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ABSTRACT

This monograph describes the job-related basic skills requirements of the work force and explores ways of developing and improving the reading, writing, and computational abilities of workers. The paper first examines trends that are influencing the demand for basic skills, such as the decline in youth population and the increase in service and technology-related occupations, changing the nature of job skills requirements. The middle section presents three case studies of basic skills training programs: (1) a public/private sector effort to train disadvantaged persons in word processing, (2) a municipal government's retraining program to staff a wastewater treatment plant, and (3) the Functional Literacy (FLIT) project of the Department of Defense (DOD). Based on the demonstrated effectiveness of basic skills training that is integrated with real job requirements, guidelines and methods for skill development programs are discussed. This section highlights research on adult skills training, program development principles, and the DOD's Instructional Systems Development process. A list of references concludes the document. (SK)

JOB-RELATED BASIC SKILLS: CASES AND CONCLUSIONS

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The Educational Resources Information Center Clearinghouse on Adult, Career, and Vocational Education (ERIC/ACVE) is one of 16 clearinghouses in a nationwide information system that is funded by the National Institute of Education. One of the functions of the Clearinghouse is to interpret the literature that is entered into the ERIC database. This paper is of particular interest to vocational and adult education practitioners, administrators, and policymakers and to individuals working with the Job Training Partnership Act.

The profession is indebted to Thomas G. Sticht, the United States Naval School and Applied Behavioral and Cognitive Sciences, and Larry Mikulecky, Indiana University-Bloomington, for their scholarship in the preparation of this manuscript.

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EXECUTIVE SUMMARY

This monograph describes the job-related basic skills requirements of the work force and explores ways of developing and improving the reading, writing, and computational abilities of workers. The paper first examines the trends that are influencing the demand for basic skills, such as the decline in youth population and the increase in service and technology-related occupations that change the nature of job skills requirements. Literature related to these trends reveals the following:

- Most occupations require a high level of basic skills, i.e. 10th to 12th grade levels, although the applications of these skills may be diverse.
- The workplace requires not only the ability to read, write, and compute, but also the ability to use these skills in problem solving on the job.
- Research suggests there is a relationship between the basic skills levels of workers and job performance, but the relationship is by no means overwhelming or direct.
- There is some evidence to suggest that employers are taking a somewhat larger role in providing basic skills training for their employees; however, they are more likely to be training employees at all levels in job-specific literacy skills.

The middle section presents three case studies of basic skills training programs: (1) a public/private sector effort to train disadvantaged persons in word processing, (2) a municipal government's retraining program to staff a wastewater treatment plant, and (3) the Functional Literacy (FLIT) project of the U.S. Department of Defense (DOD). Conclusions drawn from these case studies are as follows:

- It is possible to make fairly rapid gains in ability to comprehend technical material if training is focused on that material.
- General literacy improvement is not a noticeable result of job-related basic skills training unless there is sufficient time on task (i.e., 5 hours per week) with appropriate general materials.
- Integration of basic skills training with technical training produces the best results.
- Training that employs job simulations and applications of literacy increases trainee time on task.

Based on the demonstrated effectiveness of basic skills training that is integrated with real job requirements, guidelines and methods for skill development programs are discussed. This section highlights research on adult skills training, program development principles, and the DOD's Instructional Systems Development process. The following should be addressed in developing job-related basic skills programs.

- o Organizational mission--The mission and goals of the organization, rather than the needs of the individual, are the primary concern in job-related basic skills training.

- o Functional context--Skills and knowledges are best learned if they are presented in a context that is meaningful to the persons. Training should therefore use job reading and numeracy materials and tasks.

- o Time on task--Program developers and operators should seek to arrange the conditions of learning so that the greatest amount of time possible is spent with each trainee actively engaged in a learning task.

- o Competency-based mastery learning--The skills and knowledges to be taught should be related to the person's occupational setting and mastery levels should be set accordingly.

A list of references concludes the document.

Information on job-related basic skills training may be found in the ERIC system under the following descriptors and identifiers: Adult Education; *Basic Skills; Business; *Employment Potential; *Functional Literacy; Industry; *Job Skills; *Job Training; Labor Force; Learning Processes; Literacy; Literacy Education; Military Training; Readability; Reading Ability; Reading Skills; Skill Development; *Job Literacy; Instructional Systems Development. (Asterisks indicate descriptors having particular relevance.)

OVERVIEW

Several trends are influencing the basic skills training that prepares individuals to enter and thrive in the work force. Some of these trends are demographic. For example, there will be a continued decline in the number of 18- to 24-year-olds, the population age group from which industry has traditionally selected qualified, entry-level workers. At the same time that this number is shrinking, more of these young people are entering higher education and therefore are unavailable for entry-level jobs in industry and the military. Thus, not only does business have fewer youth from which to choose prospective workers, but also more of the best trained youth are choosing to continue their education rather than enter the work force.

A nondemographic trend is also influencing basic skills training. The very nature of the basic skills required to perform available jobs is changing. "Muscle work" jobs requiring few basic skills are rapidly disappearing or being upgraded through technological supplements, while service and technology-related occupations are growing. This doesn't mean that all new jobs are "high tech." It does mean, however, that higher minimum levels of reading, writing, and computational abilities are required in order to perform the jobs.

This monograph will examine these trends, while focusing upon research that highlights basic skills demands in the workplace and some efforts made by business and the military to meet the new basic skills requirements. Three case studies of successful training programs in business, municipal government, and the military demonstrate the effectiveness of devising basic skills training that is efficient and integrated with realistic job requirements. The final section of the monograph discusses guidelines and methods for developing occupationally related basic skills training programs. These guidelines draw upon established research and the three case studies of effective training programs.

