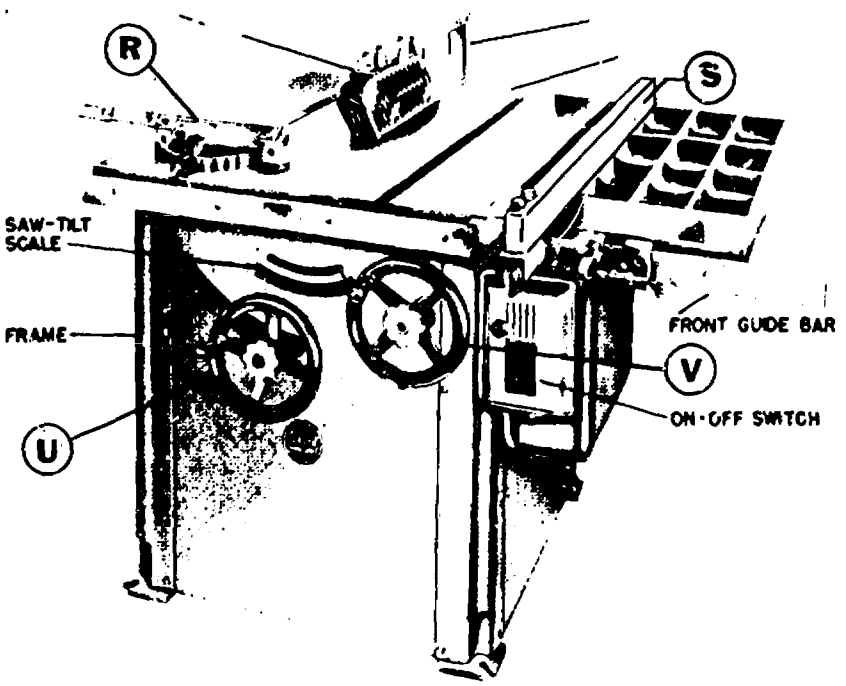
Given a circular saw, stock, and a blueprint:

Step **A.** Identify a circular saw by its blade size.

1. The size of a circular saw is determined by the

   a. diameter of the blade.
   b. coarseness of the teeth.
   c. size of the table.
   d. number of teeth in the blade.

B. Identify the parts of a circular saw by their appearance and function.



3/70

2. R = b. ripping fence
   d. miter gage saw tilt wheel

3. S = b. ripping fence
   d. miter gage

4. U = b. saw tilt wheel
   d. blade raising wheel

5. V = a. saw tilt wheel
   b. blade raising wheel

6. O = c. safety guard
   d. splitter

7. P = c. table
   d. table extension

8. N = a. splitter
   b. guide bar

C. Identify circular saw blades by their appearance and function.

W

X

Y

Z

9. W = a. best for grooving
   b. best for crosscutting

10. X = c. best for grooving
    d. best for crosscutting and ripping

11. Y = a. best for ripping
    b. best for crosscutting

12. Z = c. best for grooving
    d. best for ripping

D. Choose the correct saw blade for the type of cut needed and install the blade tightly. Do this now or show the instructor how you would do it.

STOP_____
initials

INSTRUCTOR CHECK:
Check A, B, C and D above on Criterion Checklist. Check safety items on the following machine operations.

E. Cut stock to rough length.

STOP _____ initials

INSTRUCTOR CHECK: Complete assessment on Criterion Checklist. Check safety items on finish cuts.

F. Cut stock to finish size. Have instructor complete evaluation.

OPS/AIR/ABLE
GENERAL
WOODWORKING
LEVEL I

CIRCULAR SAW
OPERATION
PE 5-3

TASK	C.O.	T.O.
18	1	1-6

NAME
NAME
DATE
MAN-HOURS
INSTRUCTOR

CRITERION CHECKLIST

L M S

Operates circular saw (machine and parts identification; blades, blade functions and installation; correct and safe use; rough and finish cuts).

U	S	
☐	☐	1. Tells the difference between circular saws by blade size.
☐	☐	2. Identifies the major parts of a circular saw by their appearance and function.
☐	☐	3. Identifies circular saw blades by their appearance and function.
☐	☐	4. Chooses correct saw blade for the type of cut needed and installs blade tightly.
☐	☐	5. Cuts stock to rough length and width ± 1/16" (or with at least 1/8" allowance where dressing or additional operations are necessary).
☐	☐	5.1 Chooses specified stock required by print.
☐	☐	5.2 Sets ripping fence from inside of blade from tooth set toward the fence.
☐	☐	5.3 Positions stock <u>cup side up</u>. 
☐	☐	5.4 Cuts off rough lumber from mill end cut.
☐	☐	5.5 Keeps height of blade 1/8" above thickness.
☐	☐	5.6 Cuts length from right hand side of saw blade.
☐	☐	5.7 Leaves proper amount of stock for dressing.
		5.8 Turns machine power off when operation is completed.

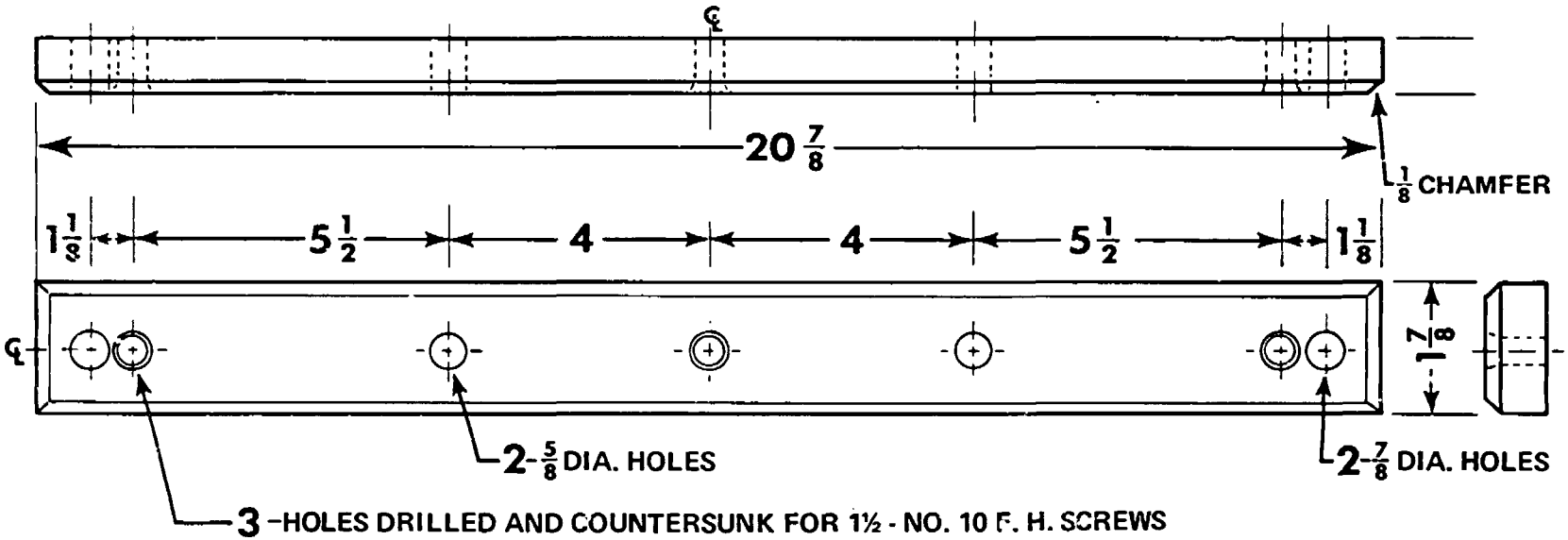
U	S	
☐	☐	5.9 Lowers saw blade after finishing cut.
☐	☐	6. Cuts stock to finish size ± 1/64" (or with at least 1/32" allowance where dressing operations are necessary). Performs to similar criteria to that specified for cutting of rough stock. Checks blade to table for 90° adjustment.
☐	☐	7. Observes ALL critical safety procedures for proper use of the saw.

TOOLS AND MACHINES TO USE

JOINTER - THICKNESS PLANNER - DRILL PRESS - DRILL - DISC SANDER - SCREWS
SCREWDRIVER - COUNTERSINK - SQUARE - MARKING GAGE - T BEVEL - RULE
KNIFE - STRAIGHTEDGE - CIRCULAR SAW - DIVIDERS - MACHINE BIT - WIRE - GAGE
RADIAL SAW

ACTIVITIES

DRESSING LUMBER - USING POWERTOOLS - CHAMFERING - LAYING OUT - BORING
DRILLING - COUNTERSINKING - FASTENING WITH WOOD SCREWS - SPACING ON
DIAMETERS - BLUEPRINT READING - SCREW SHANK CLEARANCE HOLES



KIND OF WOOD SPECIFIED BY INSTRUCTOR

QUINCY VOC TECH GEN WOOD DEPT	KNEEHOLE DESK LEG CLEAT	DWN BY FL. P.T.	QUANT 1	SCALE	DATE 6 - 69	PART NO. 31	DWG NO. KD - 3	MAT'L TO SUIT	REV. 1

Step 1. Get the specified stock. Check thickness, width and length.

2. For rough cuts, mark the length about 1/2" longer than the finished dimension. If an end of the stock has not been previously cut, add another 3" for the first rough cut. (Rough lumber mill cuts contain grit and dirt.)

3. Use the circular saw to cut the rough piece. (If 3" has been allowed for cutting off the rough lumber mill cut, cut this off now.) SAFETY--glasses, loose clothing, etc.

4. Set ripping fence to width plus 1/2".

5. Adjust height of blade. It should project 1/8" above the stock.

6. Inspect stock for warp and cup. Keep cupped surface facing up from the table. Cut stock to width. Keep your body to the left side of the saw blade. Use push stick if necessary.

7. Stock having working surfaces which have been planed to thickness, should have the ends cut square. Use the miter gage.

8. Set your fence to the width plus 1/64" to 1/32". The extra stock will allow for planing off saw marks.

9. Set fence to the required length. Use the miter gage and cut stock to length. If the ends are to be sanded smooth on disc sander allow an extra 1/32".

10. The stock may be too short to cut to length with the miter gage between blade and fence. In this event, put the miter gage on the left side of the blade. Use a cut-off block clamped to the fence.

11. Shut off machine when finished. Lower the blade below the table surface.

APPENDIX E

Sample Learning Unit:
Power Mechanics

DOT #915.867

UNIT # 3-1

POWER MECHANICS

JACKS AND LIFTS

JULY 1969

Prepared by

Quincy Public Schools
Coddington Street, Quincy, Massachusetts 02169

American Institutes for Research
135 North Bellefield Avenue, Pittsburgh, Pennsylvania 15213

as part of Project ABLE under Contract No. OE-5-85-019
with the Bureau of Research, Office of Education
U. S. Department of Health, Education, and Welfare

Name

Date

Hr Min

Power Mechanics 915.867
Learning Unit #3-1
(1hr. 30min.) 7-69

JACKS AND LIFTS

OBJECTIVE: In this project, you will raise vehicles correctly and safely using the twin-post lift. You will also use both the floor jack and combination bumper-frame jack with safety stands.

OVERVIEW: There are many jobs which require lifting the vehicle. In some cases, jacks are used when only one end or one wheel need be raised. However, when rotating tires, lubricating, etc., the lift becomes a valuable time-saver in lifting the entire vehicle.

You must know which type of jack can or cannot be used with various makes of cars. For example, bumper jacks cannot be used on some vehicles. Furthermore, lift points are different from one make car to another. You must know how to adjust the lift and jack and where to attach the unit under the vehicle frame. Improper placement could cause serious mechanical damage to the car. More important, vehicles can fall or slip from improperly placed jacks and lifts.

Bumper jacks of the type used for emergency road use (furnished with car and mounted in the trunk) are unsafe for repair work. In fact, safety stands are usually required when using the floor and bumper-type industrial jacks.

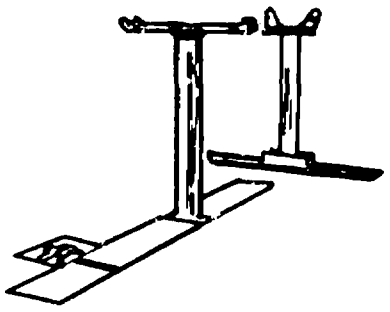
EQUIPMENT: Floor jack, combination bumper-frame jack, twin-post lift, two safety stands, service guide manual.

T-T No. Z-11: The correct answer is **T**. Start with question **18**.

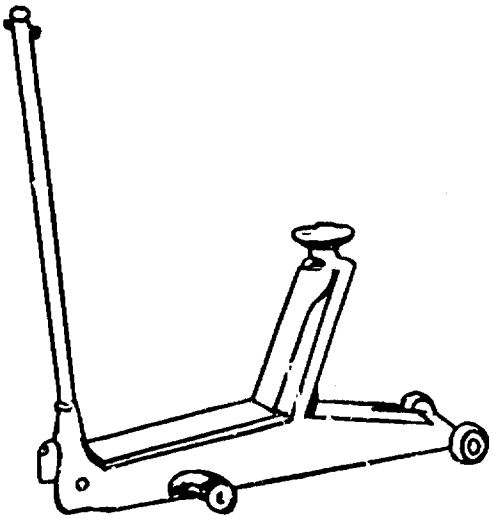
Project ABLE
Quincy Public Schools
American Institutes for Research

INTRODUCTION:

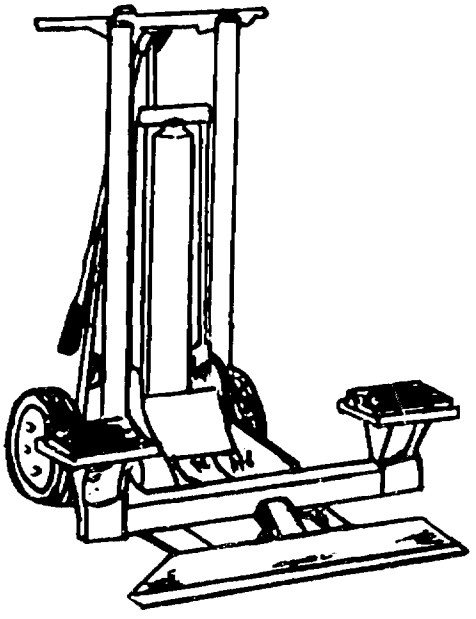
Three common hydraulic lifting devices used in service stations and garages are lifts, floor jacks, and combination bumper-frame jacks of the type shown below.



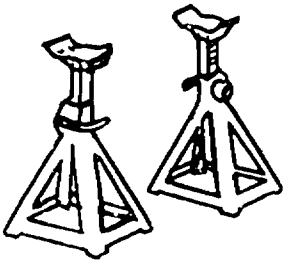
Twin Post Lift



Hydraulic Floor Jack



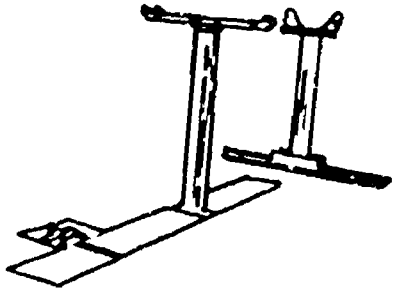
Bumper Jack



Safety Stands

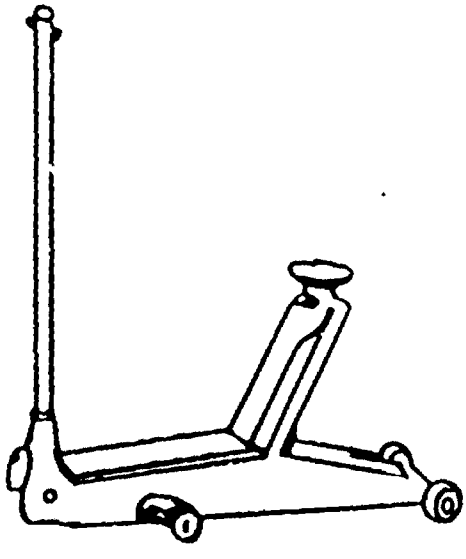
Twin-post lift:

The twin-post lift is used to best advantage when the job requires raising the entire vehicle. For example, lubrication and oil change, tire rotation, brake shoe adjustment and brake service, exhaust system inspection, suspension service, shock absorber replacement, etc.



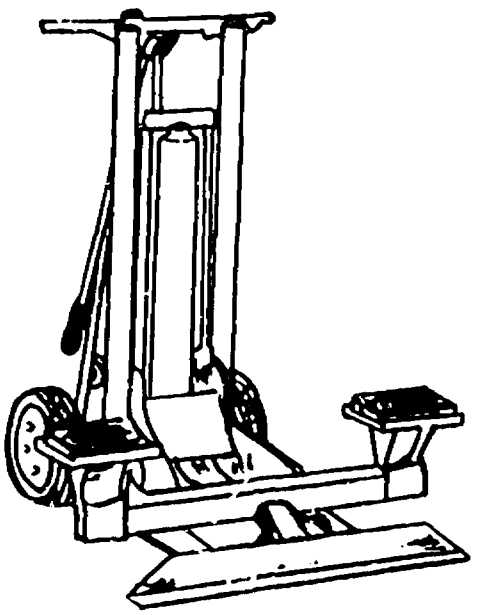
Floor jack:

While the twin-post lift can be used to raise one end of the vehicle, it is often more convenient to use the floor jack or the combination bumper-frame jack. The floor jack is also used when changing one tire or similar tasks which require raising only one corner of the car. Floor jacks are usually used when placing the car on safety stands for such jobs which would tie up the lift for too long a period of time.



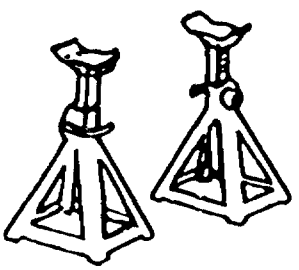
Combination bumper-frame jacks:

While the floor jack has only one lifting point, the combination bumper-frame jack has two lift points. It is probably more stable than the floor jack when the bumper is strong or when frame members are accessible. Some autos, such as Volkswagons through 1968, cannot be lifted by bumper type jacks. Some of the larger cars are too heavy to be lifted by the bumper.



Safety Stands:

Safety stands must always be used with floor jacks and combination bumper-frame jacks. Floor jacks and combination bumper-frame jacks can be dislodged by other vehicles or persons moving about the shop.



UNIT OBJECTIVE 1:	Safely raise a vehicle with the twin-post lift using correct procedures and appropriate lift points.

Step **1.** Ask the instructor to drive vehicle into position. NOTE: Students are <u>not</u> allowed to drive vehicles in school shop.

2. Check vehicle position. It must be centered squarely over the lift pistons. The rear wheels must be in chucks (depressions in floor) which automatically centers vehicle rear axle housing over rear lift saddle. This method is for front-engine autos. Rear engine vehicles require other arrangements.

3. Place transmission in NEUTRAL. Do NOT set parking brake--check and release.

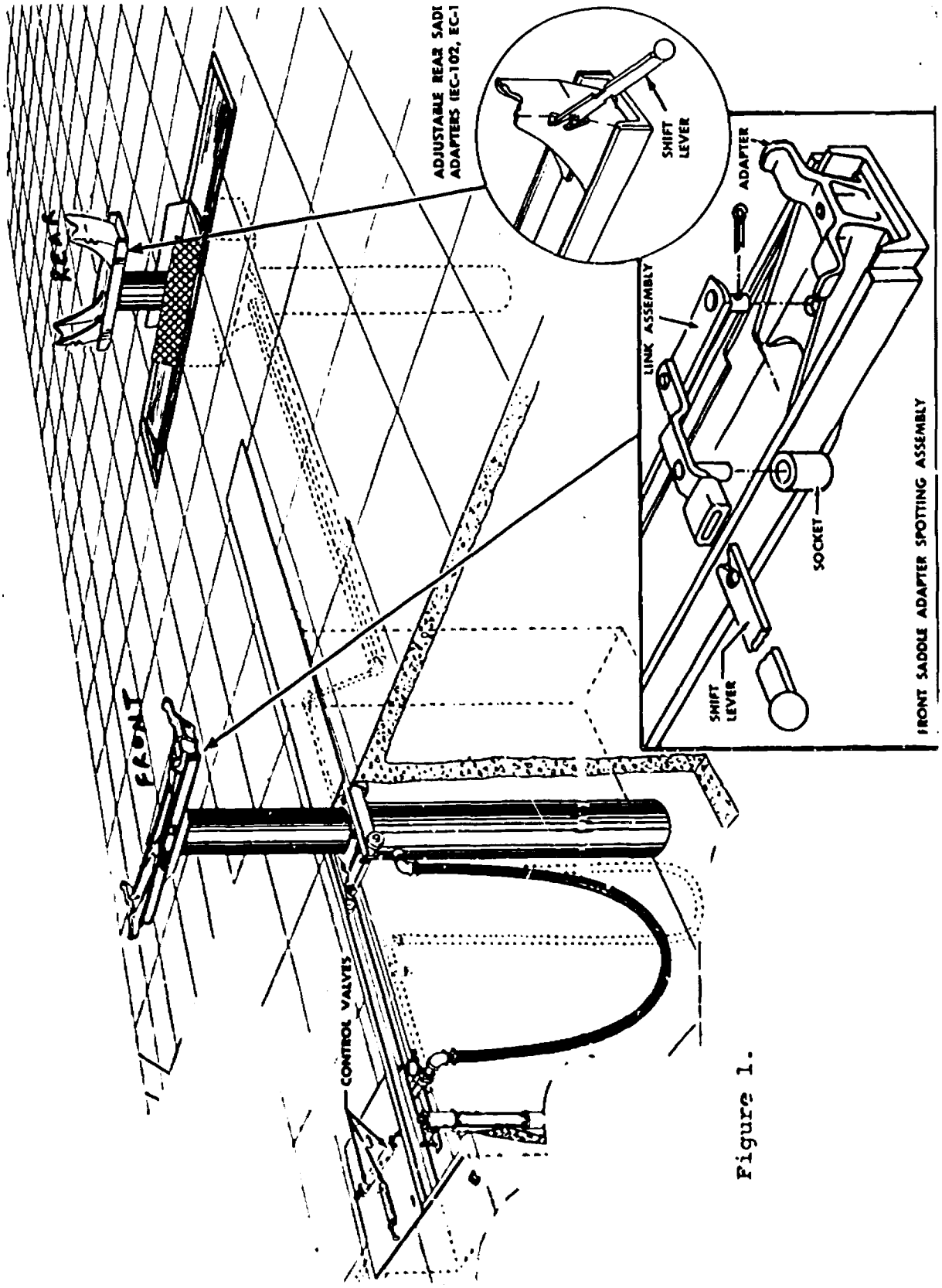

ADJUSTABLE REAR SADDLE ADAPTERS (EC-102, EC-1
SHIFT LEVER
ADAPTER
LINK ASSEMBLY
SOCKET
SHIFT LEVER
FRONT SADDLE ADAPTER SPOTTING ASSEMBLY
REAR
FRONT
CONTROL VALVES

Figure 1.

