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ABSTRACT

This paper concentrates on two aspects in the development of curriculums for technical training: the identification of curriculum content for specific courses of study; and the organization of such content in training programs. Seven steps in the HumRRO procedure for systematic curriculum engineering are identified: determining the performance required; deriving training objectives; basing training content on training objectives; selecting appropriate training methods; minimizing training interference with learning; monitoring the school-trained product; and modifying training as required. Procedures for identifying and sequencing curricular content and for generating curricular information have been discussed--a job model for use in creating listings of job tasks; functional context principles for content integration; and hierarchical structures of technical concepts (use of a word-associational technique for hierarchical grouping of technical concepts). The use of a word association technique in a military radar maintenance course revealed that more research was needed before this approach could become an operational tool of curriculum designers. (PT)

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# Systematic Approaches for Identifying and Organizing Content for Training Programs

by

Harry L. Ammerman

Presentation to
Invitational Conference for
Curriculum Development and Vocational Education
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HumRRO

HUMAN RESOURCES RESEARCH ORGANIZATION

The Human Resources Research Organization (HumRRO) is a nonprofit corporation established in 1969 to conduct research in the field of training and education. It is a continuation of The George Washington University Human Resources Research Office. HumRRO's general purpose is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation.

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## Prefatory Note

This paper was presented at the Invitational Conference on Curriculum Development and Vocational Education in Minneapolis, Minnesota in March 1970. The author participated in the Seminar of the Research Coordinating Unit in Occupational Education. Proceedings of the seminar are now in preparation by the University of Minnesota.

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## SYSTEMATIC APPROACHES FOR IDENTIFYING AND ORGANIZING CONTENT FOR TRAINING PROGRAMS

Harry L. Ammerman

There are many aspects to the development of curriculums for technical training. This paper concentrates on two of these matters: (a) the *identification* of curriculum content for specific courses of study and (b) the *organization* of such content in training programs. Both of these topics are discussed in the context of systematic curriculum engineering, with primary concern being devoted to specific procedural techniques to be used by training curriculum personnel.

My organization, the Human Resources Research Organization (HumRRO), has been conducting training research for the Department of the Army and for non-defense agencies. Much of the work has pertained to electrical and electronic maintenance training, but considerable research has also been conducted on such topics as training for equipment operators, vehicle mechanics, team operations, low-aptitude trainees, and leadership and supervision. This research has frequently been concerned with the development and application of innovative approaches to the solution of curriculum and instructional problems.

One of the major lessons learned in the HumRRO studies of technical training is that there is a need for a *systematic*, *generalized* procedure for building, testing, and revising training courses (1)—*systematic* to assure completeness in considering all relevant aspects of the work performance and learning requirements, *generalized* so that the schema can be used effectively for many different kinds of job training courses. The evolved guidelines represent an amalgam of many researchers' thoughts, experiences, and concepts that have been developed both within HumRRO and within numerous other training research laboratories.

### The HumRRO Generalized Procedure for Developing Technical Training

There are seven steps, or points, in the HumRRO procedure for systematic curriculum engineering (1):

Step 1: Determine the performance required. The assumed purpose of training is to develop job-relevant human performance capabilities. Therefore, the initial and most critical step in the development of any technical training program is to specify and describe what a person must know and be able to do in the job situations for which he is being trained.

Step 2: Derive training objectives from performance requirements. Once performance requirements have been determined, the next step is to derive corresponding training objectives which specify the tasks the trainee must master and the level of proficiency required. Properly established training objectives serve as a standard against which training effectiveness can be evaluated, as well as serving to communicate the intent of the instructional program. A clear specification of an objective is considered to be a behavioral statement that describes the following elements:

(1) The particular job-relevant performance or behavior the student is expected to be able to display after training, described in terms of student actions.
(2) The relevant conditions under which such performance is to be observed.
(3) The standard of performance accuracy or speed to be attained by each student.

Three levels of behavioral objectives for training courses are distinguished. First is the *general goal or purpose* of a course or unit of instruction. Second is the *terminal objective,* which describes a meaningful unit of work activity. Third are *enabling objectives,* which describe knowledges, skills, and attitudinal behaviors that must be acquired to accomplish the terminal objective.

Step 3: Base training content on training objectives. The content of training (that which is taught) is based on the objectives, distinguishing between that content which is essential and that which is useful but not essential for school learning. Where abstract or conceptual knowledge seems required, an earnest attempt to restate such knowledge in specific items of information required for and used in job performance has been helpful. The concern here is that a school must know *what* to teach before it can realistically determine *how* to teach.