NATURE AND EXTENT OF THE PROBLEM

Decline in Youth Population

Some demographic projections are relatively safe to make. For example barring any unforeseen catastrophe, it is possible to predict with a high degree of accuracy the number of young, newly trained persons likely to be available for employment during the next few decades. That is, everyone who will be 20 years of age in the year 2000 has already been born.

According to U.S. Bureau of the Census (1983) data, the United States has recently reached the peak of a 20-year growth in the number of young adults (18- to 24-year-olds) available for employment. In 1981, more than 30 million individuals were in this age group. By 1995, there will be only 24 million young people aged 18 to 24 in the United States. This is a decline of 22 percent in less than a decade and a half. The decline is not likely to be spread equally geographically. Western States like Utah and Arizona may have no decline at all, while the drop may be considerably more severe in the Northeast and Midwest, areas that are experiencing high out-migration. Recently the Western Interstate Commission for Higher Education (McConnell and Kaufman 1984) attempted to determine the decline in the number of high school graduates on a state-by-state basis. Even allowing for a slight National growth in the number of 18-year-olds beginning in 1995, Massachusetts and New Jersey, for example, are predicted to experience declines of between 30 and 34 percent in high school graduates between 1982-83 and 1998-99.

The cohort of 18- to 24-year-olds who do not go to college forms the pool of what is generally called entry-level workers. It is from this group that the majority of workers in American industry and the military are drawn. In the 1930s and 1940s, between 10 and 15 percent of 17- and 18-year olds went on to higher education (Grant and Lind 1979), leaving over 85 percent of the remaining population available for entry-level work. Many of these individuals who did not enter university training were highly intelligent and self-taught. The more competent of this group were "creamed off" for positions of some responsibility as skilled blue-collar and service workers in thousands of workplaces. In many cases, these intelligent, competent, noncollege graduates were the ones who made sure things worked.

The Nation no longer has 85 percent of the population from which to draw in filling entry-level jobs. According to Lisack (1984), director of the Office of Manpower Studies at Purdue University, the National percentage of high school graduates who go on to college is now 56 percent, with less than half of the shrinking 18- to 24-year-old population available for entry-level work. For the most part, the 44 percent of those electing not to go to college are less competent in terms of basic skills than the 56 percent who do. Sticht (1982) reports that the contingent of individuals available for

military enlistment averages only an eighth-grade reading level ability. Many, of course, are below this level. In the civilian sector, this noncollege graduate contingent is applying for entry-level positions in industry, retail, service, and clerical work. The number from this group available for "creaming off" is likely to be considerably less than in previous decades.

Alice Bird McCord, personnel vice-president of the National Retail Merchants Association in New York City, notes another aspect of the phenomenon of competent workers moving out of traditional occupations. In Businessweek she comments that it is a decidedly different labor market today than it was 15 or 20 years ago. "The kind of well-educated housewife who formerly took a part-time minimum wage job in a department store then is probably a full-time careerist now, leaving the lower-level job to the less well equipped" ("How Business Is Joining" 1984, p. 98).

The Changing Nature of Work

The nature of work in the United States and other industrialized countries is changing. As new jobs are created and old jobs disappear, new levels and types of basic skills for employment are also created. U.S. Department of Labor projections of occupational areas experiencing the largest growth include service workers, psychiatric aides, dental assistants, claims clerks, secretaries, and sales clerks ("Training for What Jobs in 1990?" 1983). Among jobs experiencing large declines in employment (13 to 20 percent) are farm laborers and tenants, logging workers, housekeepers, maids, and home child-care workers. Among the occupations projected for greatest growth by 1990 by the Bureau of Labor Statistics are--

- o industrial robot production,
- o geriatric social worker,
- o energy technician,
- o industrial laser processing, and
- o online emergency medical and genetic engineering. ("Growth Industries of the Future" 1983)

Workers in declining jobs such as farm laborers, logging workers, or home child-care workers require few basic literacy skills as compared to workers in growing occupational areas such as laser processing or robot production.

The Bureau of Labor Statistics data do not suggest that all new jobs will be high-technology jobs involving lasers or robots and calling for years of specialized training. Rumberger (1984) reports that the greatest number of new jobs in our future economy will be unrelated to high technology. Between 1978 and 1990, the United States will need 672,000 new janitors and sextons but only 199,000 new computer systems analysts. Robots and software, Rumberger speculates, are likely to take over the work of entire classes of skilled workers. Rumberger also suggests that as robots assume more skilled

jobs, workers could be asked to perform duties requiring lower levels of basic skills. It is doubtful, however, that these levels will be lower than today's minimum levels.

Though years of training will not be required for all of the new jobs, it is likely that higher minimum levels of basic skills will be required. Janitors currently do more than push brooms and will most likely be required to do still more as they become responsible for additional technical equipment. Occupations requiring little or no basic skills abilities are rapidly disappearing, while newly created occupations require workers to use reading and writing and computation at a fairly high level of skill in the solving of daily problems on the job. The growth areas for employment are a combination of service and high-technology jobs. Though extensive technical training will not be necessary for many of these occupations, for most a fairly high level of basic reading, writing, and computation skills will be required. Adults in need of retraining have few occupational choices if they are unable to meet the fairly high basic skills requirements of the workplace.

According to a Center for Public Resources survey, Basic Skills in the U.S. Workforce (Henry and Raymond 1982),

> over 65% of responding companies note that basic skill deficiencies limit the job advancement of their high school graduate employees, and 73% responded that deficiencies inhibit the advancement of non-graduates. (p. 23)

Percentages of the basic skills difficulties reported by employers in the survey were the following.