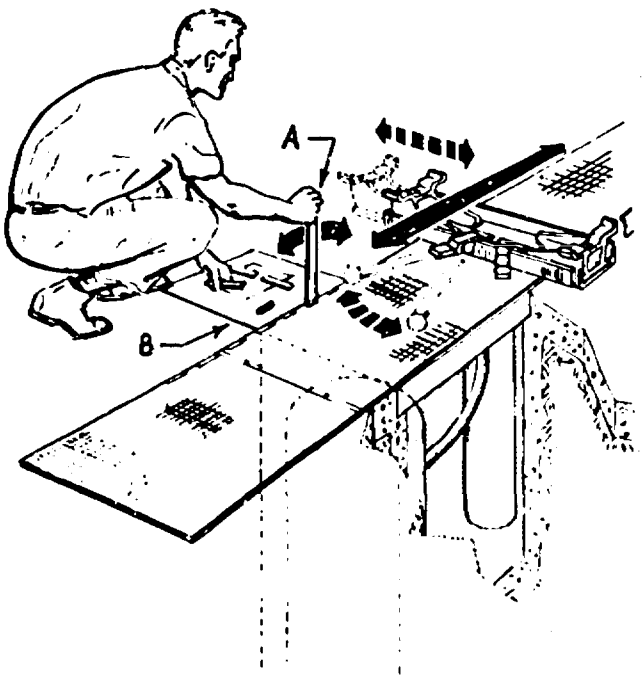
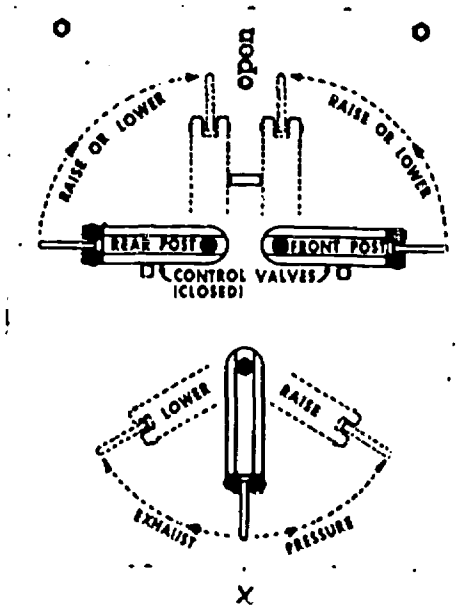


Figure 2

4. Use shift handle "A" to position front piston. Use same handle to position adapters in saddle. Keep shift handle in control cover slot "B" when not in use.

5. Select lift points.
NOTE: See lube chart for manufacturer's recommended lift point. In general: front axle or suspension should be cradled in adapters; permit no contact with tie rods or steering arms; spread front saddle adapters as far apart as possible. Special swivel adapters are available if additional clearance is required.
NOTICE: Never place a lift or jack into contact with a vehicle until instructor checks positioning of vehicle and saddles. You may be liable for damages caused by violation of this shop rule.



Operator here ↗ facing vehicle.

Figure 3

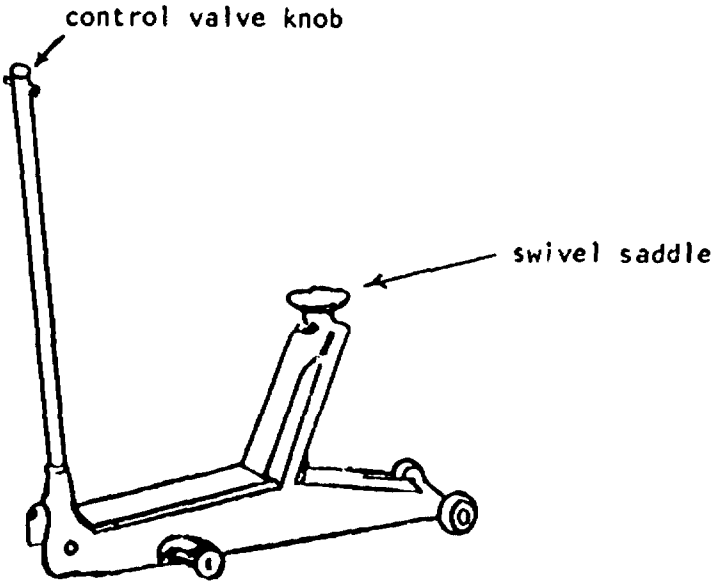
6. Now raise the posts to within a few inches of the vehicle.
   a. Move lower control to PRESSURE.
   b. Push REAR POST control valve toward OPEN. Stop before touching vehicle. Check for proper alignment under rear axles.
   c. Repeat for FRONT POST. Adjustment will be required to properly position front post adapters. Spread as far apart as possible. Permit no contact with tie rods or steering arms.

STOP _____ INSTRUCTOR CHECK #1:
initials Have student make "contact" and raise vehicle.

7. Now open both piston controls. Release when desired height is reached.
   NOTE: One piston may move faster than the other. The vehicle should be level at all times--going up or down. Adjust speed of each piston with the control valves (FRONT POST or REAR POST).

8. Place air control on NEUTRAL "x" and front post and rear post valves on CLOSED while working on vehicle.
9. To lower: Place air control on EXHAUST. Open both piston controls (REAR POST and FRONT POST). Hold open until front saddle rests on floor and doors close on rear saddle.
10. Check again to make certain both posts are down.

UNIT OBJECTIVE 2:	Safely raise a vehicle with the floor jack using correct procedures and proper lift points.



Step 1. Check service guide manual lube chart for lift points which are best suited to lifts (those which raise the entire vehicle). Lift points also include heavy steel cross members, frames, axle housing, spring hanger or saddle and A-frames. Do not attempt to lift on engine, transmission, drive lines, or sheet metal sections.

2. Position swivel saddle under vehicle lift point.

3. Close hydraulic valve by turning knob in clockwise ↷ direction until snug.

4. Bring saddle to within an inch or two of contact with lift point by moving handle in up and down (pumping) motion.

Read ahead--discuss safety stands and lift points with instructor.

STOP _____ initials

INSTRUCTOR CHECK #2: Have student make "contact" and raise vehicle. Have him demonstrate proper use of safety stands. Have student identify proper lift points for each position in STEP 5. Make certain he used the manual to identify lift points.

NOTE: You will place safety stands in proper position for each of the lift points in STEP 5. NEVER, NEVER work under or around a car raised off the ground by a floor jack or combination bumper frame jack without first properly positioning SAFETY STANDS. Have instructor check your placement of safety stands. In general, safety stands are placed as far apart as possible on frame members or other lift points.

WARNING: No student at any grade level is allowed under or around any vehicle which is raised from the ground until:

1. Safety stands are in place (for cars on jacks).
2. Instructor has checked and approved positioning of lift or jacks with safety stands.

5. Repeat the above steps in each of the following positions. Place safety stands at proper point for each lift position. Check ☑ as you complete each step. Lower vehicle slowly.

- ☐ One front wheel.
- ☐ Complete front end.
- ☐ One rear wheel.
- ☐ Complete rear end.

UNIT OBJECTIVE 3:	Safely raise a vehicle with a combination bumper-frame jack using correct procedure and proper lift points.

Step 1. Identify lift points. Always use the frame if possible. NOTE: There are no available references for bumper lift instructions other than the auto manufacturer's manual for each make, year, and model car. Check with mechanic on lift points.

2. Place jack under front-end or rear-end frame and adjust saddles to proper lift points. Spread as wide as possible. CAUTION: Check for obstructions--you could puncture a gas tank, ruin a front-end section, etc.

3. Bring saddles to within an inch or two of contact. Close hydraulic valve by turning notched end of jack in clockwise direction. Pump by moving handle in up-down motion.

Read ahead--discuss safety stands and lift points with instructor.

STOP _____ initials

INSTRUCTOR CHECK #3: Have student make "contact" and raise vehicle. Have student demonstrate proper use of safety stands. Have student identify proper lift points for each position in STEP 4.

NOTE: The same safety regulations apply as outlined for the floor jack.

NOTE: When lifting on bumper, position each saddle in the center of a bumper bracket.

4. Repeat the above steps in each of the following positions. Place safety stands at proper points for each lift position. Check ☑ as you complete each step. Lower vehicle slowly.

   ☐ Front bumper.
   ☐ Front frame.
   ☐ Rear bumper.
   ☐ Rear frame.

REFERENCE: None available other than lube charts for lift points.

SUMMARY: Working around raised vehicles is one of the more hazardous tasks for the mechanic. You now know how to use three major types of jacks and lifts--you will use them often. Always check lift points, observe the safety rules, and get instructor checks before raising vehicles.

UNIT EVALUATION

Jacks and Lifts

Test Questions: T-T No. Z-11. The correct answer is T.

18. After positioning vehicle on twin-post lift, place transmission in

    a. PARK and set parking brake.
    b. NEUTRAL and set parking brake.
    c. PARK and do not set parking brake.
    d. NEUTRAL and do not set parking brake.

19. When adjusting the front saddle adapters on the twin-post lift

    a. spread as wide as practical.
    b. avoid spreading if possible.
    c. place snugly against tie rods or steering gear.
    d. do not permit contact with front axle or suspension.

20. The combination bumper-frame jack

    a. has safety features which do not require safety stands.
    b. should be placed against the bumper when possible.
    c. should not be used if the floor jack is available.
    d. should be placed against the frame when possible.

Identify the proper lift points for a floor jack:

21. Oil pan

    c. Lift point d. Not a lift point

22. Frame

    c. Lift point d. Not a lift point

23. Drive line

    c. Lift point d. Not a lift point

24. Cross members

    b. Lift point c. Not a lift point

25. Bumper

    c. Lift point d. Not a lift point

26. Transmission

    c. Lift point d. Not a lift point

(Continued)

27. A-frame or saddle
    c. Lift point d. Not a lift point

28. Radiator
    c. Lift point d. Not a lift point

29. Axle housing or differential
    b. Lift point c. Not a lift point

30. Spring hanger
    c. Lift point d. Not a lift point

Instructor Checks:

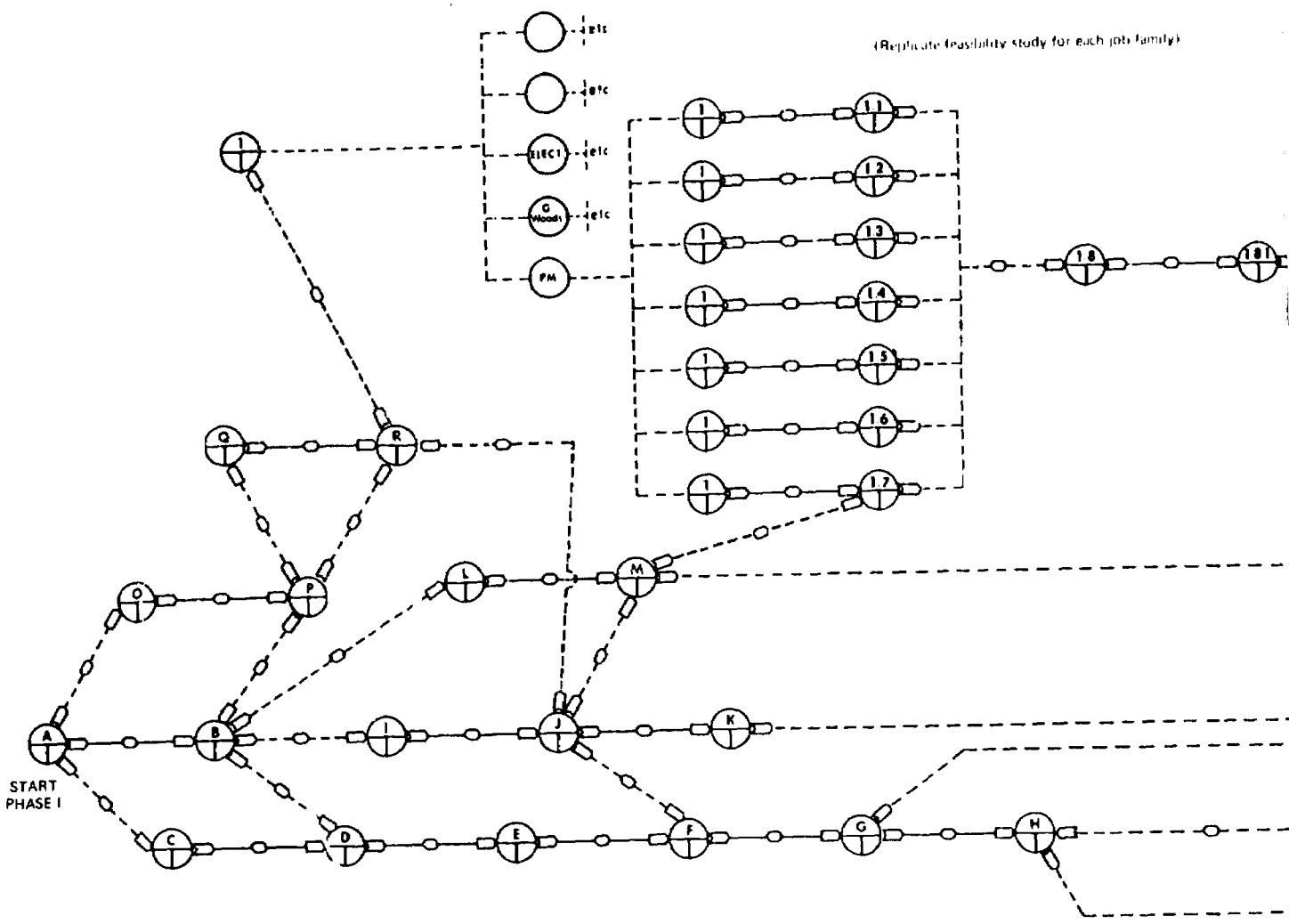
1.	Correctly answers 80% (10) of the test questions.	U | S
2.	Safely raises a vehicle with the twin-post lift using correct procedures and appropriate lift points.	
	a. Positions vehicle properly.	U | S
	b. Places transmission in NEUTRAL and releases parking brake.	U | S
	c. Positions front piston and spreads saddles as wide as possible at appropriate lift points, without touching tie rods or steering arms.	U | S
	d. Gets instructor check before making contact with vehicle.	U | S
	e. Properly operates control valves.	U | S
3.	Safely raises a vehicle with floor jack using correct procedures and proper lift points.	
	a. Identifies proper lift points.	U | S
	b. Gets instructor check before making contact with vehicle.	U | S
	c. Properly places and uses safety stands.	U | S
	d. Raises vehicle to a secure position from four different locations. Lowers vehicle slowly and safely.	U | S

(Continued)

4.	Safely raises a vehicle with a combination bumper-frame jack using correct procedures and proper lift points.		
	a. Identifies proper frame and bumper lift points.	U	S
	b. Gets instructor check before making contact with vehicle.	U	S
	c. Properly places and uses safety stands.	U	S
	d. Raises vehicle to a secure position from front and rear frame and bumper positions.	U	S
5.	Performs unit in an appropriate amount of time.	U	S

APPENDIX F

Application of PERT to Instructional System Development for Multiple Job Family Projects in Vocational and Technical Education

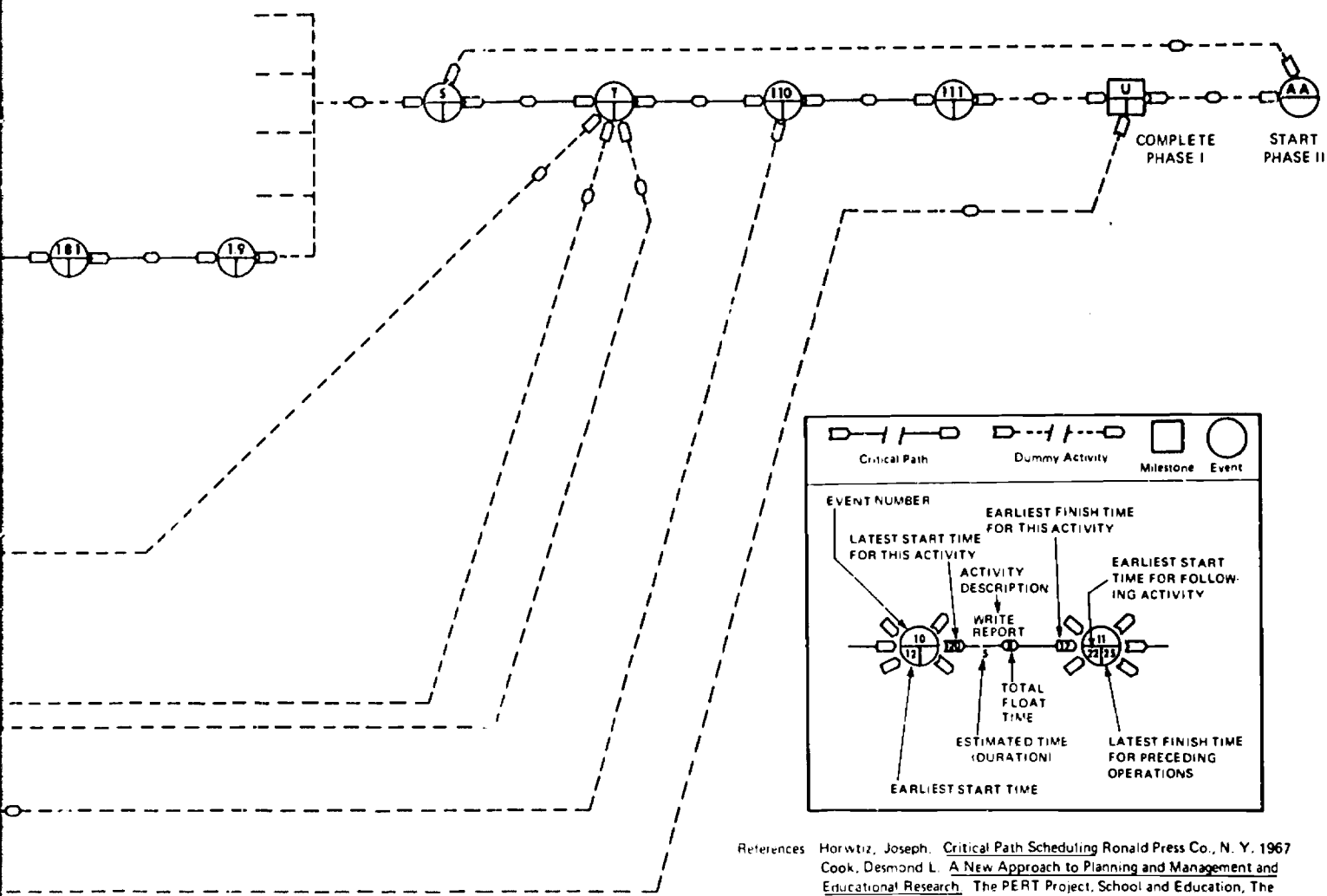


PHASI

START PROJECT AND COMPLETE FEASIBI

APPLICATION OF PERT TO INSTRUC

FOR MULTIPLE JOB FAMILY PROJECTS IN VO



References Horwtiz, Joseph. Critical Path Scheduling Ronald Press Co., N. Y. 1967
Cook, Desmond L. A New Approach to Planning and Management and Educational Research. The PERT Project, School and Education, The Ohio State University, 1964