Step 4: Select appropriate training methods. Thus, Step 4 of the procedure is to select the instructional methods best suited for creating the appropriate learning experiences. Intensive research efforts have been and continue to be directed toward finding effective ways to organize and sequence training content and to select appropriate training and teaching methods for the creation of effective learning experiences. From this research are emerging several general concepts as well as specific procedural techniques.

The remaining three steps need only be stated briefly, as they are less relevant to the techniques to be discussed in the remainder of this paper:

Step 5: Administer training so as to minimize interference with learning and maximize learning principles.

Step 6: Monitor the school-trained product. The general objective of this quality control program is to determine the responsiveness of training activities to performance requirements.

Step 7: Modify training as required.

Within the framework of these guidelines there are many specific techniques that need to be applied by various researchers to permit effective implementation in specific training programs. The remainder of this paper will describe several of these procedures as they pertain to the work of identifying and sequencing curricular content in Steps 1 through 4 of the above guidelines. The procedures range from simplified job models for use by curriculum personnel, to empirical techniques for generating curricular information in as objective manner as possible. The procedures consist of:

(1) A job model for use in creating listings of job tasks.
(2) Functional context principles for content integration.
(3) Hierarchical structures of technical concepts, per the notions of Moss, Smith, and Pratzner.

Such procedures by no means represent all that is required, nor the ultimate methodologies, in curriculum development. The need for developing more effective techniques of identifying and designing training courses probably will never be satisfied, though significant advancements have been demonstrated in other papers presented at this session. Such innovative methodologies are desperately needed if systems engineering of technical training courses is to become a reality in common practice.

HumRRO experiences with technical training schools have fully shown the need for practical techniques by which school personnel can themselves derive relevant and effective curriculums. The military, through its command directives (2, 3), has indicated its desire to employ certain HumRRO-based systematic approaches on a large scale. Implementation of these guidelines by in-house personnel has highlighted the need for further advances in providing user agencies with the procedural means by which they can accomplish the intent of the generalized system guidelines. Improved procedures are needed for determining the relevancy, importance, and completeness of curricular content. Additional practical procedures are needed to permit effective grouping and sequencing of instructional units.

## A Job Model for Use in Creating Listings of Job Tasks

One common means used to create a listing of tasks for a job or occupation is to ask experienced job incumbents what they do on their jobs. Probing interviews are often used to assure reasonable completeness and accuracy of the task statements. This process has often been difficult to apply, however, when the job is non-procedural or not oriented to hardware operation or maintenance. In a study of junior officer jobs (4), several ways of reorganizing available statements of supervisory and managerial actions were considered. One such grouping that appeared to account for most of the available action statements consisted of four categories:

(1) Objectives of the job that are sought by the officer (e.g., "Acts to maintain a high state of discipline in the unit"), labeled as "Job Goals and Standards."

(2) Actions to obtain those job objectives (e.g., "Recommends the type of disciplinary action to be taken"), labeled as "Controlling Activities."

(3) Actions to obtain information about states of affairs and conditions pertinent to the job, unit, or mission (e.g., "Observes

military deportment of personnel"), labeled as "Information-Gathering Activities."

(4) Evaluation of job situations made on the basis of inspections, checks, observations, and communications (e.g., "Determines the troops' current opinion of the unit mess"), labeled as "Determinations."

This simplified grouping of categories for organizing existing statements of work proved useful to interviewers in breaking apart the overly general statements of job activities.

In addition to the two classes of overt job activities, inclusion in the job description process of two other components of the model is desirable to indicate the *intent* of the overt tasks that are performed. By viewing the "determinations" as *purposes* to be served by performance of "information-gathering activities," and by viewing the "job goals and standards" as *purposes* to be served by performance of "controlling activities," it became possible to probe extensively into all aspects of the job.

The "determinations," in addition to being a useful concept for the job analysis, provide meaningful units of work that an individual may be trained to accomplish with proficiency. Thus, "determinations" serve a dual role in the description of the job—as job purposes and as tasks performed. They meet the qualifications for task statements in that they:

(1) May be expressed by an action verb plus a statement of what is acted upon (e.g., "Determine the rate of learning progress being made by a job trainee").
(2) Represent discrete and perceptible units of work, each having a definite beginning and ending within a limited period (i.e., it is reasonable for an individual to answer *how often* he performs the activity).
(3) Are suitable for treatment by task analysis procedures, wherein it is possible to describe how, when, and why each is accomplished on the job.