Secretaries having difficulty reading at the level required by the job	30 percent
Managers and supervisors unable to write paragraphs free of mechanical errors	50 percent
Skilled and semiskilled employees including bookkeepers unable to use decimals and fractions in math problems	50 percent

Demands for Basic Skills in Work Settings

The Wall Street Journal (Hymowitz 1981) cites industry reports that indicate increased economic problems resulting from workers who are unable to meet the basic skills demands of their jobs. William Barnes, vice-president of finance of JLG Industries, reports that "poorly educated workers are our no. 1 problem, the main factor slowing our growth" (ibid., p. 1). JLG reports having spent over $1 million to correct worker literacy mistakes. Mutual of New York reports "an estimated 70% of the insurance firm's correspondence must be corrected or retyped at least once" (ibid.). Concerns regarding the safety of workers who cannot read warnings and follow written directions have been issues in a growing number of court cases and have led to several firings at

Westinghouse Electric Corporation's defense gear plant in Sunnyvale, California. In many industries, workers with low basic skills are being replaced. For example, following the lead of the Japanese, U.S. employers in auto industries are replacing unskilled workers with robots. Larry Vickery, General Motors' director of employee relations, reports that GM currently employs 1 skilled worker for every 5.6 assembly line workers and projects a one-to-one ratio in less than 20 years.

A good deal of recent research has examined basic skills in the workplace. This research includes work done in the military (Sticht 1975a; 1979; 1982), work examining wide ranges of occupations and workplaces (Diehl and Mikulecky 1980; Mikulecky 1982; Miller 1982; Moe, Rush, and Storlie 1979a, 1979b, 1979c, 1979d, 1979e, 1980a, 1980b, 1980c, 1980d, 1980e; Smith 1973), and single occupations or workplaces (Heath 1980; Jacobs 1982; and Kirsch and Guthrie 1984). The findings in these studies indicate several trends. Most occupations require a high level of basic skills, although the applications of these skills may be diverse. The workplace requires not only the ability to read, write, and compute, but also the ability to use these skills in problem solving on the job.

Research studies have revealed that the use of reading, writing, and computation in the workplace is ubiquitous and at a relatively high level. Diehl and Mikulecky (1980) examined 100 workers from a representative cross section of occupations ranging from executive vice-president to forklift driver. Only 2 percent of occupations examined required no reading or writing. Time spent reading print, charts, graphs, and computer terminals averaged nearly 2 hours daily. Difficulty levels of the vast majority of reading materials on the job ranged from 10th- to 12th-grade levels. This finding concurs with the work of Moe, Rush, and Storlie (1979a, 1979b, 1979c, 1979d, 1979e, 1980a, 1980b, 1980c, 1980d, 1980e) and Mikulecky (1982). Similarly, military training manuals have been found to be fairly difficult. Sticht (1982) reports readability levels in the 10th- to 13th-grade range for publications in Air Force, Army, and Navy jobs. Table 1 summarizes the findings of these studies regarding difficulty levels of occupational reading materials.

In addition to fairly difficult on-the-job materials and training materials, new workers may be unfamiliar with how basic skills are used in the workplace. Most of the reading, writing, and computation in the workplace is to accomplish tasks and make assessments, with learning being an incidental activity. Sticht (1975a) has noted this reading-to-do versus reading-to-learn difference in work with the military, and the high incidence (80 to 90 percent) of reading-to-do activities has been confirmed in civilian settings by Diehl and Mikulecky (1980). In a federally funded study comparing the reading of workers to that of students, Mikulecky (1982) found that students read less in school than did nearly every category of worker. When students did read, 95 percent of the time it was from textbook material and for the purpose of gathering literal facts as opposed to reading for application and assessment as most workers do when reading materials related to their jobs. Kirsch and Guthrie (1984) note that work materials are characterized by forms, some prose, directions, notices, labels, memos and notes, computer programs, tables, and schematics. Nearly every civilian and military study cited notes the use of basic skills in the workplace to solve specific problems. Material

TABLE 1

DIFFICULTY LEVELS OF OCCUPATIONAL READING MATERIALS

Study	Difficulty Levels (Reading Grade)
Moe, Rush, and Storlie 1978a-e: 1980a-e	10th-grade to college level
Diehl and Mikulecky 1980	10th- to 11th-grade average for most occupations
Mikulecky 1982*	10th- to 11th-grade average (70 percent from 9th- to 13th-grade level)
Sticht 1982	10.6- to 12th-grade plus (military manuals for varying Military Occupational Specialities or occupations)

* Workers were able to comprehend familiar work materials at one to two grade levels above their abilities to comprehend newspaper msterial.

is read or skimmed for specific information, decisions are made, and skills are applied. Very little of this sort of basic skills use is present in school studies.

Relationship of Basic Skills to Job Performance

An underlying assumption behind concern about basic skills levels in the workplace is that job performance is related to basic skills levels of workers. The research suggests that there is a relationship, but that it is by no means overwhelming or direct.

Research about the relationship of literacy to job performance is sketchy and based, to a large extent, upon information obtained from military studies. Kulp (1974) found, in a controlled study, that performance of an assembly task decreased significantly when worker reading skills were more than two grade levels below the difficulty level of instructions.