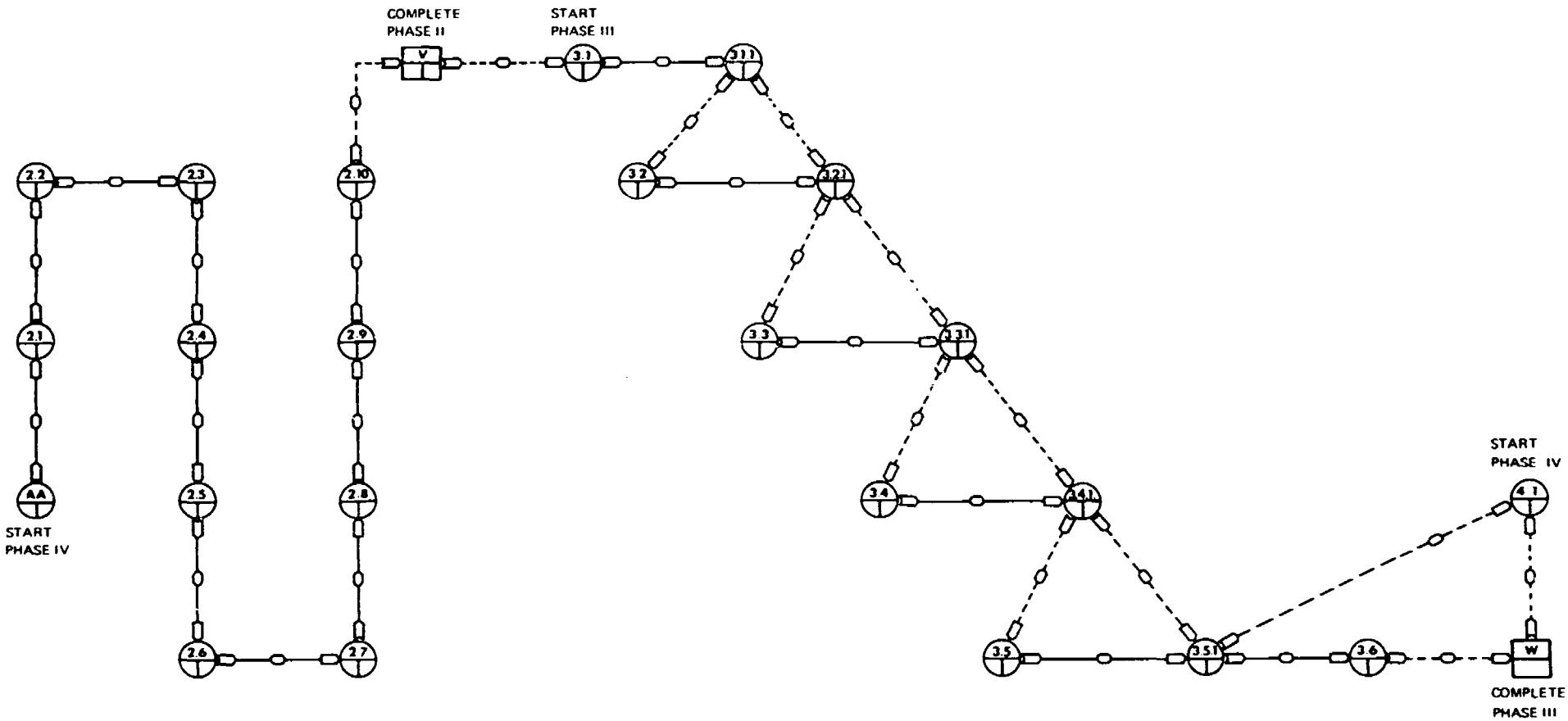
PHASE I

FEASIBILITY STUDY FOR EACH JOB FAMILY

NSTRUCTIONAL SYSTEM DEVELOPMENT

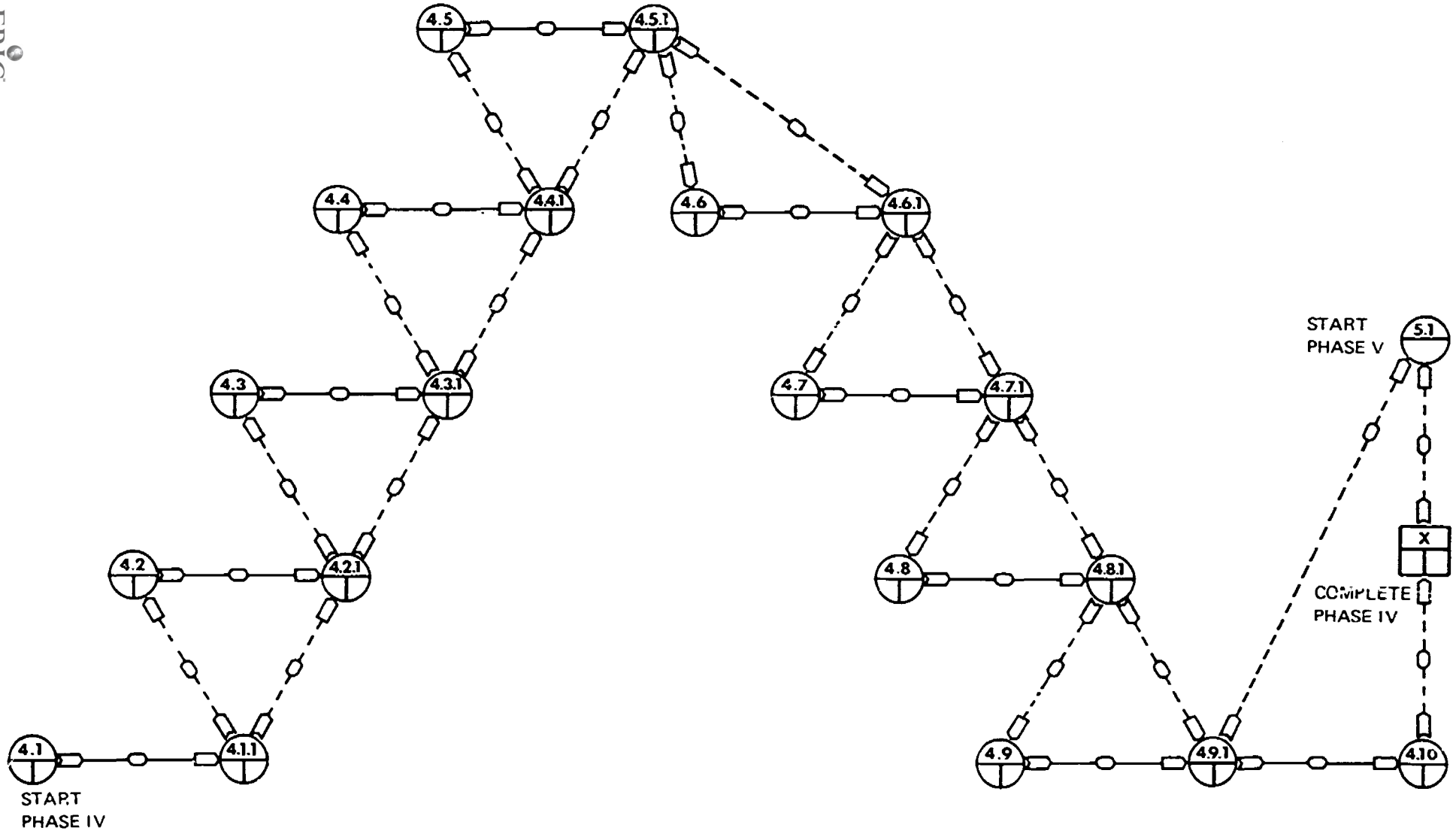
TS IN VOCATIONAL AND TECHNICAL EDUCATION

J.W.U. 4/70

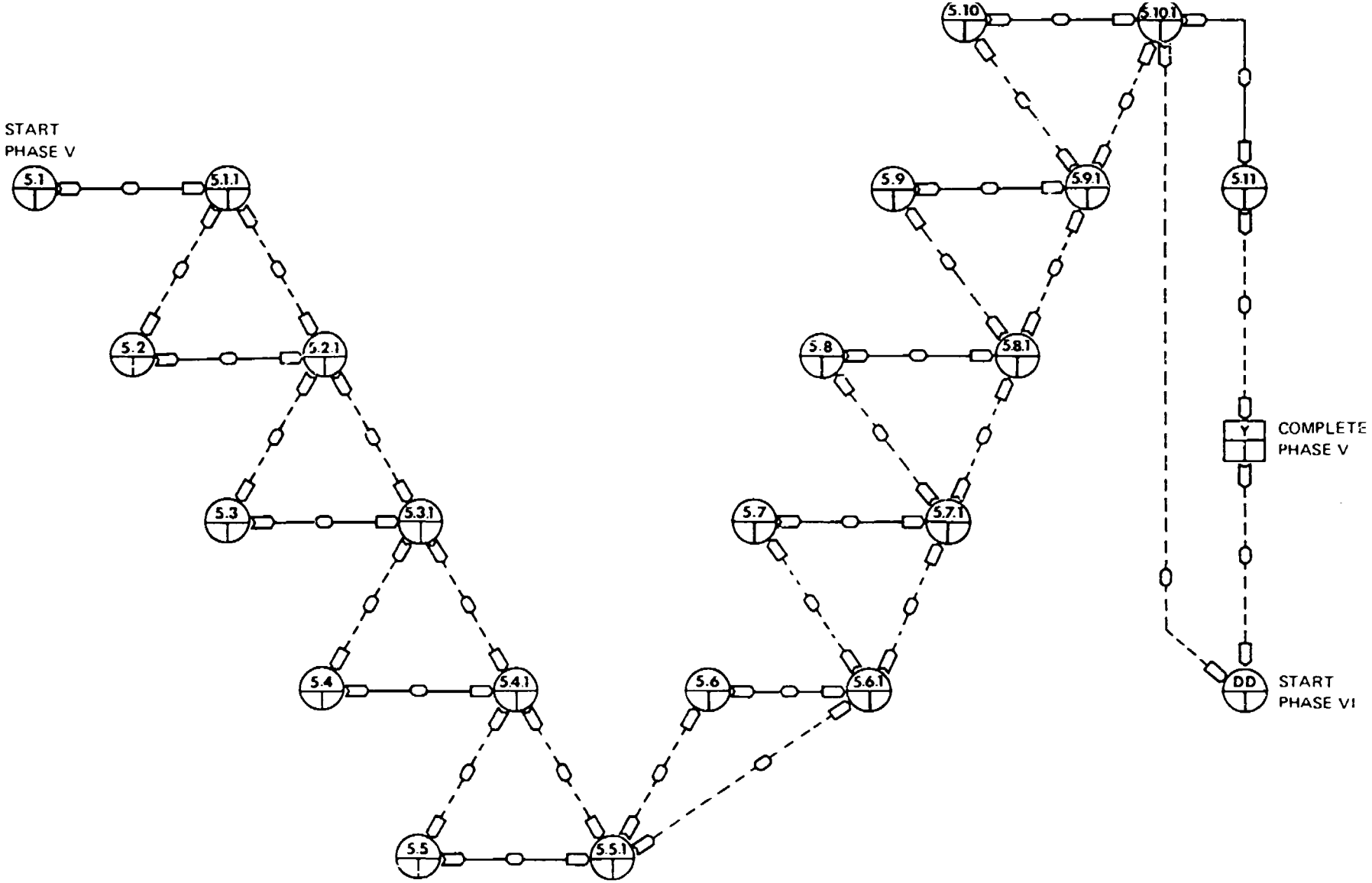


PHASE II
CONDUCT JOB AND TASK ANALYSIS
(Process must be replicated for each job family)

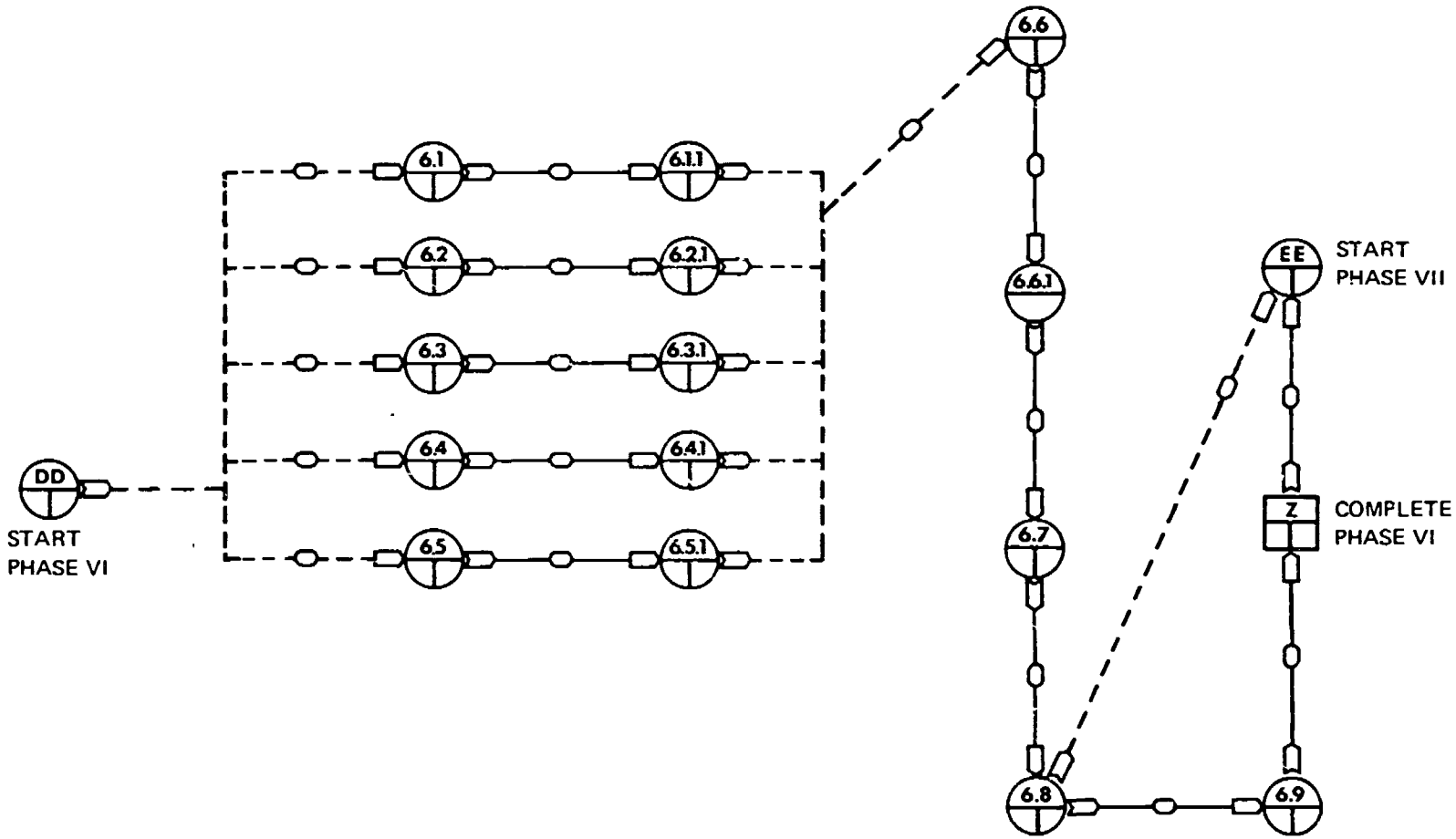
PHASE III
DEVELOP PERFORMANCE OBJECTIVES
(Process must be replicated for each job level and family)



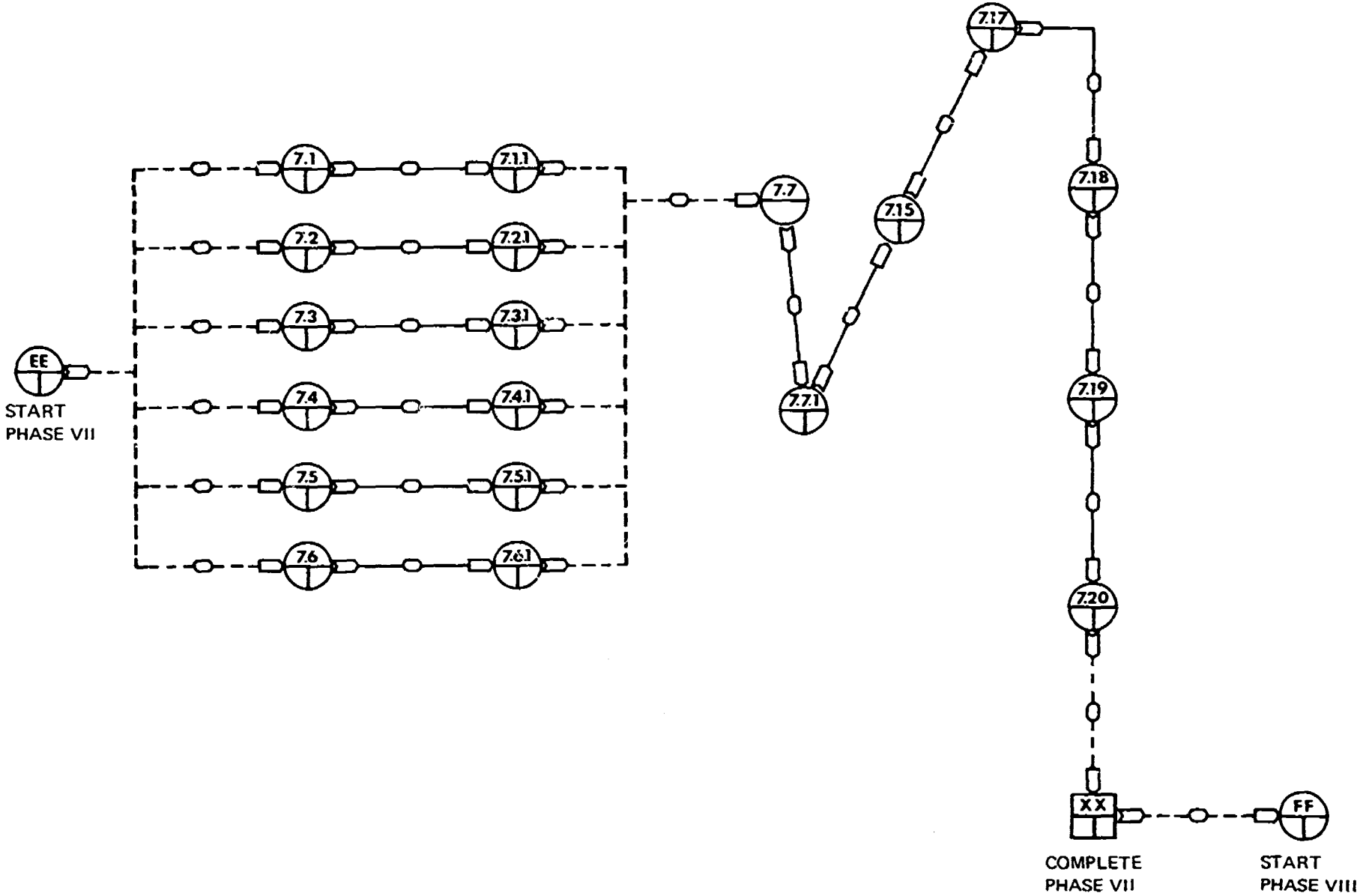
PHASE IV
DEVELOP AND VERIFY CRITERION INSTRUMENTS
(Process must be replicated for each job level and family)



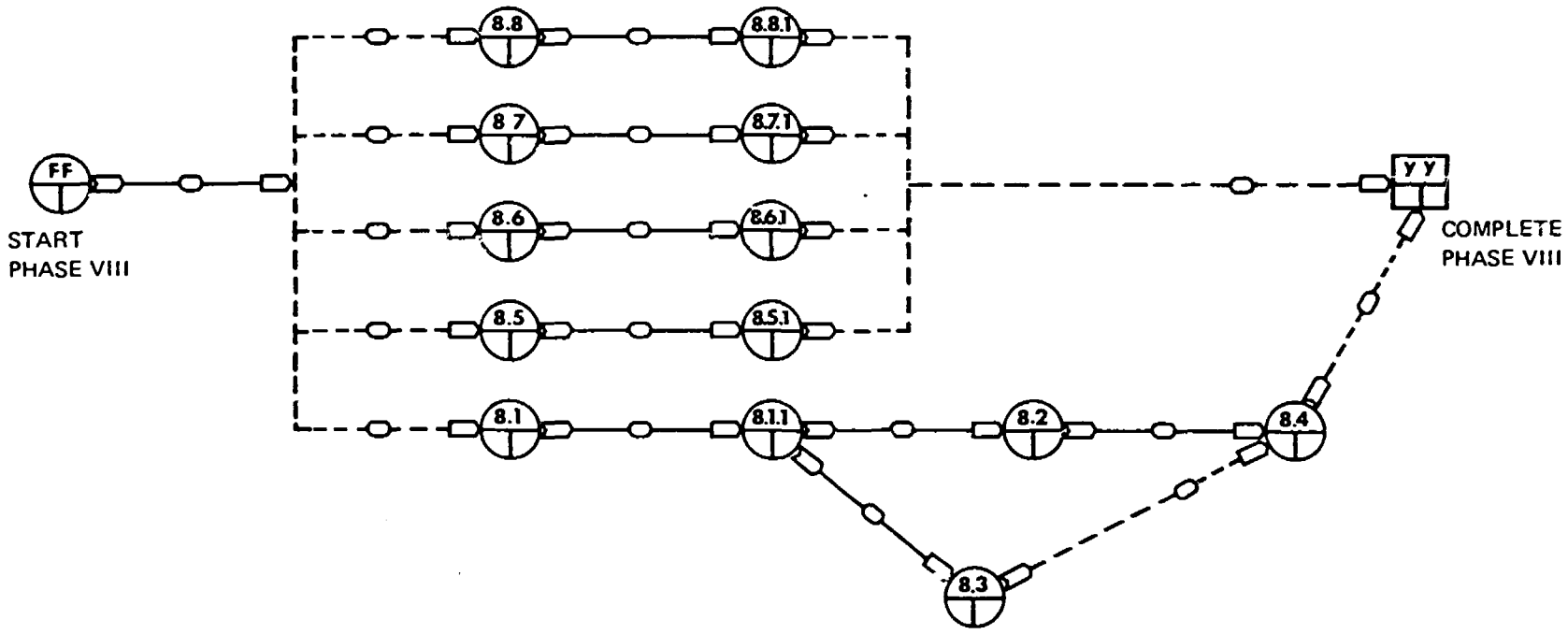
PHASE V
DEVELOP LEARNER ACTIVITY GUIDES
(Process must be replicated for each job level and family)