The statements of "job-goals and standards", however, do not meet the requirements for task statements. They do not state what the individual *does*, but instead define—without *direct* implications for action—the various states of affairs sought by the worker on the job. Their primary utility is as a description aid for the job analysts, with possible subsequent consideration given to the priority of each job goal and standard.

The initial job description for one officer position listed 533 controlling and information-gathering activities and 435 job goals and standards and determinations. These were distributed across the several arbitrary areas of responsibility as shown in Table 1. Since the descriptive statements of job goals and standards (152) are not statements of work performance, this means there were 816 task statements, far more than typically derived for one job position.

Table 1

Distribution of Descriptive Statements

| Area of Responsibility | Type of Descriptive Statement[a] | | | |
|---|---|---|---|---|
| | Physical Activities | | Job Purposes | |
| | CA | I-GA | JG&S | Det |
| Tactical Operations | 3 | 0 | 3 | 0 |
| Operational Readiness | 14 | 68 | 2 | 46 |
| Organizational Maintenance | 11 | 43 | 4 | 156 |
| Parts Supply | 16 | 21 | 11 | 16 |
| Manning | 12 | 11 | 12 | 7 |
| Job Training | 23 | 13 | 41 | 20 |
| Discipline, Welfare, and Morale | 19 | 37 | 18 | 12 |
| Safety | 21 | 9 | 18 | 7 |
| Security | 17 | 10 | 4 | 7 |
| Additional Duties (battery level) | 85 | 61 | 37 | 9 |
| Secondary Duties and Details (outside the battery) | 26 | 13 | 2 | 3 |
| Total | 247 | 286 | 152 | 283 |

[a]CA = Controlling Activities
I-GA = Information-Gathering Activities
JG&S = Job Goals and Standards
Det = Determinations

## Functional Context Principles for Content Integration

Functional Context Training (FCT) is a name for a procedure-oriented approach to curriculum design that was originally developed under HumRRO research programs on the training of repairmen for electrical and electronic systems. The FCT method is based on the hypothesis that typical vocational trainees learn best when they can see a real need for the facts, procedures, and concepts they are learning, and when they have a meaningful framework within which to organize these facts. Identification of relevant course content and the sequencing of such content become the prime concerns of the FCT methodology.

The main features of the Functional Context approach to curriculum design for specific courses of any study are (5, 1):

(1) *A meaningful and work-relevant context is provided for the learning of new and abstract material.* This feature requires that a functional context be established for the total training course, thus equipping students with a framework within which they can organize new knowledge as it is acquired in each block or unit of instruction. The set of behavioral objectives, derived from actual job activities, creates one significant basis for defining the context, wherein the job situation also provides a framework for organizing course content. One result of applying this feature is that abstract technical and theoretical concepts cannot be grouped and taught as a separate instructional unit. Although some concepts, rules, and definitions need to be learned, they

would be introduced as needed in the context of learning specific occupational procedures.

(2) *Within the primary context established by the work situation, the individual units of instruction are then sequenced generally as they would be encountered by a worker on the job.* This is done in a "whole-to-part" sequence, from a major item of equipment down to specific piece parts, so that the relevance of instruction at each successive stage can be readily and immediately apparent to the learner. Difficult conceptual material is presented at the time it is needed for learning to perform a specific job activity. The whole-to-part sequencing within a job context is particularly suited for the beginning student who does not have adequate experience to provide a meaningful frame of reference for the course material.

(3) *Additional sequencing restrictions are imposed by generally requiring that each succeeding unit of instruction should introduce a few new demands for the learning of relevant principles, concepts, and skills.* These units of instruction start with relatively simple job tasks which require little theoretical background and proceed in a graded series to the more complex job-related tasks.

(4) *Use of job-related tasks as the basis for units of instruction permits students to have a chance to apply their new knowledges and skills soon after each is acquired.* Planned sessions during which students may practice job activities help each student to see that he is learning to do a job, not simply memorizing abstract concepts or facts. The need for each theoretical fact becomes clear to the student as he learns it.