Sticht (1975a), in Reading for Working, reports correlations of reading ability to job sample performance thst range from r=.26 to r=.37. These correlations are significant, but only explain from 8 to 13 percent of the job performance variance. A good deal more than basic reading ability as measured by a reading test is needed to explain job performance ability. Sticht's (1982) review of basic skills training in the military notes that

> the most highly skilled, non-high school graduates in one study had a job success rate equal to those having the lowest basic skill levels among high school graduates. Thus basic skills competence per se does not appear to be the overriding determinant of success in the military. (p. vii)

In a testing and observational study of the relationship between job performance and literacy abilities among nurses, Mikulecky and Winchester (1983) note a similarly low correlation between measured reading ability and job performance. A much higher relationship was noted, however, between job performance and the ability to apply and use reading, writing, and computation skills critically. This same call for higher level use of basic skills may be present in many other occupations.

The survey by the Center for Public Resources (Henry and Raymond 1982) takes a different perspective on the role of basic skills. Respondents were not as concerned about overall correlations between general basic skills levels and performance as they were about costly one-time mistakes resulting from low basic skills. Examples cited include workers accidently killed because of inability to read warning signs, costly mistakes made because of inability to comprehend correspondence, and time lost due to the need to give regular lectures on the use of equipment as opposed to step-by-step written instructions (ibid., p. 18). Low ability levels in applied computation and measurement, according to respondents, regularly accounted for losses in production, quality, and general corporate performance (ibid., p. 20).

Basic skills, especially as measured by nonapplication tests, appear to be related to job performance, but only slightly. This slight relationship may be enough to warrant moves by business to screen out low-ability job applicants, especially when the stakes are high in terms of worker safety and lost production costs. It appears likely that, in relation to job performance, it is considerably more important to apply basic skills in specific job situations than it is to demonstrate such skills on standardized tests. This focus upon specific, job-oriented basic skills characterizes the basic skills activities of employers, as indicated in the following section.

Business-Industry Basic Skills Activities

In 1977, Lusterman surveyed general training in 610 companies employing 500 or more employees. The survey estimated that U.S. companies spent $1.6 billion nationally on training 4.3 million employees or roughly 1 in 8. Large companies were more likely to have training programs than smaller ones, and financial institutions (banks, insurance companies) generally averaged more training programs than other companies. Lusterman found only 8 percent of surveyed companies sponsoring training in basic education for employees in contrast to 60 percent offering management training and 54 percent offering technical training.

There is some evidence to suggest that the basic skills training percentage may be increasing, however. According to the Wall Street Journal (Hymowitz 1981), several businesses such as Equitable Life, Chase Manhattan

Bank, General Motors, and Continental Bank are directly addressing their basic skills training needs as part of their own programs. Henry and Raymond (1982) found an astounding 75 percent of responding companies reporting remedial programs of some sort. These data must be considered in light of the fact that only 184 of nearly 2,000 businesses responded to the survey, however, and that those who did respond were most likely to be concerned with basic skills issues.

Mikulecky and Cousin (1982) surveyed a 5 percent sample (25 corporations) of the Fortune 500 companies to determine involvement in training with special emphasis on literacy and basic skills training programs. Literacy programs, for the purpose of the survey, were defined as those involving reading and writing skills training ranging from remedial level to those designed for management. Twenty-two of the corporations responded for an 88 percent response rate.

Though management training was by far the most common type of training, basic skills and English-as-a-second-language (ESL) training were also present. Percentages for types of training were as follows:

Management training	91 percent
Skill and technical training	68 percent
Clerical training	32 percent
Sales training	41 percent
Trade and craft training	18 percent
Basic education training	9 percent
English-as-a-second-language (ESL) training	14 percent

Trainers from corporations reporting literacy training were asked to describe literacy-related training provided to employees. Examples given included blueprint reading, effective writing, business English courses, and reading efficiency courses (ibid.).

Some type of literacy training was reported by 67 percent of the companies surveyed. The main divisions of literacy-related programs, in order of frequency, were for management (71 percent), clerical personnel (29 percent), and technical personnel (57 percent). The literacy training programs for management and clerical personnel generally focused on effective writing, effective reading, and business English. Programs for technical personnel focused on improving job-related reading skills such as blueprint reading and reading material related to operating machinery (ibid.).

Literacy-related training programs ranged in length from 8 hours to 50 hours. Typical programs (43 percent) were conducted for 4 to 5 weeks and involved 16 to 25 hours of course time. Training conducted during business hours was reported by 57 percent of respondents. Only one company reported that all training was conducted after business hours. A combined before-and-after-business-hours approach was reported by 36 percent of companies. Several of these companies reported split time training in which training began during working hours but continued beyond them, for example from 4 p.m. to 7 p.m. Almost half of all surveyed companies mentioned the availability of

tuition reimbursement for postsecondary education, which could include a literacy component (ibid.).

Lusterman's (1977) figure of 8 percent for basic skills training and the 9 percent figure from the Mikulecky and Cousin (1982) survey are nearly identical. If, however, the ESL courses are included as part of basic skills training, the figure becomes 23 percent. Such a combining of categories may be justified since the ESL programs are relatively new and may not have been part of the Lusterman survey. More important, 67 percent of the current sample reported literacy training for one or more levels of employee. This training was usually job related and ranged from blueprint reading, through machinery operation and repair manuals, to efficient reading and writing for managers. These major corporations deemed it cost-effective to improve the skill levels of employees.

Though the presence of "literacy programs" was widespread, as in the Lusterman survey, the number of employees served in any specific program was small. A minority of literacy programs (9 to 23 percent) dealt with basic skills or English-as-a-second-language training. Most programs were oriented toward direct improvement of job-related literacy skills.

In addition, there are indications that some businesses and industries are becoming involved with efforts to address the functional illiteracy problem on a broader social scale. B. Dalton Bookseller has earmarked $3 million over 4 years for a National literacy program and has helped found the National Coalition for Literacy. Corporations in Milwaukee, Nashville, and other cities are also becoming involved in adopt-a-school programs designed to combat illiteracy ("How Business Is Joining" 1984).