PHASE VI
VERIFY INDIVIDUAL MODULES
(Validation Possible)
(Process must be replicated for each job level and family)



PHASE VII
IMPLEMENT SYSTEM
(Process must be replicated for each job level and family)



PHASE VIII
FOLLOW-UP OF GRADUATES
(Process must be replicated for each job level and family)

WORK SHEET

Application of PERT to Instructional System Development for Multiple Job Family Projects in Vocational and Technical Education

PHASE I

Start Project and Conduct Feasibility Study for Each Job Family
(Feasibility Study must be replicated for each job family)

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
	A	Start Phase I					
A	B	Conduct preliminary administrative activities--one complete scheduling through CPM and PERT.					
A	C	Dummy					
C	D	Prepare RFP on commercial dissemination (for involvement of publishers and private industry.)					
D	E	Process clearance with USOE on commercial dissemination Revise RFP accordingly.					
E	F	Conduct RFP distribution. Conduct selection.					
F	G	Negotiate and write contract for commercial dissemination.					
G	H	Sign contracts (1.10 dependency).					
B	D	Dummy (dependency)					
B	I	Dummy					
I	J	Secure Technical Advisory Board review of: R&D procedures; administrative considerations, PERT; available resources, staff training; publishers; feasibility study; funding, etc.					
J	K	Secure action on Technical Advisory Board recommendations (reports, revisions, etc.)					
B	L	Dummy					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
L	M	Conduct visitation and establish contacts with prototype schools and R&D centers in the military, industry, etc. Collect all available materials, behavioral objectives, criterion tests, etc.					
J	M	Dummy (dependency)					
J	F	Dummy (dependency)					
A	O	Dummy					
O	P	Identify and recruit staff.					
P	B	Dummy (dependency)					
P	Q	Dummy					
Q	R	Orient and train staff.					
P	R	Dummy (dependency)					
J	R	Dummy (dependency)					
R	1	Dummy					
1	1.1	Focus on and select jobs which, in comparison with related jobs, require performance of a wider variety of tasks and a larger range of skill levels.					
1	1.2	Focus on and select jobs which require an appropriate amount of vocational training time (given various limitations of schools).					
1	1.3	Focus on and select jobs which have entrance, apprenticeship, or on-the-job training requirements which can be met better as a result of vocational training.					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
1	1.4	Focus on and select jobs which are appropriate with respect to the cost, size, support requirements, staffing, and expected usage of training facilities and training equipment.					
1	1.5	Focus on and select jobs which are predictable with respect to the skills and knowledges which will be required in the next five years.					
1	1.6	Focus on and select jobs which have favorable employment expectations.					
1	1.7	Determine and document availability of research information and materials applicable to the developmental stages and processes.					
M	1.7	Dummy (dependency)					
1.1--1.7	1.8	Dummy					
1.8	1.8.1	Prepare feasibility study report with supporting documentation, recommendations, cost projection, equipment & materials needed, etc.					
1.8.1	1.9	Verify feasibility study (panel of experts and project officials).					
1.9	S	Dummy					
S	T	Prepare for Policy Board meeting--review and summarize reports, CPM and PERT, prepare recommendations, etc.					
M	T	Dummy (dependency)					
K	T	Dummy (dependency)					
G	T	Dummy (dependency)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
T	1.10	Policy review--make decisions.					
1.10	H	Dummy (dependency)					
1.10	1.11	Modify and adjust as result of policy agreement.					
1.11	U	Dummy (Complete Phase I)					
H	U	Dummy (dependency)					
U	AA	Dummy (Start Phase II)					
S	AA	Dummy (Start portions of Phase II activity prior to completion of Phase I)					

PHASE II

Conduct Job and Task Analysis

(Process must be replicated for each job level and family.)

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
	AA	START					
AA	2.1	Enumerate job titles for entire occupational family.					
2.1	2.2	Group and arrange job titles on hierarchy of skills, knowledges, and training time from D.O.T.					
2.2	2.3	Cluster job title by subfamilies or groups from an analysis of job tasks horizontally and vertically within the hierarchy.					
2.3	2.4	Select representative jobs (for training vehicle) for each cluster and evolve a flow chart illustrating milestones or exit levels within the hierarchy.					
2.4	2.5	Develop a job description document for the first exit level. Must include definition of population, statement of mission, segments, functions, and contingencies. Must also include a preliminary and tentative task classification enumeration by basic (job entry level) advanced, specialty, auxiliary, and redundant categories.					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
2.5	2.6	Develop questionnaire--observation instrument/s for validation of job description and task classification. (Data to be collected should enable a ranking by frequency of tasks performed by pay or job level. Identification should be attempted of critical tasks such as those which involve a human safety or damage factor with expensive equipment and the "money makers". Other data and information may be necessary.) NOTE: All or part of the required information may be available as a result of activities from PHASE I on I-J, L-M and 1-1.7.					
2.6	2.7	Verify (in the field) job description and task classification-enumeration. (Validation possible.) Collect and analyze data and finalize job description and task classification-enumeration. NOTE: All or part of the required information may be available as a result of activities from PHASE I on I-J, L-M and 1-1.7.					
2.7	2.8	Prepare Course Development Progress Chart matrix showing estimated man-hour requirements for each developmental phase by basic job task.					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
2.8	2.9	Review recommendations. Review estimates on man-hour projections, costs by category, scope of work, schedule of work, PERT analysis, personnel needs, equipment and material needs, etc. Review policy decisions.					
2.9	2.10	Make necessary adjustments.					
2.10	V	Dummy (Complete PHASE II)					
V	3.1	Dummy (Start PHASE III)					

PHASE III
Develop Performance Objectives
(Process must be replicated for each job level and family.)

NOTE: The following activities also relate to the sequence which can be applied task-by-task. The process, then, must be replicated for each task. (Start with the easiest task.) Of course, the time estimates and PERT chart relate to a job family or level as a whole.

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
V	3.1	Dummy (Start PHASE III)					
3.1	3.1.1	Formulate terminal performance objectives, by job tasks, for each basic task identified in job description. (Can usually be secured from the military, industry or other sources.) This is a most difficult step. It is not a teacher-type skill. Do not attempt until all possible resources have been explored. All or part of the required material may be available as a result of activities from PHASE I on I-J, L-M and 1-1.7.					
3.2	3.2.1	Complete breakdown of each terminal performance objective into sub-objectives to a level of specificity required to build criterion checklist instruments for the performance evaluation and analysis.					
3.1.1	3.2	Dummy (activity 3.2-3.2.1 can begin before completion of activity 3.1-3.1.1).					
3.1.1	3.2.1	Dummy (dependency--completion of 3.2.1 dependent on completion of 3.1.1).					
3.3	3.3.1	Develop criterion checklist instruments for each major performance objective.					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
3.2.1	3.3	Dummy					
3.2.1	3.3.1	Dummy					
3.4	3.4.1	Secure review and verification of each criterion checklist instrument from panel of experts.					
3.3.1	3.4	Dummy					
3.3.1	3.4.1	Dummy					
3.5	3.5.1	Transpose and correct as necessary, each instrument and objective.					
3.4.1	3.5	Dummy					
3.4.1	3.5.1	Dummy					
3.5.1	3.6	Conduct review of PERT, management, and R&D systems.					
3.6	W	Dummy (Complete PHASE III)					
W	4.1	Dummy (Start Phase IV)					
3.5.1	4.1	Dummy					

PHASE IV
Develop and Verify Criterion Instruments
(Process must be replicated for each job level and family.)

NOTE: The following activities also relate to the sequence which can be applied objective-by-objective. The process, then, must be replicated for each performance objective. (Start with the easiest job task.) Of course, the time estimates and PERT chart relate to a job family or level as a whole.

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
4.1	4.1.1	Construct "hands-on" (pre and/or post assessment) Performance Activity section (or alternative simulation, graphic, paper-pencil situations) for each objective. Should have flexibility for use in "live" situations if at all possible. Must include carefully structured checkpoints (Stop_____Instructor Check) at appropriate points. Include test questions and response items where necessary. Check reading level. Estimate time requirements and adjust modules accordingly. Check for possible interdependence of sequenced responses.					
4.2	4.2.1	Identify and prepare specifications for mock-ups, samples, simulators and other physical devices required for realistic skill and knowledge assessment for each objective. Key to self-scoring response devices in every possible instance.					
4.1.1	4.2	Dummy (activity 4.2-4.2.1 can begin before completion of 4.1-4.1.1).					
4.1.1	4.2.1	Dummy (completion of 4.2.1 dependent upon completion of 4.1.1).					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
4.3	4.3.1	Prepares paper-pencil test items, organizes and keys to self-scoring response device for each objective. (Critical information--pre and/or post assessment section.)					
4.2.1	4.3	Dummy					
4.2.1	4.3.1	Dummy					
4.4	4.4.1	Specify and record all tools, materials and equipment required for each objective.					
4.3.1	4.4	Dummy					
4.3.1	4.4.1	Dummy					
4.5	4.5.1	Combine objectives where necessary and build functional modules (Performance Evaluation Sets).					
4.4.1	4.5	Dummy					
4.4.1	4.5.1	Dummy					
4.6	4.6.1	Acquire, organize and operationalize all aids, mock-ups, samples, simulators, materials, tools, equipment, etc. for each module.					
4.5.1	4.6	Dummy					
4.5.1	4.6.1	Dummy					
4.7	4.7.1	Print each instrument or module set complete with instructor checklist, art work, and illustrations.					
4.6.1	4.7	Dummy					
4.6.1	4.7.1	Dummy					
4.8	4.8.1	Submit each criterion performance test instrument (Performance Evaluation Set) to panel of experts. Secure verification.					
4.7.1	4.8	Dummy					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
4.7.1	4.8.1	Dummy					
4.9	4.9.1	Test/revise/retest each module to specifications on experienced and inexperienced populations. (Validation may be possible given an adequate number of test subjects and appropriate research procedures.) Use "Characteristics of Test Group" instrument, Teacher and Student Reaction Forms.					
4.8.1	4.9	Dummy					
4.8.1	4.9.1	Dummy					
4.9.1	4.10	Conduct review of PERT management and R&D systems.					
4.10	X	Dummy (Complete PHASE IV)					
4.9.1	5.1	Dummy					

PHASE V
DEVELOP LEARNER ACTIVITY GUIDES
(Process must be replicated for each job level and family.)

NOTE: The following activities also relate to the sequence which can be applied guide-by-guide. The process, then, must be replicated for each guide. (Start with the easiest.) Of course, the time estimate and PERT chart relate to the job family or level as a whole.

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
5.1	5.1.1	Specify prerequisite performance certification for each guide.					
5.2	5.2.1	Write objective for each guide in brief form.					
5.1.1	5.2	Dummy (activity 5.2-5.2.1 may begin before completion of 5.1-5.1.1).					
5.1.1	5.2.1	Dummy (completion of 5.2.1 dependent upon completion of 5.1.1).					
5.3	5.3	Write a brief overview (comments, etc.) for each guide.					
5.2.1	5.3	Dummy					
5.2.1	5.3.1	Dummy					
5.3	5.4.1	Specify student-instructor contract options for each guide.					
5.3.1	5.4	Dummy					
5.3.1	5.4.1	Dummy					
5.5	5.5.1	List tools, materials and aids for each guide which must be collected by the student prior to or during the evaluation activities. (Should be organized by Tote-Trays and training stations.)					
5.4.1	5.5	Dummy					
5.4.1	5.5.1	Dummy					
5.6	5.6.1	Specify for each guide optional reading or resource for enrichment activity.					
5.5.1	5.6	Dummy					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
5.5.1	5.6.1	Dummy					
5.7	5.7.1	Print each guide.					
5.6.1	5.7	Dummy					
5.6.1	5.7.1	Dummy					
5.8	5.8.1	Determine need for each and every guide for new instructional materials development. Prepare specifications. Prepare rationale, documentation and recommendations. Prepare man-hour projections and cost estimates. Detail alternatives and consequences. Detail management-developmental plans. Submit for policy decision. Initiate action as required. (Avoid if at all possible--this is a very expensive new project. The range of activities here could vary from the simple collection and preparation of outline steps to large and quite complex developmental efforts. The degree and sophistication of R&D will depend on the level of investment. New management-developmental plans may be necessary.)					
5.7.1	5.8	Dummy					
5.7.1	5.8.1	Dummy					
5.9	5.9.1	Secure review and verification from panel of experts for each guide.					
5.8.1	5.9	Dummy					
5.8.1	5.9.1	Dummy					
5.10	5.10.1	Transpose and modify, as necessary, each guide.					
5.9.1	5.10	Dummy					
5.9.1	5.10.1	Dummy					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
5.10.1	5.11	Conduct review of PERT, management and R&D systems.					
5.11	Y	Dummy (Complete Phase V).					
Y	DD	Dummy (Start Phase VI).					
5.10.1	DD	Dummy					

PHASE VI
VERIFY INDIVIDUAL MODULES

(Process must be replicated for each job level and family.)

NOTE: The following activities also relate to the sequence which can be applied to each module. The "Performance Evaluation Set & Learner Activity Guide", is an example of the module. The process must be replicated for each module--one at a time. Start, again, with the easiest basic job task. (Validation may be possible given an adequate number of test subjects and appropriate research procedures.) Of course, the time estimates and PERT chart relate to the job family or level as a whole.

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
DD	6.1--6.5	Dummy (Start Phase VI).					
6.1	6.1.1	Place into operation, as specified, all training aids, mock-ups, simulators, samples and other such devices for each module or unit prior to testing of respective units. Analyze specifications. Secure or build components. Mark, label and identify as specified. Keep spares of appropriate items ready for immediate substitution.					
6.2	6.2.1	Assemble Tote-Trays, kits, or panels of specified tools, materials and equipment for each module. Analyze specifications. Secure and organize as specified. Attach inventory list to each "set". Keep spares of appropriate items ready for immediate substitution. Provide duplicate sets for those activities which are most likely to be performed by more than one student at the same time. Complete requirements for each unit or module prior to testing or using same.					
6.3	6.3.1	Assemble references, manuals, guides, catalogs, etc. for each module. Analyze requirements. Secure and organize as specified for each unit prior to the testing of respective (Continued)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		modules. Keep spares of appropriate items ready for immediate substitution.					
6.4	6.4.1	Acquire and maintain an adequate supply of self-scoring response devices. Assemble by code item and catalog number. Store in place accessible to instructor but secure from students.					
6.5	6.5.1	Review word-for-word each module before testing or using respective module. Check for proper placement, organization, and labeling of all aids, tools, references, etc. Analyze requirements for instructor evaluations and checkpoints. Check safety considerations against State, local and school requirements. Check condition of equipment, room arrangement, condition of tools, ease of supervision and observation, etc. Check for possible interference from or to other activities.					
6.1.1-6.5.1	6.6	Dummy					
6.6	6.6.1	Test each module on target population according to research plan. Test/revise/retest until 85% of population reach criterion. Administer questionnaire "Characteristics of Test Group" to potential candidates for target group. Identify students by name on (Continued)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		form. Analyze returns for target group typical of those needing and electing training and select group for testing. (Exclude those who are taking the course because the one they wanted was not available. Exclude those who do not intend to find employment in occupations related to the job family. Exclude those who might qualify for the experienced group.) Test only those units which are completely operational with all aids, tools, equipment, references, evaluation devices, etc. Identify actual time required to complete module (record on module). Complete accurately, all instructor evaluation checks of student performance. Administer Student Reaction Form immediately after student completes module and Criterion Checklist. Record PE module number on each self-scoring response card in proper place (to keep track of which module for which such cards were used). Identify on self-scoring response cards, items-of-difficulty (those with more than one erasure) by making mark on edge of card as per instructions. Administer each unit, if at all possible, to at least 2 or more persons from the target group. Upon completion of test, (Continued)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		complete Teacher Reaction Form for each unit. Detail on attached copy of unit all necessary information. Complete all units, response cards information forms, reaction forms, and checklists and review with research team.					
6.6	6.7	Secure review for each module from panel of experts.					
6.7	6.8	Transpose and modify each module as necessary.					
6.8	6.9	Conduct review of PERT, management, and R&D systems.					
6.9	Z	Dummy (Complete Phase VI)					
Z	EE	Dummy (Start Phase VII)					
6.8	EE	Dummy					

PHASE VII

Implement System

(Process must be replicated for each job level and family.)

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
EE	7.1 thru 7.6	Dummy (Start PHASE VII)					
7.1	7.1.1	Define and document instructor role and tasks. Conduct review of evaluation checklist on instructor performance.					
7.2	7.2.1	Develop and print Occupational Readiness Record and Course Activities Guide.					
7.3	7.3.1	Build student tracking system (e.g. a progress chart on pegboard with various colored tags [indicating performance evaluation modules] and/or learning modules to be placed in matrix cells identifying students by job level tasks and sub-objectives.) Also, master teacher chart not accessible to students.					
7.4	7.4.1	Organize and establish distribution and materials handling system. Establish central distribution center for Tote-Trays, tools, materials and supplies, references, performance evaluations, etc. Secure compartmentalized containers for performance evaluation units organized and labeled for student management. Establish daily inventory system operable by one (Continued)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		student assigned to distribution center. Mark PE unit numbers along side of the self-scoring response card items applicable to that unit. Catalog cards for distribution by units and/or sets of units.					
7.5	7.5.1	Secure adequate supply of student materials (complete sets). Performance Evaluation Sets. Learning materials (as specified). Self-scoring response cards. Occupational Flow Chart and Selected List of Occupations. Job Description and Task Analysis for first level. Student notebooks, pencils with erasers (for response cards), clipboards, paper, etc.					
7.6	7.6.1	Complete State, local and school requirements for shop management and organization, supply acquisition, soap and towels, rags, clean-up schedule and assignments, rules and regulations, etc.					
7.1.1-7.6.1	7.7	Dummy					
7.7	7.7.1	Conduct formal test of fully operational system. Secure various observers to analyze student-teacher interactions, course management (internal design), interference factors, etc. Administer on a random basis, Student Reaction (Continued)					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		Forms (two per unit per 20 students). Complete Teacher Reaction Form for each Performance Evaluation module. Apply no sequence in assignments not designed into course. Follow sequence of modules where designed. Administer Performance Evaluation module within one or two weeks to students taking learning units or other learning activities (those who did not attempt or take the performance evaluation as a pre-test). Administer Performance Evaluation modules as pre-tests to all students who indicate an ability to complete the tasks at the specified minimum level of acceptable job entry performance (with safety factors taken into consideration). Service all student requests for Instructor Checks within 2 or 3 minutes of student request.					
7.7.1	7.15	Conduct review (with research staff) of Criterion Checklists. Conduct item analysis on self-scoring response cards. Conduct review of master student progress chart.					
7.15	7.17	Test/revise/retest. Modify materials and environment accordingly. Conduct review of instructor role, student achievement, and administrative effective-					

(Continued)

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
		ness.					
7.17	7.18	Secure review from panel of experts.					
7.18	7.19	Modify materials and environment accordingly.					
7.19	7.20	Conduct review of PERT, management and R&D systems.					
7.20	XX	Dummy (Complete Phase VII)					
XX	F	Dummy (Start Phase VIII)					

PHASE VIII

Follow-Up of Graduates

(Process must be replicated for each job level and family.)

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
FF	8.1 & 8.5--8.8	Dummy (Start Phase VIII)					
8.1	8.1.1	Conduct six month survey on all graduates (6 months in the work force). Vocational Student Survey Questionnaire. Employer Questionnaire. Administer instructor checklist in field (check for retention and valid objectives). Review results and prepare recommendations for review by school officials research team, and panel of experts.					
8.5	8.5.1	Establish and document procedures for continuation of systematic follow-up and revision-evaluation system to insure regenerative aspects and continued flow of corrective feedback information.					
8.6	8.6.1	Complete instructor manual					
8.7	8.7.1	Complete requirement for dissemination.					
8.8	8.8.1	Prepare for development of next job level.					
8.8.1	8.2	Secure review task analysis and instructional objectives.					

Operation		Description	Duration	Early Start	Early Finish	Latest Start	Latest Finish
8.8.1	8.3	Secure review by panel of experts and school officials.					
8.3	8.4	Dummy					
8.2	8.4	Revise and modify system as required (or detail recommendations with cost revision estimates where policy decisions are indicated).					
8.4	YY	Dummy					
8.5.1-8.8.1	YY	Dummy (Complete Phase VIII)					

APPENDIX G

Accountability Checklist--
Performance Contract for
Instructional System Development Process

PROJECT ABLE
ACCOUNTABILITY CHECKLIST – PERFORMANCE CONTRACT
FOR
INSTRUCTIONAL SYSTEM DEVELOPMENT PROCESS

Job Family Area _____	Director _____
Level Under Development _____	Coordinator _____
Systems Team _____	
Location _____	Starting Date _____

□ = Certification by contract sponsor or research director.

○ = Certification by supervisor or director.

◇ = Certification or self-check by instructor or writer.

NOTE: Each task or phase must be certified when completed, with initials of authorized official and date of completion or certification.

□ 1. CONDUCT FEASIBILITY STUDY

○ 1.1 Focuses on and selects jobs which, in comparison with related jobs, require performance of a wider variety of tasks and a larger range of skill levels.

○ 1.2 Focuses on and selects jobs which require an appropriate amount of vocational training time (given various limitations of schools).

○ 1.3 Focuses on and selects jobs which have entrance, apprenticeship, or on-the-job training requirements which can be met better as a result of vocational training.

○ 1.4 Focuses on and selects jobs which are appropriate with respect to the cost, size, support requirements, staffing, and expected usage of training facilities and training equipment.