## Hierarchical Structures of Technical Concepts

One recent innovation having great potential for organizing training content is the use of a word-associational technique for hierarchical grouping of technical concepts, as described in the presentations by Smith, Moss, and Pratzner.[1] The applications of the procedure thus far indicate that various subgroups of experienced technicians can reliably provide word associations that yield unique concept structures for each subgroup. This suggests the possibility that the technique could be useful as an empirical means by which curriculum designers could structure educational and job training courses to most effectively match the characteristics of different subgroupings of students. Thus, a class of low aptitude students could attend a training course organized to maximize the meaningfulness of technical concepts for them, whereas high aptitude students might well be presented a completely different structuring of the same technical concepts.

The technique, being new, presents many challenging questions for research. For instance, how much job experience (and of what type) is

[1]Brandon B. Smith, Jerome Moss, and Frank C. Pratzner. "An Empirical Procedure for Identifying the Structure of Technical Concepts Possessed by Selected Workers," paper presented at the Seminar on Vocational Curriculum Development, sponsored by Minnesota Research Coordinating Unit for Vocational Education, February 28-March 1, 1970, Minneapolis, Minn.

necessary before persons can provide useful word associations? Do students themselves know the technical concepts sufficiently well to yield any meaningful hierarchical structure? Are similar concept structures provided by matched groups of respondents? What influence do aptitude, experience, verbal ability, and other such individual factors have upon derived concept structures? How many respondents are needed to provide meaningful hierarchies? What proportion and what types of technical concept words are needed?

It was the intent of the present paper to begin exploring some of these questions, starting with a foreshortened quick-look replication of the reported procedures. Using five subgroups of inexperienced students midway through a lengthy job training course, clues were sought for the answers to the following general questions:

(1) Can students in training provide meaningful concept structures?

(2) Do matched subgroups of student respondents yield similar concept groupings?

(3) How do student groupings of concepts compare with those of their instructors, both those instructors with some job experience and those without any job experience?

(4) Are concepts grouped differently when the course content is organized by two different curriculum approaches, conventional versus functional context?

Procedures. Twelve students and eight instructors in a 29-week military radar maintenance course were used to provide word associations to a sample of electronic concepts. The concepts used were 68 of the most relevant terms[2] employed in the study reported by Smith.[3] Respondents were combined, four to a group, into five groups as noted in Table 2.

To the extent possible the student groups were roughly matched on length of exposure to concepts of the training course, general and electronics aptitude test scores, education level, and achievement scores in the instruction so far received. See Table 3 for personal data summaries, including workers from Smith's Minnesota study.

Word associations were obtained in group sessions. Instructions given respondents were essentially identical to those used by Smith. Subsequent analyses tried to follow Smith's procedures exactly.

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[2]For purposes of brevity in this paper, complete listings of these terms and of subsequent relatedness coefficients and factor loadings are omitted.

[3]Brandon B. Smith. "Testing and Empirical Procedures for Identifying Technical Associative Conceptual Structure: Discriminating Between Flexible and Inflexible Radio and Television Repairmen," Doctoral Dissertation, University of Minnesota, September 1968.

Table 2

**Identification of Student and Instructor Groups**

| Group Code | Definition |
|---|---|
| C1 | Students in 16th week of *Conventional* electronics maintenance course. |
| C2 | Partially-matched group of students in same *Conventional* course. |
| M2 | Students in 10th week of *Multi-level* (functional context) version of same electronics maintenance course, partially matched with Groups C1 and C2. |
| I1 | Instructors for conventional electronics maintenance course, with no field/job experience. |
| I2 | Instructors for conventional course, with average of 7.5 years of field/job experience. |

Table 3

**Personal Data Describing the Characteristics of the Samples**

| | U. of Minnesota | | | | | | |
|---|---|---|---|---|---|---|---|
| | Flexible | Inflexible | C1 | C2 | M1 | I1 | I2 |
| Age | 38.5 | 39.8 | 19.0 | 19.75 | 19.75 | 21.25 | 34.25 |
| Education | 12 | 11.25 | 12.25 | 13.0 | 12.75 | 14.0 | 12.25 |
| Years Experience | 13.75 | 12.50 | | Not Applicable | | | 7.50 |
| Class Standing | | | 92.9 | 93.6 | 98.4 | Not Applicable | |
| GT Score (general aptitude) | | | 117.0 | 122.25 | 119.75 | Not Applicable | |
| EL Score (electronics aptitude) | | | 119.75 | 128.0 | 121.25 | Not Applicable | |

Results. First examined were selected indices of the comparability of responses between subgroups of this study and of the two groups in the study by Smith. These comparisons are recorded in Table 4. Smith's groups are identified by the label UM (University of Minnesota), flexible and inflexible.