In conclusion, it appears that business and industry may be taking a somewhat larger role in teaching basic skills to employees (especially if ESL is considered), but that role is still quite small in terms of industries and individuals involved. A much more typical pattern is for a majority (67 percent) of businesses to be training workers at all levels in job-specific literacy skills. These skills can range from management training in communications skills to technical training in blueprint or machine operation job sheets.

PROGRAMS FOR IMPROVING OCCUPATIONALLY RELATED BASIC SKILLS

To find ways to permit businesses, industries, and other work organizations to expand their basic skills offerings, while satisfying organizational goals for cost-effectiveness in training, several research and development projects have recently been conducted that demonstrate how to integrate basic skills and job technical skills training. Three of these projects are reported here in case study format to describe approaches basic skills or vocational skills specialists can take to develop integrated basic and technical skills training programs. Two of the projects are concerned with training in civilian settings, while the third project took place within a military setting.

During the early 1980s, an increasing number of private consulting firms specializing in basic skills training began to make their appearance. Often such firms arranged and became service providers for cooperative training ventures involving businesses and municipalities. Such training programs were designed and used before and during employment for occupational upgrading and often included components for improving job-related reading, writing, and computation skills. Two such programs are described here. (For more detail on these programs, see Mikulecky [1984].)

A Public and Private Sector Cooperative Effort to Prepare CETA-eligible Workers as Competitive Word Processor Operators

A characteristic employment problem is the inability to find properly trained employees even though thousands of unemployed workers are available. In Chicago during 1981 and 1982, the local Private Industry Council faced such a problem with word processor operators for major industries and businesses. Positions paying over $20,000 per year were going unfilled.

Being a word processor operator involves a good deal more than being a traditional secretary who knows how to operate the new machinery. When working for local Chicago employers, most word processor operators work in centrally located pools or groups. Supervisors receive jobs from various departments; estimate the time needed to edit, format, and produce letter-perfect copy; and then assign the job to an operator. The operator must be able to edit for spelling, verb-subject agreement, and a number of other flaws. The operator must also be able to produce copy rapidly with no mistakes. All work is proofread and returned to the word processor operator to be redone if errors are found. Correction time is added to total production time. In order to retain a job, an operator must perform at or above specified standards.

A survey of businesses involved with the Chicago-area Private Industry Council had revealed the need for trained word processor operators. Administrators of the Comprehensive Employment and Training Act (CETA) program were interested in training CETA-eligible individuals for such jobs but did not have a lengthy history of cooperative efforts with business. Then, a private consulting corporation, Technical Assistance Training Corporation (TATC), proposed developing a word processing training program for applicants eligible for training provided through CETA. The program was designed to integrate basic skills training with job training and used performance levels of employed word processor operators as criteria for program completion.

Careful task analyses of on-the-job word processing were used to develop a curriculum based on realistic goals and expectations. Every attempt was made to assure employers that high standards would be met. The fact that a private business was doing the training seemed to help convince employers that trainers were sensitive to their needs.

Recruiting and Screening Applicants for Training

Announcements describing the TATC word processing program and its goals were distributed to social agencies having contact with CETA-eligible candidates. These included schools, governmental agencies, and private agencies such as the Catholic Archdiocese of Chicago. These agencies disseminated information about the program and steered interested applicants to an assessment center to be interviewed.

The literacy ability level required to do well as a word processor operator is quite high (i.e., 10th- to 13th-grade level); therefore, success in the training program was dependent, in part, on trainees being able to attain those literacy abilities in a relatively short period of time (14 to 20 weeks). In order to select trainees who were most likely to succeed from among the thousands of potential applicants, a series of literacy screening exercises was developed from actual job materials. Already employed secretaries and word processor operators took the screening exercises so that performance levels could be set.

The first level of screening exercises were cloze tests constructed from representative written samples taken from business correspondence and word processing manuals used on the job. Trainees who scored more than two reading grade levels below the average practicing operator were likely to be screened out of the training program.

A second level of literacy screening involved spotting and correcting errors on actual job correspondence, invoice forms, and business reports. Norms were set on these problem-solving tasks by establishing how well the average secretary or word processor operator performed. Potential trainees were given two chances with each type of problem-solving situation. First, they were asked to identify and correct errors on a piece of print material. When they had done their best, the test giver showed them what they had missed and how to make additional corrections. Following this, an extremely similar task was given to determine their rate of learning. Acceptance into the

training program was based on performance slightly below that of employed secretaries, or the ability to learn quickly. A large percentage of applicants with no or extremely low basic skills were screened out of the program.

Population Selected for the Word Processing Program

All trainees selected for the program were CETA eligible (i.e., economically disadvantaged, unemployed or underemployed, and identified as having particular difficulties in entering or advancing in private sector employment). One hundred trainees were selected to enter the program in 3 waves of 30-plus students. Approximately 30 percent of the trainees were male and 70 percent female. The majority, 80 percent, were between the ages of 22 and 44. The racial distribution of trainees was 79 percent black, 15 percent Hispanic, 5 percent Caucasian, and 1 percent Asian. Although about half of the applicants had some secretarial or clerical experience, a few trainees had no work experience at all.