○ 1.5 Focuses on and selects jobs which are predictable with respect to the skills and knowledges which will be required in the next five years.

○ 1.6 Focuses on and selects jobs which have favorable employment expectations.

○ 1.7 Determines and documents availability of research information and materials applicable to the developmental stages and processes.

○ 1.8 Details recommendations with supporting documentation (including cost projections, equipment and materials needed, etc.)

○ 1.9 Verifies feasibility study (panel of experts and project officials).

○ 1.10 Initiate policy review, decisions, action.

○ 1.11 Completes necessary modifications.

☐ 2. CONDUCT JOB AND TASK ANALYSIS

○ 2.1 Enumerates job titles for entire occupational family.

○ 2.2 Groups and arranges job titles on hierarchy of skills, knowledges, and training time from D.O.T.

○ 2.3 Clusters job titles by sub-families or groups from an analysis of job tasks horizontally and vertically within the hierarchy.

○ 2.4 Selects representative jobs (for training vehicle) for each cluster and evolves a flow chart illustrating milestones or exit levels within the hierarchy.

○ 2.5 Develops a job description document for the first exit level. Must include definition of population, statement of mission, segments, functions, and contingencies. Must also include a preliminary and tentative task classification-enumeration by basic (job entry level) advanced, specialty, auxiliary, and redundant categories.

○ 2.6 Develops questionnaire--observation instrument/s for validation of job description and task classification. (Data to be collected should enable a ranking by frequency of tasks performed by pay or job level. Identification should be attempted of critical tasks such as those which involve a human safety or damage factor with expensive equipment and the "money makers". Other data and information may be necessary.) NOTE: All or part of the required information may be available as a result of activities from PHASE I on I-J, L-M, 1-1.7.

○ 2.7 Verifies (in the field) job description and task classification-enumeration. Collects and analyzes data and finalizes job description and task classification-enumeration. NOTE: All or part of the required information may be available as a result of activities from PHASE I on I-J, L-M, 1-1.7.

○ 2.8 Prepares Course Development Progress Chart matrix showing estimated man-hour requirements for each developmental phase by basic job task.

○ 2.9 Reviews recommendations. Reviews estimates on man-hour projections, costs by category, scope of work, schedule of work, PERT analysis, personnel needs, equipment and material needs, etc. Reviews policy decisions.

○ 2.10 Makes necessary adjustments.

☐ 3. DEVELOP PERFORMANCE OBJECTIVES

◯ 3.1 Formulates terminal performance objectives, by job tasks, for each basic task identified in job description. (Can usually be secured from the military, industry or other sources. This is a most difficult step. It is not a teacher-type skill. Do not attempt until all possible resources have been explored. Sub-contract if possible.)

◯ 3.2 Completes breakdown of each terminal performance objective into sub-objectives to a level of specificity required to build criterion checklist instruments for the performance evaluation and analysis.

◯ 3.3 Develops criterion checklist instruments for each major performance objective.

◯ 3.4 Submits criterion checklist instruments to panel of experts. (This should result in a detailed review of the criterion specified within each performance objective--in other words, a review of the job standards.)

◯ 3.5 Makes necessary adjustments.

4. DEVELOP & VERIFY CRITERION INSTRUMENTS

(Each of the following milestones are in reference to specific sub-objectives. The process must be replicated for each objective. Start with the easiest job task.)

- ◯ 4.1 Designs "hands-on" (pre and/or post assessment) Performance Activity section (or alternative simulation, graphic, paper-pencil situations). Should have flexibility for use in "live" situations if at all possible. Must include carefully structured checkpoints (Stop_____Instructor Check) at appropriate points. Include test questions and response items where necessary. Check reading level. Estimate time requirements and adjust modules accordingly. Check for possible interdependence of sequenced responses.

- ◯ 4.2 Identifies and prepares specifications for mock-ups, samples, simulators, and other physical devices required for realistic skill and knowledge assessment. Keys to self-scoring response devices in every possible instance.

- ◯ 4.3 Prepares paper-pencil test items, organizes and keys to self-scoring response device. (Critical information--pre and/or post assessment section.)

- ◯ 4.4 Specifies all tools, materials and equipment required.

- ◯ 4.5 Combines objectives where necessary to build functional modules (Performance Evaluation Sets).

- ◯ 4.6 Acquires, organizes and operationalizes all aids, mock-ups, samples, simulators, materials, tools, equipment, etc.

- ◯ 4.7 Prints instruments complete with instructor checklist, art work, and illustrations.

- ◯ 4.8 Submits criterion performance test instruments (Performance Evaluation Sets) to panel of experts.

- ◯ 4.9 Tests/revises/retests to specifications on experienced and inexperienced populations. (Validations may be possible given an adequate number of test subjects and appropriate research procedures.) Use "Characteristics of Test Group" instrument, Teacher and Student Reaction Forms.

- ◯ 4.10 Reviews PERT system (upon completion of all modules).

☐ 5. DEVELOP LEARNER ACTIVITY GUIDES

(Each step is in reference to each module. The process must be replicated for each module.)

◯ 5.1 Specifies prerequisite performance certification.

◯ 5.2 Writes unit or module objective in brief form.

◯ 5.3 Writes overview (comments, etc.). MUST BE BRIEF --one or two sentences.

◯ 5.4 Specifies student-instructor contract options.

◯ 5.5 Lists tools, materials and aids which must be collected by the student prior to or during the evaluation activities. (Should be organized by Tote-Trays and training stations.)

◯ 5.6 Specifies optional reading or resources for enrichment activity.

◯ 5.7 Prints guides.

◯ 5.8 Determines need for new instructional materials development. Prepares specifications. Prepares rationale, documentation and recommendations. Prepares man-hour projections and cost estimates. Details alternatives and consequences. Details management-developmental plans. Submits for policy decisions. Initiates action as required. (Avoid if at all possible--this is a very expensive new project. The range of activities here could vary from the simple collection and preparation of outline steps to large and quite complex developmental efforts. The degree and sophistication of R & D will depend on the level of investment. New management-developmental plans may be necessary.)

◯ 5.9 Submits to panel of experts and supervisor.

◯ 5.10 Makes necessary adjustments.

◯ 5.11 Review of PERT system (upon completion of all modules.

☐ 6. VERIFY INDIVIDUAL MODULES

(Each step is in reference to each module. The "Performance Evaluation Set & Learner Activity Guide", is an example of the module. The process must be replicated for each module--one at a time. Start, again, with the easiest basic job task. NOTE: Validation may be possible given an adequate number of test subjects and appropriate research procedures.)

◯ 6.1 Places into operation as specified, all training aids, mock-ups, simulators, samples and other such devices for each module or unit prior to testing of respective units.

- ◇ Analyze specifications.
- ◇ Secure or build components.
- ◇ Mark, label and identify as specified.
- ◇ Keep spares of appropriate items ready for immediate substitution.

◯ 6.2 Assembles Tote-Trays, kits, or panels of specified tools, materials and equipment.

- ◇ Analyze specifications.
- ◇ Secure and organize as specified.
- ◇ Attach inventory list to each "set".
- ◇ Keep spares of appropriate items ready for immediate substitution.
- ◇ Provide duplicate sets for those activities which are most likely to be performed by more than one student at the same time.
- ◇ Complete requirements for each unit or module prior to testing or using same.

◯ 6.3 Assembles references, manuals, guides, catalogs, etc.

- ◇ Analyze requirements.
- ◇ Secure and organize as specified for each unit prior to the testing of respective modules.
- ◇ Keep spares of appropriate items ready for immediate substitution.

○ 6.4 Acquires and maintains an adequate supply of self-scoring response devices.

◇ Assemble by code item and catalog number.

◇ Store in place accessible to instructor but secure from students.

○ 6.5 Reviews word-for-word each module before testing or using respective module.

◇ Check for proper placement, organization, and labeling of all aids, tools, references, etc.

◇ Analyze requirements for instructor evaluations and checkpoints.

◇ Check safety considerations against State, local and school requirements.

◇ Check condition of equipment, room arrangement, condition of tools, ease of supervision and observation, etc.

◇ Check for possible interference from or to other activities.

○ 6.6 Tests each module on target population according to research plan. Test/revise/retest until 85% of population reach criterion.

◇ Administer questionnaire "Characteristics of Test Group" to potential candidates for target group. Identify students by name on form.

◇ Analyze returns for target group typical of those needing and electing training and select group for testing. (Exclude those who are taking the course because the one they wanted was not available. Exclude those who do not intend to find employment in occupations related to the job family. Exclude those who might qualify for the experienced group.)

◇ Test only those units which are <u>completely</u> operational with all aids, tools, equipment, references, evaluation devices, etc.

- ◇ Identify actual time required to complete module (record on module).
- ◇ Complete accurately, all instructor evaluation checks of student performance. Administer Student Reaction Form immediately after student completes module and Criterion Checklist.
- ◇ Record PE module number on each self-scoring response card in proper place (to keep track of which module for which such cards were used).
- ◇ Identify on self-scoring response cards, items-of-difficulty (those with more than one erasure) by making mark on edge of card as per instructions.
- ◇ Administer each unit, if at all possible, to at least 2 or more persons from the target group.
- ◇ Upon completion of test, complete Teacher Reaction Form for each unit. Detail on attached copy of unit all necessary information.
- ◇ Complete all units, response cards, information forms, reaction forms, and checklists and review with research team.

○ 6.7 Submits to panel of experts and school officials.

○ 6.8 Makes necessary adjustments.

○ 6.9 Reviews PEPT system.

7. IMPLEMENT SYSTEM

- 7.1 Defines instructor role and tasks. Reviews evaluation checklist on instructor performance.
- 7.2 Develops and prints Occupational Readiness Record and Course Activities Guide.
- 7.3 Organizes student tracking system.
  - ◇ Tracking system board (e.g. a progress chart on pegboard with various colored tags [indicating performance evaluation modules and/or learning modules] to be placed in matrix cells identifying students by job level tasks and sub-objectives.)
  - ◇ Master teacher chart not accessible to students
- 7.4 Organizes distribution and materials handling system.
  - ◇ Central distribution center for Tote-Trays, tools, materials and supplies, references, performance evaluations, etc.
  - ◇ Compartmentalized containers for performance evaluation units organized and labeled for student management.
  - ◇ Daily inventory system operable by one student assigned to distribution center.
  - ◇ Mark the PE unit number along side of the self-scoring response card items applicable to that unit. Catalog cards for distribution by units and/or sets of units.
- 7.5 Obtains adequate supply of student materials (complete sets).
  - ◇ Performance Evaluation Sets.
  - ◇ Learning materials (as specified).
  - ◇ Self-scoring response cards.
  - ◇ Occupational Flow Chart and Selected List of Occupations.
  - ◇ Job Description and Task Analysis for first level.
  - ◇ Student notebooks, pencils with erasers (for response cards), clipboards, paper, etc.

○ 7.6 Completes State, local and school requirements for shop management and organization, supply acquisition, soap and towels, rags, clean-up schedule and assignments, rules and regulations, etc.

○ 7.7 Applies no sequence in assignments not designed into course.

○ 7.8 Follows sequence of modules where designed.

○ 7.9 Administers Performance Evaluation module within one or two weeks to students taking learning units or other learning activities (those who did not attempt or take the performance evaluation as a pre-test).

○ 7.10 Administers Performance Evaluation modules as pre-tests to all students who indicate an ability to complete the tasks at the specified minimum level of acceptable job entry performance (with safety factors taken into consideration).

○ 7.11 Services all student requests for Instructor Checks within 2 or 3 minutes of student request.

○ 7.12 Secures various observers to analyze student-teacher interactions, course management (internal design), interference factors, etc.

○ 7.13 Administers on a random basis, Student Reaction Forms (two per unit per 20 students).

○ 7.14 Completes Teacher Reaction Form for each Performance Evaluation module.

○ 7.15 Reviews with research staff, copies of the Criterion Checklist from all Performance Evaluation modules, complete with time required to complete module (recorded on each Criterion Checklist) and all self-scoring response cards.

○ 7.16 Reviews with research staff, copy of instructor's master student progress chart showing modules completed (both Performance Evaluation modules and learning activities).

○ 7.17 Tests/revises/retests. Modifies materials and environment accordingly. Reviews instructor role, student achievement, and administrative effectiveness.

◯ 7.18 Presents for review to panel of experts and school officials.

◯ 7.19 Makes necessary adjustments.

◯ 7.20 Reviews PERT system.

☐ 8. FOLLOW-UP ON GRADUATES

○ 8.1 Conducts six month survey on all graduates (6 months in the work force).

- ◇ Vocational Student Survey Questionnaire.
- ◇ Employer Questionnaire.
- ◇ Administer instructor checklist in field (check for retention and valid objectives).
- ◇ Review results and prepare recommendations for review by school officials and research team.

○ 8.2 Reviews task analysis and instructional objectives.

○ 8.3 Reviews by panel of experts and school officials.

○ 8.4 Revises and modifies system as required (or details recommendations with cost revision estimates where policy decisions are indicated).

○ 8.5 Establishes procedures for continuation of systematic follow-up and revision-evaluation system to insure regenerative aspects and continued flow of corrective feedback information.

○ 8.6 Completes instructor manual.

○ 8.7 Completes requirements for dissemination.

○ 8.8 Prepares for development of next job level.

APPENDIX H

Instructor Performance Checklist

PROJECT ABLE
CHECKLIST OF INSTRUCTOR PERFORMANCE

Family Area _____ Director _____

Level Under Development _____ Coordinator _____

Instructor _____ Location _____

NOTE: The performance contract requires certification at two administrative levels with instructor self-checks at a third level. Initial and mark date of certification, completion or review.

◇ 4. DEVELOP AND VERIFY CRITERION INSTRUMENTS

○ Places into operation as specified, all training aids, mock-ups, simulators, samples and other such devices for each module or unit prior to testing of respective units.

- ☐ Analyze specifications.
- ☐ Secure or build components.
- ☐ Mark, label and identify as specified.
- ☐ Keep spares of appropriate items ready for immediate substitution.

○ Assembles Tote-Trays, kits, or panels of specified tools, materials and equipment.

- ☐ Analyze specifications.
- ☐ Secure and organize as specified.
- ☐ Attach inventory list to each "set".
- ☐ Keep spares of appropriate items ready for immediate substitution.
- ☐ Provide duplicate sets for those activities which are most likely to be performed by more than one student at the same time.
- ☐ Complete requirements for each unit or module prior to testing or using same.

○ Assembles references, manuals, guides, catalogs, etc.

- ☐ Analyze requirements.
- ☐ Secure and organize as specified for each unit prior to the testing of respective modules.
- ☐ Keep spares of appropriate items ready for immediate substitution.

○ Acquires and maintains adequate supply of self-scoring response devices.

- ☐ Assemble by code item and catalog number.
- ☐ Store in place accessible to instructor but secure from students.

○ Reviews word-for-word, each unit before testing or using respective unit.

- ☐ Check for proper placement, organization, and labeling of all aids, tools, references, etc.
- ☐ Analyze requirements for instructor evaluations and check-points.
- ☐ Check safety considerations against State, local and school requirements.
- ☐ Check condition of equipment, room arrangement, condition of tools, ease of supervision and observation, etc.
- ☐ Check for possible interference from or to other activities.

○ Tests each module on experienced and inexperienced populations according to research plan.

- ☐ Administer questionnaire "Characteristics of Test Group" to potential candidates for experienced and inexperienced group. Identify students by name on form.
- ☐ Analyze each return and select experienced group on basis of criteria provided for entry level employment including number of months of on-the-job experience.
- ☐ Analyze returns for inexperienced group typical of those needing and electing training and select group for testing. (Exclude those who are taking the course because the one they wanted wasn't available. Exclude those who do not intend to find employment in occupations related to the job family. Exclude those who might qualify for the experienced group.)
- ☐ Test only those units which are <u>completely</u> operational with all aids, tools, equipment, references, evaluation devices, etc.
- ☐ Identify those units (to be tested on the experienced group) which cannot be tested under realistic conditions in the training laboratory. Administer, if possible, on-the-job and under live conditions.
- ☐ Identified actual time required to complete unit (record on unit).
- ☐ Administer student reaction form immediately after completion of test of each unit.

☐ Upon completion of test, complete teacher reaction form for each unit. Details on attached copy of unit, all necessary information.

☐ Complete accurately, all instructor evaluation checks.

☐ Identify Learning or PE unit number on each self-scoring response card in proper place.

☐ Identify on self-scoring response cards, items-of-difficulty (those with more than one erasure) by making mark on edge of card as per instructions.

☐ Administer each unit, if at all possible, to 2 to 4 persons in each of the two groups.

☐ Administer each instructor checklist (from back of each performance evaluation unit) to a panel of content experts currently working at the job or supervising persons for which the training is intended.

☐ Complete all units, response cards, information forms, reaction forms, and checklists and return to the research unit.

◇ 6. VERIFY INDIVIDUAL MODULES

○ Compares requirements and specifications of learning units or individual lessons against criterion or performance tests. Provides additional aids, tools, materials, references, etc. as needed.

○ Replicates the same procedures as used under DEVELOP AND VERIFY CRITERION INSTRUMENTS. (It will not be necessary to administer again, the checklist to the panel of experts.)

○ If using the criterion exam test population, do not give any student the learning unit which corresponds to a criterion test he may have completed.

○ Administers learning units or lessons to individual students in sequence where prerequisite units are specified.

○ Places into operation as specified, all training aids, mock-ups, simulators, samples and other such devices for each module or unit prior to testing of respective units.

☐ Analyze specifications.

☐ Secure or build components.

☐ Mark, label and identify as specified.

☐ Keep spares of appropriate items ready for immediate substitution.

○ Assembles Tote-Trays, kits, or panels of specified tools, materials and equipment.

- ☐ Analyze specifications.
- ☐ Secure and organize as specified.
- ☐ Attach inventory list to each "set".
- ☐ Keep spares of appropriate items ready for immediate substitution.
- ☐ Provide duplicate sets for those activities which are most likely to be performed by more than one student at the same time.
- ☐ Complete requirements for each unit or module prior to testing or using same.

○ Assembles references, manuals, guides, catalogs, etc.

- ☐ Analyze requirements.
- ☐ Secure and organize as specified for each unit prior to the testing of respective modules.
- ☐ Keep spares of appropriate items ready for immediate substitution.

○ Acquires and maintains adequate supply of self-scoring response devices.

- ☐ Assemble by code item and catalog number.
- ☐ Store in place accessible to instructor but secure from students.

○ Reviews word-for-word, each unit before testing or using respective unit.

- ☐ Check for proper placement, organization, and labeling of all aids, tools, references, etc.
- ☐ Analyze requirements for instructor evaluations and check-points.
- ☐ Check safety considerations against State, local and school requirements.
- ☐ Check condition of equipment, room arrangement, condition of tools, ease of supervision and observation, etc.
- ☐ Check for possible interference from or to other activities.

○ Tests each module on experienced and inexperienced populations according to research plan.

- ☐ Administer questionnaire "Characteristics of Test Group" to potential candidates for experienced and inexperienced group. Identify students by name or form.

- [ ] Analyze each return and select experienced group on basis of criteria provided for entry level employment including number of months of on-the-job experience.
- [ ] Analyze returns for inexperienced group typical of those needing and electing training and select group for testing. (Exclude those who are taking the course because the one they wanted wasn't available. Exclude those who do not intend to find employment in occupations related to the job family. Exclude those who might qualify for the experienced group.)
- [ ] Test only those units which are completely operational with all aids, tools, equipment, references, evaluation devices, etc.
- [ ] Identified actual time required to complete unit (record on unit).
- [ ] Administer student reaction form immediately after completion of test of each unit.
- [ ] Upon completion of test. complete teacher reaction form for each unit. Details on attached copy of unit, all necessary information.
- [ ] Complete accurately, all instructor evaluation checks.
- [ ] Identify Learning or PE unit number on each self-scoring response card in proper place.
- [ ] Identify on self-scoring response cards, items-of-difficulty (those with more than one erasure) by making mark on edge of card as per instructions.
- [ ] Administer each unit, if at all possible, to 2 to 4 persons in each of the two groups.
- [ ] Complete all units, response cards, information forms, reaction forms, and checklists and return to the research unit.

◇ 7. IMPLEMENT AND TEST SYSTEM

○ Organizes student tracking system.

- [ ] Tracking system board (e.g. a progress chart on pegboard with various colored tags [indicating criterion test or learning module] to be placed in matrix cells identifying students by units, etc.)
- [ ] Master teacher chart not accessible to students. Occupational Readiness Record cards for students (print and distribute).
- [ ] List of Activities for student notebooks (print and distribute).

○ Organizes distribution and materials handling system.

- ☐ Central distribution center for Tote-Trays, tools, materials and supplies, references, performance evaluations and learning units, etc.
- ☐ Compartmentalized containers for performance and learning units organized and labeled for student management.
- ☐ Daily inventory system operable by one student assigned to distribution center.
- ☐ Mark self-scoring cards to be used with performance evaluations differently than those to be used with learning units (i.e. paint red strip at top of performance evaluation cards). Mark the learning unit or PE number alongside of the T-T card responses applicable to that LU or PE. Catalog cards for distribution by units and/or sets of units.

○ Obtains adequate supply of student materials (complete sets).

- ☐ Performance evaluations.
- ☐ Learning units.
- ☐ Learning materials other than ABLE units (as specified).
- ☐ Self-scoring response cards.
- ☐ Occupational Flow Chart and Selected List of Occupations.
- ☐ Job Description and Task Analysis for two levels (level students are entering and next in hierarchy).
- ☐ Student notebooks, pencils with erasers (for response cards), clipboards, paper, etc.