In general, all groups were reasonably providing the same number of responses to each stimulus word. Size and organization of technical vocabularies were understandably different between students and experienced workers. Differences resulting from the length of word lists must be considered when comparing the two studies. Smith used 171 stimulus words, and there were only 68 in the present study.

Table 4

Comparative Data on Groups and on Responses

| | |
|---|---|
| **Average Extent of Meaningfulness of the Stimulus Word-Concept** | |
| Mean number of different responses elicited in a one-minute time period: | |
| UM[a] (flexible) | C1 = 20.2 |
| = 19.2 | C2 = 17.3 |
| | M1 = 19.2 |
| UM (inflexible) | I1 = 21.7 |
| = 16.6 | I2 = 24.1 |
| Mean number of pooled responses per stimulus word: | |
| UM (flexible) | C1 = 4.5 |
| = 4.3 | C2 = 3.3 |
| | M1 = 4.4 |
| UM (inflexible) | I1 = 3.3 |
| = 3.3 | I2 = 4.3 |
| Proportion of responses to each stimulus word given by two or more workers: | |
| UM = .22 | C1 = .22 |
| | C2 = .19 |
| | M1 = .23 |
| | I1 = .15 |
| | I2 = .18 |
| Number of "non-meaningful" (no common associative responses) stimulus words: | |
| UM (flexible) = 8 of 171 | C1 = 1 of 68 |
| | C2 = 1 of 68 |
| UM (inflexible) = 11 of 171 | M1 = 0 of 68 |
| | I1 = 5 of 68 |
| UM (both) = 3 of 171 | I2 = 1 of 68 |
| **Size and Usage of Technical Vocabulary** | |
| Total of different words in pooled responses: | |
| UM (flexible) = 200 | |
| UM (inflexible) = 131 | Student/Instructor Total = 94 |
| Number of stimulus words appearing in pooled response distributions: | |
| UM = 84 of 200 | Student/Instructor Total = 48 of 94 |
| **Organization of Technical Concepts** | |
| Number of stimulus words not loading .30 or above on any factor: | |
| UM (flexible) = 1 of 163 | C1 = 10 of 68 |
| | C2 = 23 of 68 |
| UM (inflexible) = 3 of 160 | M1 = 11 of 68 |
| | I1 = 22 of 68 |
| | I2 = 13 of 68 |
| | All = 3 |

[a]University of Minnesota.

Four technical words occurred very frequently in the student/instructor pooled responses. These were "current", "frequency", "tube", and "voltage." Their relative frequency of occurrence was highly comparable with usage in the Smith study.

Of primary interest are the factors derived for each subgroup, using the relatedness coefficient between paired stimulus words as in Smith's Minnesota study. For present purposes the principal components factor analysis program derived only the first 10 factors in each of the studies. On the average, this accounted for 36% of the variance in each study. First-order factors were labeled as in the previous research.

Table 5 compares the first 10 first-order factors for each subgroup with the Minnesota factor with which each is mostly highly correlated. Twenty-one of the Minnesota factors were comparable to some extent, with eight of them consistent with three or more of the student/instructor subgroups.

At this first-order factor level it would appear that there is little comparability between the three student groups, the two instructor groups, or between students and instructors. Perhaps larger listings of stimulus

Table 5

**Comparison of First-Order Factors**

| UM First-Order Factors | | Student/Instructor Subgroups | | | | |
|---|---|---|---|---|---|---|
| | | C1 | C2 | M1 | I1 | I2 |
| (1) | Frequency | 2 | . | . | 10 | . |
| (2) | Voltage | 1 | . | . | . | . |
| (3) | Tube | . | . | . | . | 3 |
| (4) | Vertical (Hold-Roll) | 10 | 6 | 7 | 5 | 10 |
| (7) | Electron | 8 | . | 2 | 3 | . |
| (8) | Current | . | 3,10 | 4 | 7 | 1 |
| (10) | Circuit (Resistance) | . | . | . | 4 | . |
| (14) | Coil (Inductance) | . | 5 | 6 | . | 9 |
| (15) | Direct (Current) | . | . | 1 | . | . |
| (17) | Plate (Load) | . | 8 | . | . | 4 |
| (19) | Bias (Voltage) | 3 | . | . | . | . |
| (20) | Watt | 4,6 | 7 | 9 | 9 | 6 |
| (25) | Grid | . | 1 | . | 8 | 5 |
| (26) | Amplifier | 9 | . | . | . | . |
| (31) | Meter | . | 9 | . | . | . |
| (32) | Gain | 5 | . | . | . | . |
| (33) | Wave | . | 4 | . | 6 | . |
| (35) | Distortion | . | . | . | . | 7 |
| (37) | Modulation | . | 2 | 10 | 2 | 2 |
| (38) | Polarity | 7 | . | 8 | 1 | . |
| (42) | Alignment | . | . | 3,5 | . | 8 |