The screening procedures had selected individuals who were CETA eligible as well as also likely to succeed. If the first wave of trainees did not meet industry standards, it was highly unlikely that applicants in the second and third waves would be offered jobs. Applicants scoring significantly below the job literacy performance level of actual workers were not accepted because it seemed unlikely that they would gain more than two or three grade levels in job literacy abilities during the half-year program. Experience with the first wave suggested that literacy levels needed to be even more stringent (above eighth-grade reading level) for applicants without some clerical experience. Such applicants needed more time mastering typing and machinery. The extra time usually came from language training.

The Training Program

Classes of 30 to 35 trainees were accepted into the program. These individuals were paid to attend training 40 hours per week. Time each day was divided among language training, typing and word processing training, work habits training, and individual study time. Three full-time teachers (a reading specialist, a word processing specialist, and a business specialist) worked with students throughout the day.

The amount of time a trainee would spend in any given area was dependent upon how much time he or she needed. Some trainees needed more emphasis on language improvement and others in machine skills. On the average, 20 percent of time was spent attending classroom presentations and 80 percent working independently or in student work groups to master information presented in classes.

Assignments were planned to integrate language and machine skills. Much of the classroom simulated actual job demands. Students would compose business communication that other students would edit and later produce in final form on word processing equipment. A good deal of the work involved using actual business communication that was handwritten in rough draft form with

editing notations. The job simulation training that integrated language and machine experience ranged from about 5 percent of assignments the first week to nearly 100 percent in the final weeks. Class assignments attempted to replicate the time constraints present in business performance. Though much of the work was done on an individual level, some work made use of worker teams, which again replicated workplace conditions.

Trainee time on task ranged from 80 to 90 percent during any given workday as compared to public school figures of 30 to 50 percent time on task. Instructors met on a weekly basis to determine how each student's time might be most wisely allocated. Individual conferences informed students of their progress and weak areas. Feedback was also provided by wall charts showing the average class performance on a wide selection of language and machine competencies. Individual trainee performance listed by number also provided feedback on individual performance as compared to performance of others in the program.

The most clear-cut differences between this program and school programs had to do with application and integration of training. TATC trainees actually used up-to-date word processing equipment and were aware of the industry standards they had to meet. Their training in language, work habits, and machine use was integrated so that they received focused practice to meet those standards. Unlike much current "schooling," the cooperative program assumed no guaranteed transfer of basic skills training and consistently used job simulation as a major training device.

Program Results

The time needed for trainees to reach job-level competence varied. The earliest trainees were able to find employment in 14 weeks of training. The average time needed for the screened applicants to reach the preset standards was 20 weeks, with a few trainees taking nearly 28 weeks.

In 1981 and 1982, the economy entered a recession that limited the ability of cooperating industries to hire acceptably trained word processors. A third of the cooperating companies stopped all hiring. Several additional companies raised their hiring standards for accurate word processing speed from 55 words per minute to 65 or 70 words per minute.

Even in the face of these economic difficulties, slightly over 70 percent of trainees found word processing employment by October 1982. Other trainees used the training facilities as a base for a job search club.

In summary, the word processing program described here is an excellent example of how trainers can integrate basic skills training with on-the-job training while employing insights from current research.

An Urban Retraining Program for Wastewater Treatment Workers

A second type of cooperative venture involves the retraining of workers for the new basic skills and technical demands of a job that is changing. An urban municipality had recently opened a new wastewater treatment plant as a result of new clear water guidelines. The new plant incorporated several technical innovations. Workers who needed little technical training to work in the old treatment plant faced an entirely different situation in the new plant. Newer, more effective treatments called for the use of cryogenics (super-cooled oxygen and nitrogen), dangerous chlorine gasses, and the monitoring of environments for microorganisms by using computers.

As the old plant was being phased out, workers needed to be transferred to the new plant. Before workers could be transferred, however, they needed to be retrained. This retraining involved (1) learning how the new process and equipment functioned, (2) learning safety precautions when working with a variety of dangerous gases, and (3) learning how to maintain the microorganisms essential to the wastewater treatment. Mistakes made through ignorance could be costly in terms of loss of life, plant shutdowns, and equipment and organism replacement. The unstated implication of the training program was that workers unable to be retrained adequately could not be transferred to the new plant when the old one was totally phased out. Unemployment or job demotion seemed the only alternatives available.

The Retraining Program

The municipality initially contracted with an engineering firm to provide technical retraining for workers. The firm had previous experience in retraining engineers and in gathering the best technical expertise available to upgrade technicians efficiently. The firm developed a technical curriculum and arranged for workers to be paid for attending classes for full days at a centrally located training facility set up in a converted elementary school. The trainers were working under the pressures of accomplishing retraining goals with a minimum loss of worker time on the job. The learning format was 2 full weeks of classes followed by 2 weeks of on-the-job training. This procedure alternated until the employee had attended each of the ten 2-week training modules.

Relatively soon in the retraining process, it became apparent that the usual technical retraining procedures would not be sufficient for a large percentage of the wastewater treatment workers. Many workers read below an eighth-grade level and several read below a third-grade level. Classroom training materials ranged in difficulty from 11th-grade to college level and included heavy use of graphs, charts, and schematics. Actual on-the-job explanatory material was nearly as difficult. In addition, many of the workers had little or no familiarity with concepts to be covered in the brief, high-powered technical classes.

The engineering consulting firm set up a cooperative relationship with a university consultant and hired a university-trained reading specialist to develop a basic skills component for the retraining program. In addition, the

trainers integrated the use of microcomputers to provide more individual practice and feedback to students.

All workers were to be retrained for possible positions in the new plant. Workers identified as having difficulties with literacy spent three additional afternoons a week with a reading specialist. The reading specialist concentrated on occupationally related basic skills demands with these students and on teaching content reading techniques to the engineers who taught the morning classes.