○ Completes State, local and school requirements for shop management and organization, supply acquisition, soap and towels, rags, clean-up schedule and assignments, rules and regulations, etc.

○ Applies No sequence in assignments not designed into course.

○ Follows sequence of units where designed.

○ Administers performance evaluation within one or two weeks to students taking learning units or other learning activities (those who did not attempt or take the performance evaluation as a pre-test).

○ Administers performance units as pre-tests to all students who indicate an ability to complete the tasks at the specified minimum level of acceptable performance (with safety factors taken into consideration).

- ○ Services all student requests for instructor checks within 2 or 3 minutes of requests.
- ○ Secures various observers to check student-teacher interactions, course management (internal design), interference factors, etc.
- ○ Administers on a random basis, student reaction forms (two per unit per 20 students).
- ○ Completes teacher reaction for each performance evaluation unit and learning unit or activity.
- ○ Returns to the research unit, copies of the checklist from all performance evaluation units and learning units or activities. Time required to complete unit recorded on each checklist. Returns all self-scoring response cards with proper identification of unit.
- ○ Returns to research unit, copy of instructor's master student progress chart showing units completed (both performance evaluations and learning units or activities).

◇ 8. FOLLOW-UP ON GRADUATES

- ○ Conducts six month survey on all graduates (6 months in the work force).
  - ☐ Vocational Student Survey Questionnaire.
  - ☐ Employer Questionnaire.
  - ☐ Administer instructor checklist in field (check for retention and valid objectives).
  - ☐ Review results and prepare recommendations for research team.
  - ☐ Forward all instruments to research team.

APPENDIX I

Research Instruments: Student Reaction Form; Teacher Reaction Form; Characteristics of Test Group

INSTRUCTIONS

Most items will require only a check mark (✓) to give your answer. Please answer all items ACCURATELY.

Thanks for your help on this important study.

Vocational area _____ School _____ Date _____

Unit Number → Learning Unit No. _____

Performance Evaluation No. _____

NOTE: YOU MAY CHECK MORE THAN ONE ANSWER.

1. Which statements describe the activities in this unit?
   - ☐ Interesting
   - ☐ Easy
   - ☐ Hard
   - ☐ Fun
   - ☐ Too much reading.
   - ☐ Useful
   - ☐ New material (Things you did not know).
   - ☐ Too much theory.

2. Describe the help you received on the unit.
   - ☐ I received no help. (Go to number 4.)
   - ☐ I didn't need help.
   - ☐ I received help from another student.
   - ☐ I received help from my instructor.
   - ☐ I received help from others.

   Go to No. 3.

3. If you needed help — why?
   - ☐ I was unable to understand what I was to do.
   - ☐ The words were too difficult.
   - ☐ It did not cover what was to be learned.
   - ☐ The objectives did not explain what was to be learned.
   - ☐ The activities were too difficult.
   - ☐ I needed help to locate materials, or tools, or aids, etc.

4. Did you have problems?
   - ☐ following directions?
   - ☐ understanding charts or graphs?
   - ☐ getting supplies or equipment?
   - ☐ using the audio-visuals?
   - ☐ using the training aids?
   - ☐ working on your own?

5. How might we change or improve the unit?

PROJECT ABLE

INSTRUCTOR REACTION FORM

(PERFORMANCE EVALUATION SET & LEARNER ACTIVITY GUIDE)

INSTRUCTIONS

This checklist is designed to assist in identifying problems in learning units and performance evaluation units. Most items will require only a check mark (√) to give your answer. Please answer all items ACCURATELY. Your comments will be most valuable.

Thanks for your help.

Name _____ School _____ City _____

Job Family Area and Level _____

Group or Grade _____ Date _____

Unit Number → Learning Unit No. _____

Performance Evaluation No. _____

NOTE: YOU MAY CHECK MORE THAN ONE ANSWER.

UNIT OVERALL EVALUATION

- ☐ The objectives and units are not sequenced correctly (specify).
- ☐ Requires extensive teacher help.
- ☐ Needs a greater variety of learning activities.
- Reading level within unit too difficult for my students. (Select appropriate one.)
  - ☐ Better ☐ Average ☐ Poor
- ☐ Please revise as indicated on the attached copy of the unit.
- ☐ This unit should be deleted from the program. (Why)
- ☐ There is not enough difference in the units. (How should they be modified?)
- ☐ The typical student requires too long to complete the unit.
- ☐ Acceptable as is.
- ☐ Acceptable with minor revision.

OBJECTIVE

- ☐ Acceptable.
- ☐ Needs to be written in simpler language for the student.
- ☐ Not in correct sequence. (Where should it be?)
- ☐ Does not tell student what he is supposed to learn.

OVERVIEW

- ☐ Acceptable.
- ☐ Needs to be written in simpler language for the student.
- ☐ Not related to the objective.

INSTRUCTIONAL AND/OR RESOURCE MATERIALS

Where more than one reference is used in the step, indicate which reference a specific comment is directed toward.

- ☐ Acceptable.
- ☐ Instructional materials not related to the objective
- ☐ Instructional materials require extensive teacher help.
- ☐ Reading level is too difficult for my students.
- ☐ Please revise as indicated on the form or on the attached unit.
- ☐ There is a mistake in page reference, title of book, etc. Correct as indicated on the form or attached unit.
- ☐ Instructional materials not available in our school. (Which materials?)

EQUIPMENT AND TRAINING AIDS

- ☐ Acceptable.
- ☐ Not related to objectives.
- ☐ Requires too much teacher help.
- ☐ Too difficult for my students.
- ☐ Too dangerous – safety problems (specify).
- ☐ Too difficult to build.
- ☐ Revisions and modifications needed as indicated on form or attached unit.
- ☐ Too difficult or expensive to buy.

TEST QUESTIONS

- ☐ Acceptable.
- ☐ Not related to objectives.
- ☐ Too difficult for my students.
- ☐ Takes too long.
- ☐ Reading and words too difficult.
- ☐ Students dislike them.
- ☐ Revisions needed as indicated on attached unit.

PERFORMANCE ACTIVITY

- ☐ Acceptable.
- ☐ Activities not related to the objective, or they are irrelevant to overall development. (Point out on attached unit.)
- ☐ Objective needs additional activities as indicated on the form or on attached unit in order to prepare students adequately for the achievement of the objective.
- ☐ The activities are not in the correct sequence. Please revise as on the form or attached unit.
- ☐ Activities require extensive teacher help.
- ☐ Too much reading required.
- ☐ Additional activities are needed. (What activities?)
- ☐ Activities are too complicated for students.
- ☐ Activities take too long to complete.
- ☐ There are too many activities.
- ☐ Activities create shop problems. (What problems?)
- ☐ Revisions needed as indicated on attached unit.

STOP _____ Instructor Check
Initials

- ☐ Acceptable.
- ☐ Too frequent.
- ☐ More needed as indicated on attached unit.
- ☐ Please revise as indicated on attached unit.

CRITERION CHECKLIST

- ☐ Acceptable.
- ☐ Needs to be written in simpler language. (Indicate vocabulary or structure causing difficulty.)
- ☐ Does not appear to be related to the objectives.
- ☐ Format is confusing – needed teacher explanation.
- ☐ Insufficient information is given in order to know what is intended. (Specify.)
- ☐ Too much reading – too much detail.
- ☐ Requires too much time for the student.
- ☐ Requires too much time of the instructor.
- ☐ Please revise as indicated on the form or on the attached copy of the checklist.

Age _____ City _____ Date _____

Marital Status
- ☐ Married
- ☐ Single
- ☐ Other

Please describe your job.
Hours worked per week _____
Hourly wage $ _____
Job title _____
Exactly what do you do? _____

Is job related to the course you are now taking?
Please explain:
Did you have more than one such job?
- ☐ Yes
- ☐ No

How long did you work at those jobs? _____
Average number of hours worked per week _____
Hourly wage $ _____
Job title _____
Exactly what did you do? _____

Places related to the course you are taking?

Is the course of studies you really wanted to take?
How did you get to take it? → ☐ Yes, I took the course I wanted.
What course did you want (that was not offered) → ☐ No, I could not take the course I wanted because _____

Would you have taken this course had it been completed?

APPENDIX J

Sample Job Title Enumeration: Power Mechanics

JOB TITLE ENUMERATION

POWER MECHANICS

JOB NAME	SELECT Yes	SELECT No	REASON
Automobile accessories installer		/	#3
Automobile analyst		/	#3
Automobile body-parts assembler		/	#3
Automobile metalman, helper	/		
Automobile body repairman, metal	/		
Automobile body repairman, wood		/	#3
Automobile body worker	/		See #5
Automobile car loader		/	#3
Automobile collision serviceman		/	#3
Automobile fuel pump repairman		/	#3
Automobile generator repairman		/	#3
Automobile starter repairman		/	#3
Automobile headlight assembly		/	#3
Automobile inspector		/	#3
Automobile light assembler		/	#3
Automobile maintenance mechanic	/		See #89
Automobile mechanic	/		See #89
Automobile mechanic, bench	/		See #89
Automobile mechanic, motor	/		See #89
Tank motor service mechanic		/	#3
Automobile mechanic apprentice	/		
Automobile mechanic assistant	/		See #90
Automobile mechanic, chief		/	#3
Automobile mechanic, diesel engine			See #93
Automobile mechanic, foreman		/	#3
Automobile mechanic, helper	/		See #90
Automobile mechanic, motor repairman	/		See #89
Automobile mechanic, radiator man		/	#3
Automobile parker (parking lot attendant)	/		See #37
Automobile polisher	/		See #37
Automobile race driver		/	#3
Automotive service station mechanic	/		
Automobile repairman	/		See #89
Automobile repair serviceman	/		See #89
Automobile sealer		/	#3
Automobile service mechanic	/		See #39
Automobile service station attendant	/		
Automobile spring repair		/	#3
Automobile taillight assembler		/	#3
Automobile tester		/	#3
Automobile vehicle safety inspect.	/		See #32
Automobile Underwriter		/	#3
Automobile convertible top and upholsterer		/	#3

JOB NAME	SELECT Yes	No	REASON
Automobile body trimmer		/	#3
Automobile upholsterer apprentice		/	#3
Automobile washer	/		See #37
Automobile washer, straw		/	#1
Automobile woodworker		/	#3
Automobile wrecker		/	#3
Automotive department foreman		/	#3
Automotive engineer		/	#3
Automotive maintenance equipment repairman		/	#3
Automotive maintenance equipment serviceman		/	#3
Automotive maintenance foreman		/	#3
Automotive trouble-shooting mechanic	/		See #89
Dynamometer tuner	/		See #89
Automotive section chief		/	#3
Automotive test engine mechanic		/	#3
Automotive test engine mechanic foreman		/	#3
Automotive test shop supervisor		/	#3
Automotive test vehicle chassis mechanic		/	#3
Automotive test vehicle chassis foreman		/	#3
Automotive tester		/	#1--3
Automotive tester foreman		/	#3
Auto parts inspector		/	#3
Carburetor inspector		/	#3
Motor and chassis inspector		/	#3
Spring inspector		/	#3
Auto collision estimator		/	#3
Auto repairman helper	/		See #90
Auto seat inspector		/	#3
Service manager		/	#3
Automobile collision serviceman		/	#3
Automobile, body, and fender repairman	/		See #5
Automobile body line finisher		/	#3
Steam cleaner	/		See #90
Automobile body dent remover	/		See #5
Automobile body dingman	/		See #5
Automobile glass installer		/	#3
Automobile body hammer out man	/		See #5
Automobile body metal bumper	/		See #5
Automobile body metal shrinker	/		See #5
Automobile body metal worker	/		See #5
Automobile body touch-up finisher	/		See #87
Automobile body welder, acetylene	/		See #5
Automobile body welder, arc		/	#3
Automobile painter (spray)	/		
Automobile body painter helper (spray)	/		
A. R. auto mechanic	/		
A. R. auto mechanic helper	/		
A. R. truck and bus mechanic		/	#3
A. R. truck and bus mechanic's helper		/	#3

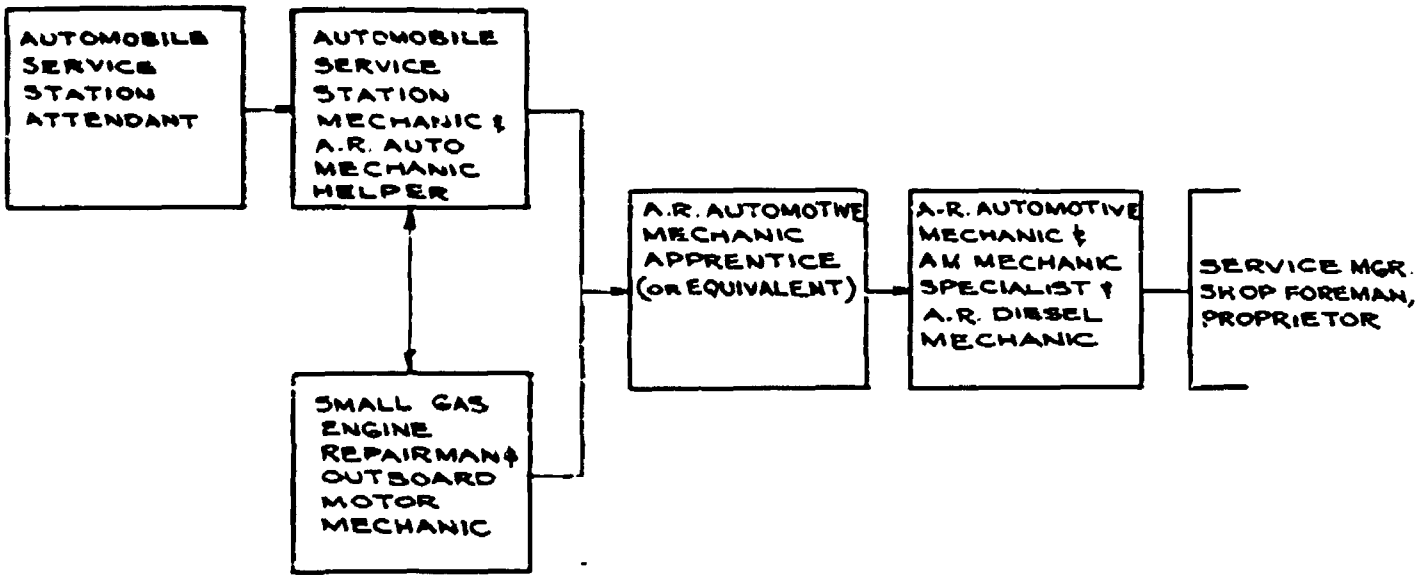
JOB NAME	SELECT Yes	No	REASON
A. R. diesel (pass) mechanic (tune-up)	/		
Fuel injection pump man, Diesel		/	#3
Foreign car mechanic	/		See #89
Automotive front-end man	/		
Automotive, chassis and springs		/	#3
Automotive, brake man	/		See #89
Automotive eng. tune-up specialist	/		
Automotive carburetion specialist	/		
Automotive electrician, starter and generators	/		
A. M., automatic trans. mechanic		/	#3
A. M. automotive trans. installer		/	#3
A. M. new car prep man		/	#3
A. M. installer of exhaust systems	/		See #32
A. M. power steering and P brakes	/		
A. M. lube man	/		See #37
A. M. automotive machinist		/	See Machines Voc. Area
A. M. engine R & R man	/		See #90
Parts jobber counterman	/		See #90
Automotive service salesman		/	#3
A. M. air conditioning man		/	#3
A. M. air supervision man		/	#3
Small gas engine repairman	/		
Diesel truck and bus mechanic	/		See #95
Outboard motor mechanic	/		
Air brakes		/	#3
Metalman helper and painter helper (comb.)	/		
Body repairman apprentice	/		
Painter apprentice	/		
Spray gun repairman	/		See #122
Body repairman and painter (comb.)	/		
Body repairman apprentice (comb.)	/		
Small gas engine repairman, helper	/		
Outboard motor mechanic, helper	/		
Motorcycle repairman	/		See #89
Tire repairman	/		See #37
Tire rebuilder		/	#3
Alignment man or mechanic	/		See #96
Axle and frame man	/		See #96
Chassis mechanic	/		See #96
Frameman	/		See #96
Tractor mechanic	/		See #115
Truck equipment mechanic	/		See #115
Aircraft mechanic or repairman		/	#3
Farm machinery mechanic or repairman		/	#3
Engine, power transmission and related mechanics	/		See #89
Body masker			
Automobile upholsterer			

APPENDIX K

Sample Occupational Flow Charts and Selected Lists of Occupations: Auto Mechanics and Auto Body Related Occupations

POWER MECHANICS

(Automotive Mechanics and Related Occupations)



NOTE: See list of occupations for a more detailed compilation of jobs and job families.

J.W.U.

POWER MECHANICS

(Automotive Mechanics and Related Occupations)

Selected List of Occupations

AUTO MECHANICS

*Automobile Service Station Attendant	915.867
Automobile Self-Service Station Attendant	915.878
Gas and Oil Man	915.587
Steam Cleaner	915.887
Taxi Serviceman	915.878
Lubrication Man	915.867
Tire Repairman	915.867
Brake adjuster	915.867
Auto slip-cover installer	915.887
Tire inspector	750.687
Tire Mounter	750.887
*Small Gas Engine Repairman	625.281
Outboard Motor Mechanic	623.281
Outboard Motor Tester	625.281
Motorboat Mechanic	623.281
Small Gas Engine Repairman, Helper	625.284
Motorboat Mechanic, Helper	623.884

*Representative Occupations

JW.U

*Automobile Service Station Mechanic	620.381
A.R. Auto Mechanic Helper	620.884
Car Checker (ret. tr.)	806.281
Tire Service Foreman	915.134
Tire Repairer	750.781
Motorcycle Tester	620.384
Body Wireman	829.684
Battery Inspector	829.684
Electrician Helper, Auto	729.884
Brake Adjuster	620.884
Clutch Rebuilder	620.884
Constr. Equip. Mechanic Helper	620.884
Engineering Equip. Mechanic Helper	620.884
Motorcycle Subassembler Repairman	620.884
Spring Repairman Helper, Hand	620.884
Tractor Mechanic Helper	620.884
Used Car Renovator	620.884
Auto-Wrecker-Wrecking Mechanic	620.884
Motorcycle Assembler	806.884
Motor-Vehicle-Light Assembler	824.884
Automotive Parts Man	223.387
Parts-Order or Stock Clerk (Motor Trans.)	223.387
Tool Clerk	223.387
New Car Inspector	919.387
Motor Assembler	721.887
Internal Combustion Engine Assembler, Helper	801.887
Motor Test Helper	806.887

*A.R. Automotive Mechanic Apprentice	620.281
Aircraft and Engine Mechanic, Helper	621.884

*Representative Occupations

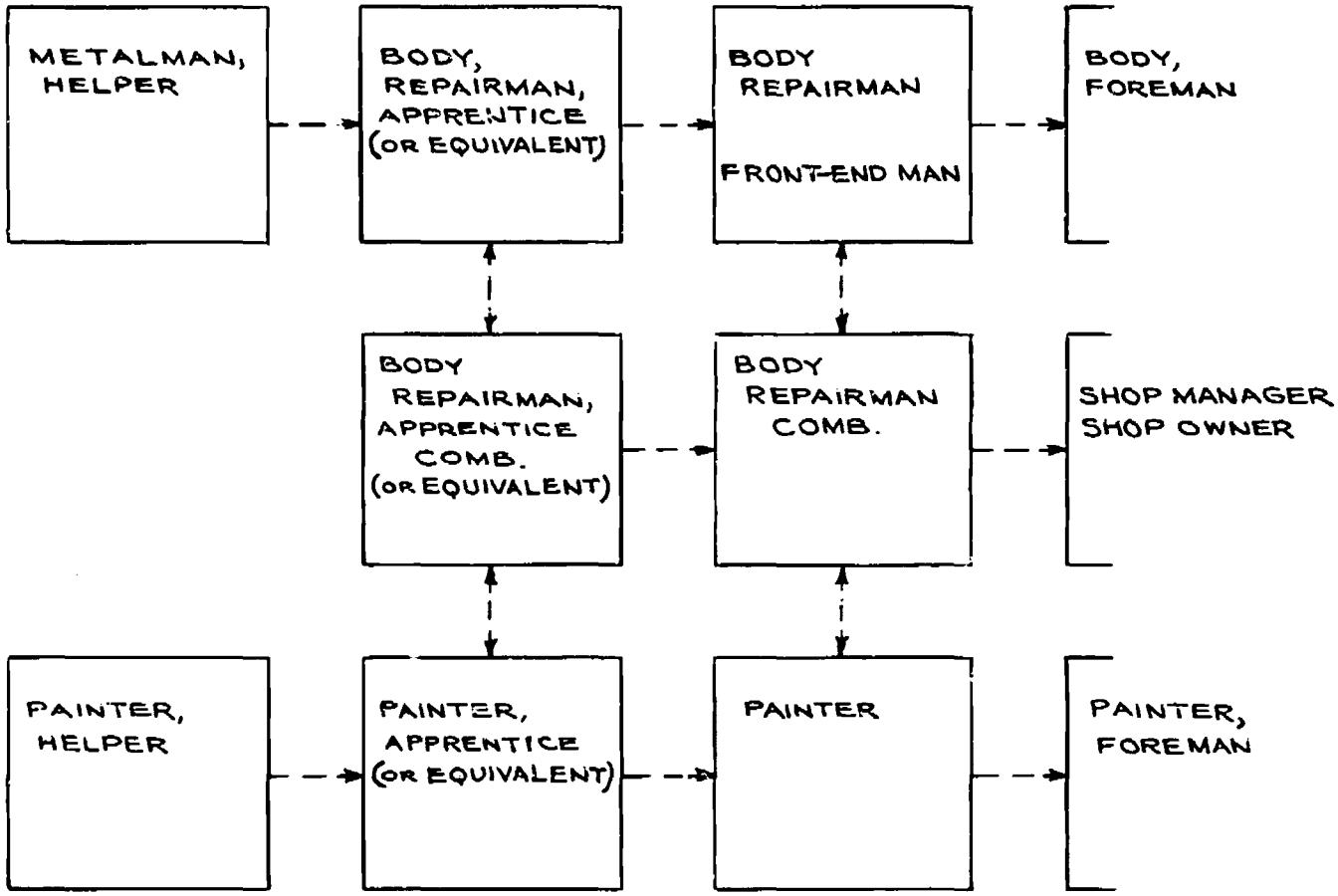
*A.R. Automotive Mechanic	620.281
Differential Repairman	620.281
Drive Shaft and Steering Part Repairman	620.281
Engine Head Repairman	620.281
Engine Repair Mechanic	620.281
Brakeman	620.281
Carburetor Man	620.281
Front-End Man	620.281
Transmission Man	620.281
Tune-Up Man	620.281
Automotive Repair Service Salesman	620.281
Motorcycle Repairman	620.281
Mechanic, Industrial	620.281
Mechanical-Maintenance Man (any ind.)	620.281
Automotive-Maintenance-Equipment Serviceman	620.281
Air Conditioning Mechanic	620.281
Automotive Tester	620.281
Construction-Equipment Mechanic	620.281
Motor and Chassis Inspector (auto mfg.)	620.281
Tractor Mechanic (any ind.)	620.281
Mechanical Unit Repairman	620.381
Repairman Heavy	620.381
Automobile Radiator Repairman	620.381
Brake Drum Lathe Operator	620.782
Aircraft and Engine Mechanic Apprentice	621.281
Engine Repairman Production (engine and turbine)	675.381
Internal Combustion Engine Subassembly	706.781
Electric-Motor Repairman	721.281
Automotive-Generator and Starter Repairman	721.281
Electrician Automotive	825.281

*Diesel Mechanic (any ind.)	625.281
Diesel Engine Mechanic, Automotive	625.281
Diesel Engine Mechanic, Bus	625.281
Diesel Engine Mechanic, Marine	625.281
Diesel Engine Mechanic, Construction	625.281
Diesel Engine Mechanic, Farm	625.281
Locomotive Repairman, Diesel	625.281
Diesel Engine Tester	625.281
Diesel Engine Erector	625.381
Diesel Mechanic, Helper	625.884
Fuel Injection Serviceman (any ind.)	625.281

*Representative Occupations

POWER MECHANICS

(Auto Body and Related Occupations)



NOTE: See list of occupations for a more detailed compilation of jobs and job families.