(concept) words are required, especially to sample effectively the total domain of concept factors. However, the derivation of only the first 10 factors may have unduly contributed to this apparent lack of inter-group consistency. Apparently this technique requires rather large listings of stimulus words, and also requires factor derivation that accounts for much more than a third of the variance. Even so, half of the 10 derived factors for any subgroup were matched in at least one other subgroup.

For only one subgroup, student group C1, did any second-order factors appear. This is shown in Figure 1, along with derived labels for each factor and the associated stimulus words having highest loadings greater than .30 on each first-order factor.

This technical conceptual structure was examined for meaningfulness by two experienced curriculum specialists concerned with the electronics maintenance course. Initially they sought to rename some of the factors, i.e., Power Supply and Operating Voltages for Factor A (Output); Measurements for Factor F (Pulse); Modulation for Factor B (Choke); Polarity for Factor 7 (Pulse); Oscilloscope with regard to Signal Channel for Factor 8 (Oscilloscope).

In addition, Grid (Screen) with regard to Tube or CRT for Factor 3 (Grid) Factor 8 (Oscilloscope) seemed to them as pertaining to use of the scope as a display system instead of as a test instrument. Factors C, D, and E (8, 10, and 3) together seemed to comprise factors relevant to CRT display subsystem. Factor A and Factors 4, 6, and 1 apparently constituted the basic electronics portion of the instruction. All-in-all, they found the structure of little value to them in structuring a training course.

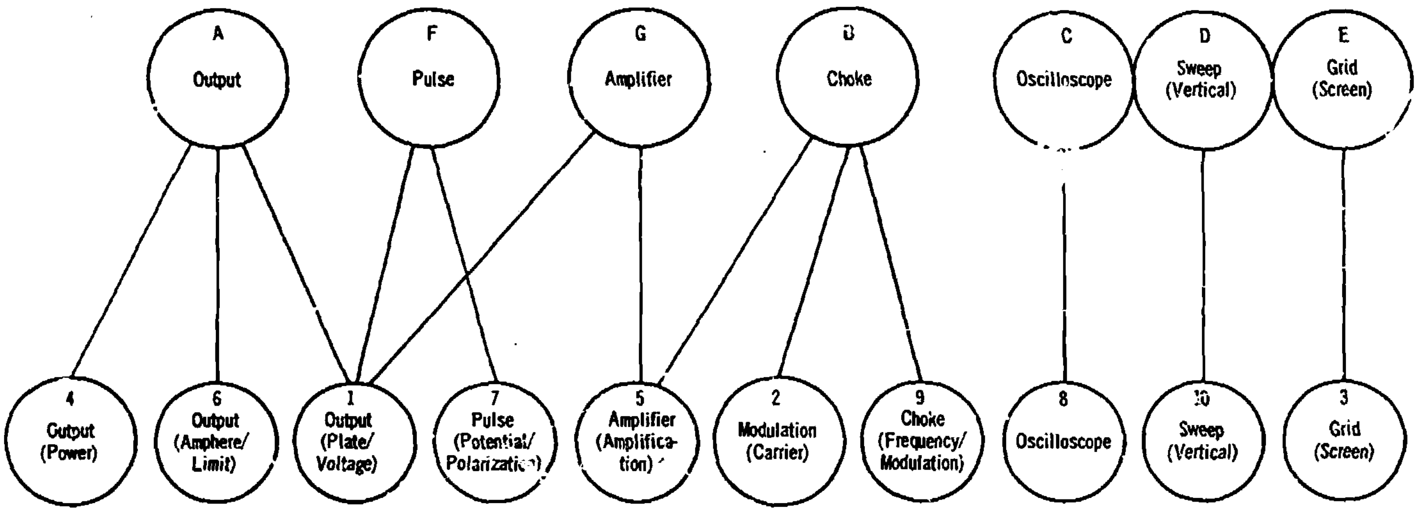
Further discussion revealed the view that the derived structure represented an academic structuring of high school physics. It was not job-oriented in radar terms. It only portrayed principles, and the labels did not apply to the training course as they knew it

The curriculum specialists wanted the structure to inform them how specific radar equipment chassis differed with regard to the concept terms.