Working with Students

Developing rapport and trust was of primary importance in working with trainees referred to the reading specialist. The reading specialist estimated that nearly 80 percent of these trainees were extremely nervous and worried about appearing to be ignorant or retarded. Most had experienced difficulty in public school and over a quarter had negative experiences in adult basic education classes. Initial attempts to diagnose basic skills difficulties in an efficient, clinical manner resulted in trainees refusing to return. Diagnostic information was more accessible through careful observation of how trainees performed during learning sessions with the specialist.

The major academic goal was to help trainees gain mastery of technical vocabulary, concepts, and materials. The reading specialist set up special study guides to break down assignments into manageable tasks. Special help was given in interpreting graphs and schematic diagrams. About 45 minutes of each 90-minute session was allocated to oral feedback and questioning trainees on what they had read from manuals or work material. The remainder of the time was spent in reading materials for which the specialist had provided a clearly understood reading purpose.

In some cases, the specialist was able to rewrite or redesign training materials to lower difficulty levels. Students would be asked to read general material at a difficulty level they could handle independently. Some used simple rewrite tests and handouts to lower difficulty levels. In many cases, difficulty levels were lowered by 40 percent without noticeably losing content. The average mastery level of students whose instructors used rewritten materials improved significantly over students whose instructors did not adjust the difficulty level of their reading materials. It should be noted, however, that lowering difficulty levels of materials below the sixth-grade level was extremely difficult and counterproductive. Students who read below that level did not understand the concepts unaided, even though they were simply expressed.

Program Results

The amount of special training received by workers varied depending upon need and the demands of the particular technical class they were attending at any given time. An average of 20 percent of the workers received some form of special help.

Trainee time on task during a typical day ranged from 30 to 50 percent (which is comparable to an average high school). During lectures some trainees would be engaged while others would not. A good deal of socializing and trips outside for a cigarette or drink of water occurred during practice time on the microcomputer or during classroom application sessions. Time on task for students referred to the reading specialist was somewhat higher since they were placed regularly in structured learning situations during their sessions. Additional time on task with basic skills materials was available to trainees who did supervised outside reading.

The basic skills component of the retraining program can be judged a success by several standards. Nearly half the students who took special basic skills training passed their technical class posttests. It was the consensus of both technical instructors and of the reading specialist that fewer than 5 percent of these students would have passed without the special attention they received. Of the students who attended sessions, 70 percent were able to summarize materials in their own words by the end of training. Retention of students receiving special basic skills training was actually higher than that of students who only attended technical classes. Gains in general reading ability were less encouraging. Only about 10 percent of the students taking special training made noticeable gains in their ability to read general material or new material for which they had received no direction or purpose provided by the teacher. According to the reading specialist, students making the most significant gains in job and general reading ability invested 5 or more hours per week in outside reading of material at an appropriate difficulty level.

There were also some successes in efforts to modify classroom teaching and materials. The reading specialist estimated there had been a 30 to 40 percent change in the way reading assignments were handled in technical classes. Nearly every instructor made some use of the material the reading specialist had been able to rewrite. Most instructors introduced key vocabulary before assigning readings. One third of the technical instructors went on to rewrite their own handouts to simpler levels, and one instructor rewrote test items with considerable success.

Areas of greatest program weakness were very similar to weaknesses in traditional schooling. Since basic skills training was not integrated with technical training from the beginning, the effectiveness of such training was severely limited. The reading specialist could provide some remedial attention to referred trainees, but follow-up reinforcement in technical classes depended upon the specialist's success in convincing technical instructors to modify teaching techniques. Instruction was often fragmented, much like traditional schooling. Classroom instructors could voluntarily meet with the specialist and the microcomputer lab director, but most often did not. Student feedback was usually limited to tests and the short-term feedback provided by computer terminals. Nobody took responsibility for regularly informing trainees of their gains or weak areas or for adjusting their learning schedules. An outgrowth of this style of teaching is very low student time on task--much like typical public school training. Since trainees were passive for a large percentage of their training time, time on task was dependent upon self-discipline and interest. Some trainees attended to learning a good deal of the time and others did not. Even within these limitations, however, the

supplementary efforts of the specialist must be judged a success--especially for the students with whom she had direct contact and the students of instructors with whom she was able to work cooperatively.

Conclusions

There are several conclusions suggested by these two case studies. It does appear possible to make fairly rapid gains in the ability to comprehend technical material if training is focused on that material. General literacy improvement, however, was not a noticeable direct by-product, but did occur with sufficient time on task (5 hours per week) with appropriate general material. Best results seemed to occur when basic skills training was integrated with technical training. Training that employed job simulations and applications of literacy increased trainee time on task. Actively involved students received up to three times more practice per paid day than did traditionally trained students. The integrated program, therefore, is also more attractive from a cost-effectiveness perspective.

Probably the most significant conclusion to be drawn is that successful technical and basic skills training programs are beginning to emerge in the vacuum left unfilled by traditional schooling. Where schools are unwilling or unable to match basic skills training and materials to specific occupational needs, private consulting firms are successfully filling the gap. They are successful to the degree that they do not assume transfer from general basic skills training to specific job training. Matching training to the application required on the job appears to be key.

Occupational Literacy Training in the U.S. Department of Defense: The FLIT Program

This section discusses projects that (1) identify the minimum competency levels needed to perform reading tasks successfully in several jobs within the United States Army and (2) develop a job-related functional literacy program to bring marginally literate readers up to the minimum competency level established for the Army in the preceding research. Complete descriptions of the research and development can be found in Sticht (1975a, 1975b).