J.W.U.

POWER MECHANICS

(Auto Body and Related Occupations)

Selected List of Occupations

AUTO BODY

*Body Repairman, Helper, Auto	807.887
*Painter, Helper, Auto	845.884
Painter, Helper, Spray (any ind.)	741.887
Painter, brush (any ind.)	740.887
Painter, Helper, Construction (any ind.)	780.887
Masker (any ind.)	749.887
Cleaner (any ind.)	919.887
*Body Repairman, Apprentice (or equiv.) Auto	807.381
Auto Bumper Straightener	807.884
Solderer, Torch (auto mfg.)	807.884
Auto Door Panel Assembler (auto mfg.)	806.884
Headliner Installer	806.884
Glass Installer	865.884
Buffer (any ind.)	705.884
Polisher (any ind.)	705.884
Metal Finisher (any ind.)	705.884
Auto Accessories Installer	806.884
Auto Seat-Cover & Convertible Top Installer	780.884
Metal--Finish Inspector (any ind.)	703.587
Metal Sander and Finisher (any ind.)	705.887
*Painter, Apprentice (or equiv.) Auto	845.781
Spray Gun Repairman	630.381
Painter, Spray (any ind.)	741.884
*Body Repairman, Combination, Apprentice (or equiv.) Auto	807.381

*Representative Jobs

J.W.U.

*Body Repairman, Auto	807.381
Body Repairman, Bus	807.381
Service Mechanic	807.381
Truck Body Builder	807.281
New Car Get-Ready Man	806.381
Automobile Upholsterer	780.381
Automatic Window-Seat & Top-Lift Repairman	825.381
Welder, Gas	811.884
Dingman (any ind.)	809.884
*Front-End Man, Auto	620.281
*Painter, Auto	845.781
Painter, Aircraft	845.781
Painter, Shipyard	840.781
*Body Repairman, Combination, Auto	807.381
Shop Estimator	807.287

*Representative Jobs

APPENDIX L

Sample Job Description and Task Enumeration With Examples of Behavioral Objectives for Auto Mechanics Related Occupations

POWER MECHANICS

Service Station Attendant D.O.T. #915.867

A. Defining the Population

The majority of service station attendants are employed in leased or independently owned service stations. Most service station attendants are trained on-the-job although short term formal training conducted by major oil companies is available. On-the-job training time varies from 30 days to three months. Personal characteristics and dependability, according to the D.O.T., are among the more significant points an employer will look for in a potential beginning employee.

Excluded from this definition are:

1. Service station mechanics who are primarily concerned with performing minor (and in some instances major) automotive repairs and adjustments.
2. Service station owners or managers who are primarily concerned with management procedures of a service station.

B. Statement of Mission

The primary mission of a service station attendant is:

1. Servicing motor vehicles and automotive equipment.
2. Selling products offered by his establishment.

Other secondary missions are:

1. Cleaning and various custodial type duties.
2. Assisting the owner, manager or mechanic in a variety of minor tasks.

Job contexts for the service station attendant are quite varied depending on the establishment in which he is employed. In most cases, he will be required to service foreign vehicles, take part in company promotional programs, diagnose minor malfunctions, give directions to travelers, and clean the service station area. In addition, in certain states, he may assist in performing state automobile safety inspections. He may also assist the service station mechanic in performing minor repairs. The attendant works inside and outside under varied weather conditions.

The physical demands require:

1) crouching, such as bending the body downward and forward by bending the legs and spine;

2) feeling, such as perceiving such attributes of objects and materials as size, shape, temperature, or texture, by means of receptors in the skin, particularly those of the finger tips;
3) color vision, such as the ability to identify and distinguish colors.

The attendant is required to make arithmetic calculations involving fractions, decimals, and percentages.

C. Functions and Components of Functions

Things	Data	People
Handling	Copying	Taking Instructions -
Manipulating	Computing	Helping
Operating-Controlling	Compiling	Servicing
		Exchanging Information

The things the service station attendant handles and manipulates are various hand tools and automotive parts, components and merchandise. He operates-controls various dispensing and service equipment such as gas pumps and grease guns. The data functions with which the attendant is concerned are computing costs of services (e.g. gas, oil, lube, etc.), compiling various types of information obtained from manuals and simple inspections of motor vehicles. He will analyze data, usually with assistance and supervision, in order to determine what necessary actions are to be taken to complete his mission. He will perform simple clerical chores such as recording information on gas pump sales. The mechanic's relation with people involve taking instructions or receiving information from customers and supervisors, helping fellow workers when necessary, and speaking to and signalling fellow workers or customers in order to convey information to them.

D. Segments

The main steps involved in the occupation of service station attendant are identifying customer needs, selling products, performing required service operations, and receiving payment for products and services.

E. Contingencies and Contexts

1. May have to perform emergency road service.
2. May have to keep records and inventories.
3. May have to order materials and supplies.
4. May have to rent trailers, trucks, and other vehicles.
5. May have to assist service station mechanic.
6. May have to assist in arranging displays.
7. May have to substitute floor jacks in raising motor vehicles when hydraulic lift is not available.

F. Task Classification

a. Basic Tasks
1. Identifies customer needs.
2. Dispenses fuel.
3. Checks oil level.
4. Checks water level.
5. Adds required fluid or oil.
6. Inspects battery.
7. Performs battery services.
8. Tests tire pressure.
9. Adjusts tire pressure.
10. Removes and replaces tires.
11. Repairs tires.
12. Lubricates.
13. Services spark plugs.
14. Replaces light bulbs and fuses.
15. Replaces drive belts.
16. Replaces filters.
17. Receives credit and cash payments.
18. Cleans service station area.
19. Keeps records and inventories.
20. Washes and polishes automobiles.
21. Services cooling system (minor).
22. Performs preventive and safety maintenance checks.

b. Advanced Tasks
1. Services front wheel bearings.
2. Services exhaust system.
3. Adjusts brakes.
4. Replaces shock absorbers.
5. Balances wheels.
6. Services windshield wipers.

A number of other basic and simple tasks included as a part of the description for Service Station Mechanic could be included as advanced tasks.

c. Speciality Tasks
1. Tire recapping.
2. Battery repair.
3. Body repair.
4. Exhaust system repair.

d. Ancillary Tasks
1. Cleaning various components and parts.
2. Some replacement tasks (these consist of removing or unfastening the component or part to be replaced and installing [reverse of removing] the replacement part or component).

e. Redundant Tasks
1. Removal of nuts, bolts and screws.
2. Turning of handles and knobs (e.g. gas pumps).
3. Some removal and replacement tasks (e.g. gas caps).

TO 1. Given a tire with tube, tools, and demounting machine, the student follows operating instructions to remove tube, without further damage to tube while maintaining position for ease of locating puncture object.

TO 2. Given tube puncture or valve stem leak, student tests by inflating and submerging in water (or using soap-solution), locates leak, and marks location.

TO 3. Given a located puncture in a tube, student associates type of puncture or injury with recommended method of repair.

TO 4. Given a variety of tube-patch kits, and various punctured or leaky tubes, student follows repair kit instruction (hot and/or cold patch types) and restores to airtight condition.

TO 5. Given defective valve core, student identifies valve removing tool, removes and replaces valve core restoring to airtight condition.

TO 6. Given a punctured tube, a student locates and removes puncture object by placing tube over tire rim in original position, maintaining relationship between valve stem and chalk mark.

CO 3. Given patches, plug patch and a tubeless-type tire with severe puncture requiring internal repair, student applies required patch returning to airtight condition.

TO 1. Given tubeless-type tire requiring repair, student associates type of puncture with recommended repair methods required to restore tire to safe operating airtight condition.

TO 2. Given a variety of tire repair kits, tools, and materials, student identifies and follows necessary instructions to successfully repair leak.

Task 12. Lubricates.

CO 1. Given an auto to be lubricated, student locates lubrication points in front suspension, drive lines, steering linkages, power line, chassis assembly, under-the-hood, and body.

TO 1. Given a variety of autos to be lubricated, the student identifies lube manual section for a specific make, model, and year of car and follows service directions as listed.

CO 2. Given lubrication points, student applies required amount and type of lubricant according to lube chart specifications until retainers are filled or excessive lubricant appears around the retainers.

TO 1. Given an auto with lubrication points and a variety of lubricants, student differentiates the various types and grades of lubricants and associates with common use and application, driving conditions, and seasons.

TO 2. Given an auto to be lubricated and lubricants, student identifies proper tools and adapters to render complete lubrication.

TO 3. Given an auto to be lubricated and lube instructions, student identifies the level or need of lubricant and services accordingly.

Task 13. Services spark plugs.

CO 1. Given an auto with spark plugs, spark plug cleaner tester, spark plug wrench, and hand tools, student removes spark plug, cleans, adjusts tests, and replaces, if necessary, with new spark plug.

TO 1. Given an auto with spark plug to be removed or replaced, student identifies proper tools and performs operation (including tightening to torque specifications) without altering gap, damaging spark plug, stripping threads, and without foreign material entering engine.

TO 2. Given a set of spark plugs to be removed from engine, student maintains relationships between each plug and the engine cylinder in which it operates and the wire which fires each plug and cylinder in the proper sequence.

TO 3. Given a removed spark plug, student visually inspects plug, compares to chart of common malfunctions and deposits to determine operating condition of engine.

TO 4. Given a spark plug and a spark plug cleaner-tester, student locates and follows operating instructions to clean spark plug to a new-like condition.

TO 5. Given a clean spark plug, student adjusts gap to engine specifications and tests spark comparing to new plug according to test machine specifications.

TO 6. Given a spark plug to be replaced and a spark plug catalog, student identifies and secures equivalent replacement part.

Task 14. Replaces light bulbs and fuses.

CO 1. Given an auto with defective light, the student determines malfunction (fuse, bulb, or loose connection) and replaces bulb or fuse if necessary, or restores connection.

POWER MECHANICS

Service Station Mechanic D.O.T. #620.381

A. Defining the Population

The majority of service station mechanics are employed in leased or independently owned service stations. Some automotive retail stores and garages also employ persons having duties similar to the service station mechanic. Some service station mechanics have had formal training during their public school years. Others gained employment as mechanics because of on-the-job training experience in local service stations and garages.

Excluded from this definition are:

1. Service station attendants who are primarily concerned with fueling, cleaning and lubricating motor vehicles and equipment.
2. Service station owners or managers who are primarily concerned with management procedures of a service station.
3. Garage mechanics who are primarily concerned with the internal and major repair of motor vehicle systems and components.

B. Statement of Mission

The primary mission of a service station mechanic is:

1. Performing minor repair and tuneup of motor vehicles.

Secondary missions are:

1. Servicing motor vehicles and automotive equipment (service station attendant tasks).
2. Supervising service station attendants and mechanic helpers.

The job duties for the service station mechanics vary from one employer to another. Usually, the mechanic is engaged in the removal, replacement, testing and adjustment of automotive components installed on a vehicle. He does not normally repair internal malfunctions of the engine, transmission, and differential. He may service vehicles and sell automotive products. The mechanic performs his duties inside the station or, in the case of emergency calls, outside at the inoperative vehicle.

C. Function and Components of Function

Things	Data	People
Handling Manipulating Operating-Controlling	Computing Analyzing	Taking Instructions Exchanging Information

The things the service station mechanic handles and manipulates are hand and power tools and automotive parts. He operates and controls various equipment such as wheel balancers and electrical testers. The mechanic is concerned with data functions of computing costs and analyzing test results. His involvement with people is in taking instructions from a station owner or manager and receiving and conveying information from and to customers.

D. Segments

The main steps involved in the occupation of a service station mechanic are receiving information, determining malfunctions, analyzing data, adjusting components, repairing vehicles and computing charges.

E. Contingencies and Contexts

1. May have to keep records and inventories.
2. May have to order materials and supplies.
3. May have to service vehicles and perform attendant duties.
4. May have to perform major repairs of vehicles.

F. Task Classification

a. Basic Tasks

1. Perform minor engine tuneups.
2. Check or inspect wheel bearings.
3. Inspect exhaust systems.
4. Service and adjust brake systems.
5. Lubricate universal joints.
6. Replace windshield wiper blades.
7. Remove, install, and adjust carburetors.
8. Perform operational brake inspections.
9. Lubricate front wheel bearings.
10. Perform operational engine inspections.
11. Remove and install starters.
12. Replace brake shoes.
13. Replace flasher units.
14. Install gaskets and seals.
15. Replace exhaust system components.
16. Replace fuel pumps.
17. Remove and install generators or alternators.
18. Perform operational checks of windshield wiper systems
19. Perform operational inspections of propeller shafts, u-joints, and center bearings.

20. Remove and install radiators.
21. Adjust or replace emergency brake controls.
22. Repair or replace master cylinders.
23. Remove, install, and adjust distributors.
24. Repair or replace master or wheel cylinders.
25. Replace shock absorbers.
26. Repair or replace switches.
27. Perform operational inspections on manual transmissions.
28. Adjust, repair, or replace backup light switches.
29. Perform operational inspections of electrical systems.
30. Replace thermostats.
31. Replace fuel filters.
32. Inspect seat belts.
33. Perform inspections of vehicle condition.
34. Perform operational inspections of fuel systems.
35. Check or replace exhaust manifolds.
36. Replace brake hoses and lines.
37. Perform visual inspections of suspension systems.
38. Repair or replace windshield wiper units.
39. Inspect vehicles for compliance with local laws.
40. Perform operational inspections of positive crankcase ventilation systems.
41. Repair or replace instruments and sending units.
42. Install seat belts.
43. Repair distributors.
44. Repair or replace relays.
45. Maintain service station lifts and lubrication equipment.
46. Replace heater water control units.
47. Balance wheels and tires.
48. Maintain tire removal equipment.
49. Inspect or resurface brake drums.
50. Initiate and complete work orders.
51. Service or replace manifold heat controls.
52. Control flow of work.
53. Initiate requests for parts.
54. Replace grease boots.
55. Repair or replace hydraulic lines and fittings.
56. Service or replace heater components.
57. Retrieve disabled vehicles.
58. Perform operational inspections of exhaust emission control systems.
59. Install emergency warning devices.
60. Maintain washrack equipment.
61. Repair or fabricate hydraulic hoses.
62. Perform operational automatic transmission inspections.
63. Review procured parts for installation on proper vehicles.
64. Repair or maintain power lawn mowers.
65. Repair locks and latches.
66. Determine actual cost of vehicle repairs.

67. Inspect, fabricate, or repair hydraulic lines.
68. Repair or replace rectifiers.
69. Test or repair radiator core leaks.
70. Perform operational inspections of air conditioning systems.

b. Advanced Tasks

1. Repair or service carburetors.
2. Analyze causes of vehicle failures.
3. Repair starters.
4. Analyze or adjust engine performance using engine analyzer.
5. Repair generators or alternators.
6. Repair air brake systems.
7. Repair or replace hydraulic power brake units.
8. Repair or replace electrical motors.
9. Repair or replace power steering pumps.
10. Repair or service air-conditioning systems.
11. Install air-conditioners in vehicles.

c. Specialty Tasks

1. Radiator repair.
2. Transmission repair.
3. Front end alignment.

d. Ancillary Tasks

1. Cleaning various components and parts.
2. Removal and replacement of components to gain access to other components.

e. Redundant Tasks

1. Removal and replacement of nuts, bolts, and screws.
2. Turning of tester handles and knobs.
3. Using small handtools and power tools.

APPENDIX M

Follow-Up Instruments: Questionnaire for Vocational Student Survey and Employer Assessment Instrument

VOCATIONAL EDUCATION IN UNITED STATES

An AMERICAN INSTITUTE FOR RESEARCH Survey

INSTRUCTIONS

Most items on this questionnaire require only a check mark (✓) to give your answer. Please answer all items ACCURATELY. The information will be STRICTLY CONFIDENTIAL.

Please return the questionnaire in the postage-paid, pre-addressed envelope provided.

THANKS FOR YOUR HELP ON THIS IMPORTANT STUDY

1. Your Name _____ 2. Your High School's Name _____

3. Year Graduated from High School: Mo _____ Yr _____ 4. High School Course Studied _____

Below are ways students are influenced to select a vocational course. Mark those that influenced you to choose the course you took in high school. CIRCLE THE NUMBER OF THE MOST IMPORTANT INFLUENCE.

- ☐ 1. Books and magazines
- ☐ 2. Parents
- ☐ 3. Brother or sister
- ☐ 4. Relative
- ☐ 5. Neighbor (adult)
- ☐ 6. Friend your age
- ☐ 7. Job opportunities
- ☐ 8. Part-time job
- ☐ 9. School teacher
- ☐ 10. School counselor
- ☐ 11. School principal
- ☐ 12. Course graduate
- ☐ 13. Other, specify below

_____

_____

_____

Did your school offer the vocational course you really wanted to take?

- ☐ 1. Yes → If Yes, did you get to take it? → ☐ 6-1.1 Yes, I took the course I wanted.
- ☐ 2. No → If No, what course did you want to take that was not offered? _____ → ☐ 6-1.2 No, I could not take the course I wanted because _____

How long after leaving high school did it take you to get your first full-time job? _____ months

How did you get your first full-time job after leaving high school? (Mark all that apply.)

- ☐ 1. By answering a want-ad
- ☐ 2. Private employment agency
- ☐ 3. State employment agency
- ☐ 4. Help of school teacher
- ☐ 5. Help of school counselor
- ☐ 6. Help of school principal
- ☐ 7. Help of school placement service
- ☐ 8. Help of friend or relative
- ☐ 9. Through school coop program
- ☐ 10. Other than above

If you never had a full-time job, mark here ☐ SKIP TO ITEM 12

Was your first full-time job in the trade or field for which you were trained in high school?

If Yes: Indicate how well your vocational course prepared you for your first full-time job.

- ☐ 1. Exceptionally well-prepared; training covered all essentials required by first job
- ☐ 2. Well-prepared on the whole; but there were some important gaps in training
- ☐ 3. Poorly prepared; much that I needed to know was not covered in vocational course

If No: Mark reason below.

- ☐ 1. No job available in area of training
- ☐ 2. Learned new job by continuing school
- ☐ 3. Learned new job in military service
- ☐ 4. Decided I liked other work better
- ☐ 5. Not accepted as apprentice in trade
- ☐ 6. Other (specify) _____

How did the: (1) tools and equipment, (2) work methods, and (3) work materials used on your first full-time job compare with those used in your vocational shop courses? If a sub-item is not applicable, mark the box NA to the right. Otherwise, mark your answer.

TOOLS & EQUIPMENT ☐ NA	WORK METHODS ☐ NA	WORK MATERIALS ☐ NA
☐ 1. Identical or almost so	☐ 1. Identical or almost so	☐ 1. Identical or almost so
☐ 2. Little real difference	☐ 2. Little real difference	☐ 2. Little real difference
☐ 3. Very much different	☐ 3. Very much different	☐ 3. Very much different

If you marked 3 above (Very much different), did it take long to learn what was new?