This review tended to point out a major difference between current curriculum organization for a specific job-oriented training course, as opposed to traditional vocational education curriculums in the public schools. In the first instance the training content is equipment specific. In the latter case the schools seemingly organize content around logical outlines of principles and concepts, without concern for specific equipment applications. This is consistent with an often expressed goal of preparing vocational students for a wide family of jobs.

<u>Discussion</u>. While this shortened version of the word-association technique does not resolve any of the original questions, it does point out the need for attention to be paid to the selection of stimulus words. Depending on the curricular goals, different types of concept structures need to be sought.

## Group C1 Technical Conceptual Structure




Stimulus Words & Loading

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Power .92 | Direct .65 | Amplitude .64 | Potential .74 | Amplifier .86 | Wave .77 | Choke .83 | Oscilloscope .83 | Vertical .50 | Grid .66 |
| Watt .88 | Level .62 | Peak .61 | Polarization .72 | Amplification .70 | Frequency .74 | Inductor .71 | Blanking .75 | Sweep .41 | Shield .61 |
| Amphere .40 | Amphere .60 | Regulation .58 | Pulse .71 | Gain .59 | Audio .71 | Receiver .36 | Video .48 | Pentode –.30 | Screen .61 |
| Bandwidth .39 | Surge .57 | Load .58 | Voltage .70 | Microphone .56 | Modulation .65 | Frequency .34 | Sync .46 | Grid –.34 | Pentode .55 |
| Output .35 | Inductance .45 | Excitation .56 | Voltmeter .61 | Video .50 | Harmonic .64 | Modulation .32 | | | Vacuum .55 |
| Positive .33 | Meter .43 | Output .56 | Positive .56 | Volume .44 | Bandpass .57 | Inductance .33 | | | Gate .54 |

Figure 1

Some response and structural consistency was apparent even in this quickened application of the technique. Obviously there are many procedural questions that need exploring before this approach can become an operational tool of curriculum designers, but it should have sufficient potential usefulness to warrant further research. Even inexperienced job trainees were able to provide numbers of associations to each stimulus word. Their inexperience showed through in their lack of having developed a unique and meaningful structure of technical concepts.

Availability of Time to Apply Innovative Procedures

Many instructional planners and classroom teachers, on being told of a need for a more rigorous procedure in deciding what are the pertinent goals of instruction, will often say that they have neither the time nor the resources to seek out performance requirements with the rigor that supposedly is desirable. In a survey of eight Army service schools, it was found that anywhere from 8 to 68 hours of decision effort to every hour of scheduled instruction went into the process of determining what should be taught (6). This did not include time spent in preparing the *actual instruction*.

The courses were not ones in which only one instructor was involved, but were training courses having large numbers of students. For training in equipment maintenance, the ratio was 8 to 1. For job training that did not involve equipment operation or maintenance, the ratio was 18 to 1. And in an advanced career preparation course, where the instructors are the acknowledged subject-matter experts, the ratio rose to a high of 68 to 1. This last value included the time required for the instructors to maintain their expert knowledge, much as academic teachers must do.

On the basis of these values, it appears that much effort is currently being expended in making instructional decisions. For example, 1 1/2 man-years of effort expenditure were being used for each complete consideration of an eight-week equipment maintenance course. And this was repeated for each periodic review or updating of the course.

The main conclusion that can be drawn is that the necessary time and manpower are *now* available to instructional institutions. The need is to redirect these efforts, so that a more rigorous and complete determination of the performance requirements may be made.

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13. ABSTRACT

This paper concentrates on two aspects in the development of curriculums for technical training: (1) the identification of curriculum content for specific courses of study, and (2) the organization of such content in training programs. Use of a word-association technique in a military radar maintenance course revealed that many procedural questions need exploring before this approach can become an operational tool of curriculum designers, but its potential usefulness warrants further research. Effort being expended in making instructional decisions should be directed toward more rigorous and complete determination of the performance requirements.



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