☐ 1. Only about a few weeks	☐ 1. Only about a few weeks	☐ 1. Only about a few weeks
☐ 2. Less than three months	☐ 2. Less than three months	☐ 2. Less than three months
☐ 3. About six months	☐ 3. About six months	☐ 3. About six months
☐ 4. About one year	☐ 4. About one year	☐ 4. About one year
☐ 5. More than a year	☐ 5. More than a year	☐ 5. More than a year

11. For each of the skill areas listed below, answer the four questions at the right. Indicate your answers by marking appropriate boxes.

	How important is it in your present job?				How much skill is required in your present job?				Where did you learn to do it?				Do you feel it would be helpful to you in your present job if you had more skill in this area?
	Of No Real Importance	Slightly Important	Considerably Important	Of Extremely Important	Almost Nothing	Some But Not Much	Large Amount	Almost All	High School Courses	High School Shop or Class	Apprenticeship Program	On-the-Job	Elsewhere	(Mark either Yes or No)
1 MANUAL JOB SKILLS. Refers to skill at using or operating tools, equipment, materials, machines, etc., in your work.													1. Yes 2. No
2 JOB PRACTICAL KNOWLEDGE. Refers to practical everyday knowledge of work processes, methods, procedures, etc.													1. Yes 2. No
3 JOB THEORETICAL KNOWLEDGE. Refers to knowledge of basic principles and concepts underlying the practical trade work.													1. Yes 2. No
4 MATHEMATICAL SKILLS. Refers to ability to use arithmetic or higher mathematics to solve work problems.													1. Yes 2. No
5 COMMUNICATION SKILLS. Refers to skill at speaking, writing, drafting, sketching, etc., to communicate ideas.													1. Yes 2. No
6 READING AND INTERPRETIVE SKILLS. Refers to skill at reading printed matter, blueprints, tables, diagrams, etc.													1. Yes 2. No
7 CLERICAL SKILLS. Refers to skill at keeping records, making out reports, and other types of routine paper work.													1. Yes 2. No
8 PERSONAL RELATIONS SKILLS. Refers to skill at dealing with people, such as customers, co-workers, other trades, etc.													1. Yes 2. No
9 SUPERVISORY SKILLS. Refers to skill at supervising others, e.g., instructing, directing, evaluating, planning, organizing, etc.													1. Yes 2. No
10 OTHER SKILLS. Add what you feel applies to your job and is not covered by the above. _____													1. Yes 2. No

12. Please give your frank opinion about the following items concerning your high school education. (Mark one answer for each item.)

	ON THE WHOLE: 1. Poor	2. Satisfactory	3. Good	4. Excel
1. Quality of instruction from shop instructors				
2. Quality of instruction from academic teachers				
3. Condition of shop facilities and equipment				
4. General physical condition of school				
5. Vocational counseling given to students				
6. Help given students to find jobs				
7. Opportunity for extra-curricular activities				
8. Interest shown by teachers in student problems				
9. Reputation of the school in community				
10. Strictness of school in maintaining discipline				

13. Please mark all kinds of education obtained since leaving high school, and provide the information requested about each. Put an asterisk (*) behind those you are presently attending. If you have not had any additional education since high school, mark here ⟶
Estimate your average _____ hours per week over the total period attended.

Mark Here	Type of Education	Major Subject or Course(s)	Dates Attended (Give Month & Year)	Credits Earned	Avg. Hrs. Per Wk. in School
0	Two-year or junior college		Fr: To:		
1	Four-year college/university		Fr: To:		
2	Post-college graduate school		Fr: To:		
3	Private trade/technical school		Fr: To:		
4	Public trade/technical school		Fr: To:		
5	Business-commercial school		Fr: To:		
6	Adult continuation school		Fr: To:		
7	Military specialist school		Fr: To:		
8	Company courses or school		Fr: To:		
9	Correspondence courses		Fr: To:		
10	Other (specify)		Fr: To:		

WORK HISTORY SINCE HIGH SCHOOL. Start with your **FIRST** job after leaving high school. List **ALL** full-time jobs. List **ONLY** part-time jobs held six months or more, except if your present job is a part-time job. List the jobs in the order that you held them, up to and including your **PRESENT JOB.** (If self-employed, give **NET EARNINGS**, not **GROSS SALES**, of your business.)

	1	2	3	4	5	6	7	8	9	10
FIRST JOB	Starting Date Mo. 7 Yr. 52 Leaving Date Mo. 12 Yr. 54	What type of work did you do? MACHINIST APPRENTICE	Did job require move to new city? 1. ☐ No 2. ☒ Yes How many miles? 20	Full Time 1. ☐ Yes 2. ☒ No If part-time, how many hours per week, on average? 15	Self Employed 1. ☐ Yes 2. ☒ No	Was the work related to vocational course you took? 1. ☒ Same trade studied. 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☒ Satisfied 3. ☐ Dissatisfied 4. ☐ Very dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ 1.25 per HR Earnings at Leaving Give $ per hr., wk., or mo. $ 1.50 per HR	Reason For Leaving Job NO WORK	Were you unemployed after leaving job? 1. ☒ Yes 2. ☐ No If Yes, how long? 5 MONTHS
SECOND JOB	Starting Date Mo. ___ Yr. ___ Leaving Date Mo. ___ Yr. ___	What type of work did you do?	Did job require move to new city? 1. ☐ No 2. ☐ Yes How many miles?	Full Time 1. ☐ Yes 2. ☐ No If part-time, how many hours per week, on average?	Self Employed 1. ☐ Yes 2. ☐ No	Was the work related to vocational course you took? 1. ☐ Same trade studied 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☐ Satisfied 3. ☐ Dissatisfied 4. ☐ Very dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ _____ per _____ Earnings at Leaving Give $ per hr., wk., or mo. $ _____ per _____	Reason For Leaving Job	Were you unemployed after leaving job? 1. ☐ Yes 2. ☐ No If Yes, how long?
THIRD JOB	Starting Date Mo. ___ Yr. ___ Leaving Date Mo. ___ Yr. ___	What type of work did you do?	Did job require move to new city? 1. ☐ No 2. ☐ Yes How many miles?	Full Time 1. ☐ Yes 2. ☐ No If part-time, how many hours per week, on average?	Self Employed 1. ☐ Yes 2. ☐ No	Was the work related to vocational course you took? 1. ☐ Same trade studied 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☐ Satisfied 3. ☐ Dissatisfied 4. ☐ Very Dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ _____ per _____ Earnings at Leaving Give $ per hr., wk., or mo. $ _____ per _____	Reason For Leaving Job	Were you unemployed after leaving job? 1. ☐ Yes 2. ☐ No If Yes, how long?
FOURTH JOB	Starting Date Mo. ___ Yr. ___ Leaving Date Mo. ___ Yr. ___	What type of work did you do?	Did job require move to new city? 1. ☐ No 2. ☐ Yes How many miles?	Full Time 1. ☐ Yes 2. ☐ No If part-time, how many hours per week, on average?	Self Employed 1. ☐ Yes 2. ☐ No	Was the work related to vocational course you took? 1. ☐ Same trade studied 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☐ Satisfied 3. ☐ Dissatisfied 4. ☐ Very dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ _____ per _____ Earnings at Leaving Give $ per hr., wk., or mo. $ _____ per _____	Reason For Leaving Job	Were you unemployed after leaving job? 1. ☐ Yes 2. ☐ No If Yes, how long?
FIFTH JOB	Starting Date Mo. ___ Yr. ___ Leaving Date Mo. ___ Yr. ___	What type of work did you do?	Did job require move to new city? 1. ☐ No 2. ☐ Yes How many miles?	Full Time 1. ☐ Yes 2. ☐ No If part-time, how many hours per week, on average?	Self Employed 1. ☐ Yes 2. ☐ No	Was the work related to vocational course you took? 1. ☐ Same trade studied 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☐ Satisfied 3. ☐ Dissatisfied 4. ☐ Very dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ _____ per _____ Earnings at Leaving Give $ per hr., wk., or mo. $ _____ per _____	Reason For Leaving Job	Were you unemployed after leaving job? 1. ☐ Yes 2. ☐ No If Yes, how long?
SIXTH JOB	Starting Date Mo. ___ Yr. ___ Leaving Date Mo. ___ Yr. ___	What type of work did you do?	Did job require move to new city? 1. ☐ No 2. ☐ Yes How many miles?	Full Time 1. ☐ Yes 2. ☐ No If part-time, how many hours per week, on average?	Self Employed 1. ☐ Yes 2. ☐ No	Was the work related to vocational course you took? 1. ☐ Same trade studied 2. ☐ Highly related 3. ☐ Slightly related 4. ☐ Completely unrelated	On the whole, were you satisfied with the work? 1. ☐ Very satisfied 2. ☐ Satisfied 3. ☐ Dissatisfied 4. ☐ Very dissatisfied	Earnings at Starting Give $ per hr., wk., or mo. $ _____ per _____ Earnings at Leaving Give $ per hr., wk., or mo. $ _____ per _____	Reason For Leaving Job	Were you unemployed after leaving job? 1. ☐ Yes 2. ☐ No If Yes, how long?

Note: If you held more than six full and part-time jobs, please list them on the page enclosed. Be sure to include your full-time and/or part-time job. Thank you.

15. YOUR PRESENT JOB. (Please give this additional information.)

1. Present Earnings? Give $ per hour, week, or month. $ _____ per _____
2. Your Employer _____
   Street Address _____
   City-State _____

16. Did you have any military service? ☐ 1. No ☐ 2. Yes → How many months? ____ Name of unit? ____

17. Were you unemployed for reasons of health or hospitalization? ☐ 1. No ☐ 2. Yes → For how many months? ____

Part of our study concerns the interests, activities, and attitudes of high school graduates. We feel we will get more reliable information from personnel in civilian jobs if we contact them directly. Please write your name and home address below.

18. How frequently do you talk about the following topics when you get together socially with others?

	ALMOST NEVER 1	INFREQUENTLY 2	FREQUENTLY 3	ALMOST ALWAYS 4
1. Your work	☐	☐	☐	☐
2. Religion	☐	☐	☐	☐
3. Politics	☐	☐	☐	☐
4. Business conditions	☐	☐	☐	☐
5. World affairs	☐	☐	☐	☐
6. National affairs	☐	☐	☐	☐
7. State affairs	☐	☐	☐	☐
8. Community problems	☐	☐	☐	☐
9. Your hobbies	☐	☐	☐	☐
10. Sports and athletics	☐	☐	☐	☐
11. Music, art, literature, etc.	☐	☐	☐	☐
12. Government matters	☐	☐	☐	☐
13. Labor union matters	☐	☐	☐	☐
14. Your family	☐	☐	☐	☐
15. Other (specify) ____	☐	☐	☐	☐

19. How frequently do you engage in the following types of leisure-time activities?

	ALMOST NEVER 1	INFREQUENTLY 2	FREQUENTLY 3	ALMOST DAILY 4
1. Reading newspapers	☐	☐	☐	☐
2. Engaging in craft hobbies (model building, jewelry making, etc.)	☐	☐	☐	☐
3. Reading professional or trade books and periodicals	☐	☐	☐	☐
4. Attending athletic events as a spectator	☐	☐	☐	☐
5. Attending plays, concerts, ballets, etc.	☐	☐	☐	☐
6. Watching television programs	☐	☐	☐	☐
7. Gardening (raising flowers, fruit trees, vegetables, etc.)	☐	☐	☐	☐
8. Reading general magazines (LIFE, LOOK, READERS' DIGEST, etc.)	☐	☐	☐	☐
9. Working at home shop activities (woodworking, metalworking, etc.)	☐	☐	☐	☐
10. Attending educational courses for self-improvement	☐	☐	☐	☐
11. Engaging in team sports (softball, football, etc.)	☐	☐	☐	☐
12. Engaging in performing arts (acting, singing, instruments, etc.)	☐	☐	☐	☐
13. Visiting or entertaining friends	☐	☐	☐	☐
14. Reading non-fiction books (biography, history, travel, etc.)	☐	☐	☐	☐
15. Collecting stamps, coins, trains, or other items	☐	☐	☐	☐
16. Attending educational lectures and discussion groups	☐	☐	☐	☐
17. Engaging in individual sports (swimming, hunting, fishing, etc.)	☐	☐	☐	☐
18. Listening to music at home for pleasure	☐	☐	☐	☐
19. Going to the movies	☐	☐	☐	☐
20. Other (please write in) ____	☐	☐	☐	☐

20. Below is a list of different type organizations and associations. Mark the space which best describes your membership status in each type of organization, association, or club.

	NOT A MEMBER 1	INACTIVE MEMBER 2	ACTIVE MEMBER 3	PRESENTLY AN OFFICE 4
1. A church or a religious organization	☐	☐	☐	☐
2. Political organization	☐	☐	☐	☐
3. Service organization (Rotary, Lions, Kiwanis, etc.)	☐	☐	☐	☐
4. Sports club or athletic organization	☐	☐	☐	☐
5. Labor union	☐	☐	☐	☐
6. Fraternal organization (Elks, Masons, K. of C., etc.)	☐	☐	☐	☐
7. Veterans' organization	☐	☐	☐	☐
8. Business or trade association	☐	☐	☐	☐
9. Music or other cultural association	☐	☐	☐	☐
10. Local civic association	☐	☐	☐	☐
11. Youth organization (Scouts, Y.M.C.A., etc.)	☐	☐	☐	☐
12. Professional association	☐	☐	☐	☐
13. Other (specify) ____	☐	☐	☐	☐

21. Marital Status
☐ 1. Single
☐ 2. Married
☐ 3. Other

22. Race
☐ 1. White
☐ 2. Negro
☐ 3. Other

23. Religion
☐ 1. Protestant
☐ 2. Catholic
☐ 3. Jewish
☐ 4. Other
☐ 5. None

24. Do you have any disabili... or health condition that... limits your work...
☐ ☐

THANK YOU FOR YOUR COOPERATION

PROJECT ABLE
VOCATIONAL GRADUATE FOLLOW-UP

INSTRUCTIONS

Most items on this questionnaire require only a check mark (✓) to give your answer. Please answer all items ACCURATELY. The information will be STRICTLY CONFIDENTIAL.

Please return the questionnaire in the postage-paid, pre-addressed envelope provided.

THANKS FOR YOUR HELP ON THIS IMPORTANT STUDY

Company or firm _____ Supervisors of employee _____

Employee's Name _____ Your Name _____ Date _____

Please evaluate the person in question in terms of the characteristics indicated below by checking the appropriate spaces.

For each of the skill areas listed below, answer the four questions at the right. Indicate your answers by marking appropriate boxes.	1 How important is this skill for his present job				2 How would you evaluate him on this skill				3 How does he compare with others of about his age who had other training?				4 Does he need more instruction or training in this area? (Mark either Yes or No)
	1 Of no importance	2 Slightly important	3 Considerably important	4 Of critical importance	1 Needs much improvement	2 Generally satisfactory	3 Usually above average	4 Outstanding	1 Has no one to talk with/work	2 Does not do as well as others doing same work	3 Does about as well as others doing same work	4 Does better than others doing same work	
1. MANUAL JOB SKILLS. Refer to skill at using or operating tools, equipment, materials, machines, etc., in your work.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
2. JOB PRACTICAL KNOWLEDGE. Refers to practical everyday knowledge of work processes, methods, procedures, etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
3. JOB THEORETICAL KNOWLEDGE. Refer to knowledge of basic principles and concepts underlying the practical trade work.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
4. MATHEMATICAL SKILLS. Refers to ability to use arithmetic or higher mathematics to solve work problems.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
5. COMMUNICATION SKILLS. Refers to skill at speaking, writing, drafting, sketching, etc., to communicate ideas.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
6. READING AND INTERPRETIVE SKILLS. Refers to skill at reading printed matter, blueprints, tables, diagrams, etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
7. CLERICAL SKILLS. Refers to skill at keeping records, making out reports, and other types of routine paper work.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
8. PERSONAL RELATIONS SKILLS. Refers to skill at dealing with people, such as customers, co-workers, other tradesmen, etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
9. SUPERVISORY SKILLS. Refers to skill at supervising others, e.g., instructing, directing, evaluating, planning, & organizing etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐ 1. Yes ☐ 2. No
10. ATTITUDE TOWARD WORK. Refers to such behavior as absenteeism, [illegible] concern for quality [illegible] etc.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	

GLOSSARY

Adjunctive Program

A structured document which makes use of existing materials (programmed or non-programmed) as the primary source of instruction, around which a programmed guide (objectives, questions, etc.) is built to direct the student through the learning experiences.

Affective Domain

Deals with emotions or feelings. Described by words such as interest, appreciation, enthusiasm, motivation and attitude.

Behaviorai Analysis

See Task Analysis.

Behavioral Objective

A behavioral objective is similar to a performance objective with the two seldom being differentiated. However, the connotation implies a clinical analysis of covert and overt behaviors, with a charting of the S-R units after the task description has been completed.

Cognitive Domain

Deals with thought processes. Described by such words as knowledge or understanding.

Content Analysis

Identification of instructional objectives by analyzing texts and other existing instructional materials.

Criterion Checklist

The portion of a performance evaluation set where an instructor records either a satisfactory or unsatisfactory rating of the student's achievement of subobjectives which may include the critical incidents of the job task.

Criterion Referenced Test Instrument

An evaluation instrument which measures a student's achievement against stated objectives rather than comparing one student to another or to a test group.

Critical Incident

Specific behavior found to be critical to performance success. Can be described as an activity or action which was either very effective or very ineffective. A decisive incident.

Feasibility Study

A study conducted for the purpose of determining whether or not the instructional system development process should be applied to a course of instruction. Factors such as course prerequisites, investment requirements, employment opportunities and a number of students to be trained are taken into consideration.

Feedback

The function of a device which provides "knowledge of results" to the student, curriculum developers, project manager and others.

Formative Evaluation

A kind of process research or outcome evaluation at an early or intermediate stage of activity for the purpose of discovering deficiencies and successes in the development. In education, such a process is used primarily to improve materials or a course rather than to appraise products or to compare methods and materials.

Hands-On

Activity in which the trainee "handles" the tools, equipment or materials required for job task performance. Simulation possible where appropriate. Activity oriented learning or laboratory work in contrast to lectures, textbook reading assignments, etc.

Individualized Instruction

Instruction which is learner-centered rather than instructor-centered. Students engaged in individualized instruction activities can be observed to be performing significantly different than students in a traditional course of instruction. Choosing the task to be mastered, charting work progress, obtaining examination results and mastering tasks at an individual rate are student activities which can be clearly observed to be different from student behaviors in traditional courses.

Iterative Evaluation

An evaluation process which is repeated time after time (i.e., test/revise/retest cyles) to assure accuracy, quality and relevancy of the training materials and program.

Job Cluster

A group of jobs within a particular job family.

Job Family

A group of jobs which have a common core of tasks and tools and use similar raw materials.

Learner Activity Devices

Training aids or equipment which provide the student with the hands-on activity required for objective mastery.

Performance Objective

A stated goal of task mastery. The statement is in reference to overt behavior (observable and measurable) and specifies the quality standards of the performance and conditions of the situation. The goal is usually derived from a task description. There are a number of methods of acquiring a description of the tasks being performed by trained personnel in the field.

PERT

Performance evaluation and review techniques often used with CPS--critical path scheduling-- for purposes of management control. A system for planning, scheduling and controlling a project. Provides a means of control by constant assessment of actual performance and progress against planned activities.

Psychomotor Domain

Deals with muscular movement. Described by such words as adjusts, turns, screws, etc.

Regenerative

To reform, to reproduce, to renew, to restore (etc.) through follow-up evaluative activities oriented toward program improvement. In vocational-technical education, evaluation systems must be especially sensitive to changes in the technology, equipment, practices and procedures, etc.

Self-Scoring Response Device

Any paper-pencil or machine device which provides a student with immediate "knowledge of results" on questions which he has answered. Can be used in hands-on situations to confirm mastery of tasks accomplished.

Summative Evaluation

An evaluation process which amasses statistical information which, in one example, is used to make comparisons among products or methodologies. Experimental control groups are usually structured for testing purposes.

Systems Approach

A management process which is focused on system design analysis, management by objectives, technology of instruction, quality assurance and performance, and accountability contracting. The specification of events, processes, outputs, etc., with information feedback mechanisms for constant monitoring and adjustments.

System Control Documents

Evaluation instruments and detailed checklists of tasks required of personnel involved in the instructional system development process. Provides for quantity and quality control of work being performed at the various levels within the developmental process.

System Development Team

The technical writers, behavioral psychologists, subject matter specialists, editors and project managers engaged in a coordinated team effort utilizing the instructional system development process.

Task Analysis

An analysis of the behavioral implications of the task description, through a clinical process which requires "...all that is known and much that is conjectured in the full area of experimental psychology". This implies an analysis of overt and covert behaviors with a charting of S-R units. It is said to be a heuristic description of activities which invites much randomness.

Task Description

A complete description of specific interactions between man and machine. It is said that a good task description could be used as a procedural manual for the novice. It should enumerate all the circumstances in the stimuli and responses that can occur. Task descriptions can be derived from a content analysis, by simulation, by interview (consensus) analysis, or by observation (identification of S-R units).

Test/Revise/Retest Cycle

That portion of the instructional system development process where individual performance evaluation and learning activity materials are systematically tested, revised and retested prior to implementation in the classroom or laboratory.

Validation

To confirm or prove. Usually accomplished through field testing with a population of adequate size to insure generalizability. Proof of doing that which was intended, as measured against specific criteria and quality standards.

Verification

To test or check accuracy or exactness. While the meaning is similar to the definition provided for validation, the connotation in education implies a less rigorous process with a population inadequate in size to claim validation.