Identifying Minimum Competency Levels for Job-related Reading

To determine the literacy requirements of Army jobs, three different approaches were used. In these three approaches, the reading requirement of a job was established in terms of one of the following:

- Direct measures of job knowledge and job performance
- The readability (reading difficulty level) of the Army manuals prescribed for use in learning and in doing the job

o The specific job reading tasks inherent in performing the job.

Each of these approaches is described here.

Job proficiency. The first approach to determining the literacy demands of jobs was to examine the relationship between the general reading ability level of job incumbents and their job proficiency. Job proficiency was measured both by a written test of job knowledge and by an extensive hands-on sample of job performance. For each of four Military Occupational Specialties (MOSs), the literacy requirement of the job was estimated as the lowest reading grade level at which no more than a chance proportion of men fell in the bottom quartile on the job proficiency measures. These analyses indicated a consistent relationship between literacy and job proficiency and suggested the requirement of seventh-grade reading level for cooks, eighth-grade reading level minimal requirement for armor crewmen and vehicle repairmen, and ninth-grade reading level for the supply clerk's job.

This approach to establishing the reading requirements of jobs has the advantage of directly using job proficiency measures as criteria. It suggests that different jobs do have different levels of literacy demands and that reading requirements for these four jobs are well above the levels typically set as objectives for remedial reading training programs. However, there are drawbacks to this approach. Clearly, it is prohibitively expensive to obtain hands-on job proficiency measures in a variety of jobs. A different problem arises from the job proficiency measures themselves, for they represent the resultant effect of many factors, of which literacy is only one. Since the job proficiency approach only involves the job reading materials if the person chooses to use them, an approach was taken that included direct study of those reading materials used in training for and performing the job.

Readability approach. The second approach to determining job reading requirements was to study the reading difficulty level of Army manuals used on various jobs. The FORCAST readability index was constructed to estimate the reading grade level of ability needed by the adult Army population to read and comprehend technical job reading materials. The formula for determining the reading grade level of job technical materials using this index is--

$$\text{Reading Grade Level} = 20 - \frac{\text{Number of 1 syllable words in a sample of 150 words}}{10}$$

This formula was developed using Army job technical materials administered as reading tests to young Army recruits. It is therefore a special readability tool for estimating young adult performance on reading tests (cloze format) consisting of job materials.

FORCAST estimates of the readability of manuals indicated these results:

o More than half of the job manuals in each of the seven jobs exceeded the 11th-grade level of reading difficulty.

- The average readability level of the materials in each of these jobs far exceeded the average reading ability of personnel working in these jobs.

The readability technique offers a low-cost method for estimating the overall reading demands of job manuals. However, it does not provide a direct indication of how well personnel can read and use their manuals for the reading tasks performed on the job; for this information, one needs to test people on samples of job reading tasks using job reading materials.

Job reading task tests. The third general approach to assessing job literacy requirements consisted of studying directly the relationship between general literacy skill and performance on job reading task tests, that is, reading tests constructed of actual job reading materials used in performing actual job reading tasks. Job reading tasks were identified by means of structured interviews with job performers at their work location. Job performers were asked to report instances of their use of printed materials in performing job tasks, to describe the information they sought to perform the job, to obtain the printed material, and to indicate the needed job information in the manual. These verified job reading tasks were then structured into Job Reading Task Tests that were standardized and normed on Army samples whose general reading ability level was also measured.

These tests consist of the most frequently mentioned types of reading material and require the individual being tested to obtain the same kinds of information from the same manuals as job incumbents reported using in their work. Thus, they represent the most direct measure of actual job-specific reading task performance.

Each of the Job Reading Task Tests (JRTTs) constitutes a set of content-valid, job-specific reading tasks that can be used as a criterion-referenced measure of job reading task performance for that job. To facilitate comparison of job reading requirements, as defined by a JRTT, between different jobs and with other indices of job reading requirements, JRTT scores were scaled in terms of reading grade level, as measured by a standardized reading test. Thus, any job-specific JRTT score could be expressed as the performance of a soldier whose general reading comprehension was at some specified reading grade level, to use that common metric. In this fashion, and using the arbitrary but plausible decision rule that 70 percent of job incumbents should get 70 percent of the items correct on their JRTT, the reading requirements for cooks was shown to be about the 7th-grade level, for vehicle repairmen, the 8th-grade level, and for supply clerks, at the 12th-grade level.

To summarize, these were the three main approaches to determining the reading-level requirements of jobs in the Army. Each studied the relationship of general reading ability to a different criterion: measures of job proficiency, the structural properties of job reading materials, and the performance of empirically determined job reading tasks. These approaches agree in general in estimating substantially different reading requirements for different jobs, and in a common ordering of the literacy requirements of the three jobs studied in all approaches.

From this work the following conclusion can be drawn: although no single level of functional literacy can adequately represent the reading requirement of the range of jobs studied, there appears to be a lower limit of seventh-grade reading level for functional literacy in the Army. Thus, remedial reading should be aimed at producing no less than seventh-grade reading ability and, optimally, should be targeted to the level of a job assignment. If elimination, retention, or promotion of career personnel is largely contingent upon paper-and-pencil job knowledge tests, formal procedures should be implemented to ensure that personnel have the opportunity to acquire both the job knowledge and the literacy skills required by the tests.

Job Functional Literacy Training Program

Based on the research on the nature of its literacy problem, the Army in 1971 sponsored the FLIT (Functional Literacy) project to develop a literacy training program that would provide a level of functional literacy appropriate to present minimal job reading requirements and that would require no more than 6 weeks of training time. Given the absolute constraint of 6 weeks of training, there appeared to be no reasonable prospects of increasing the adult students' general literacy competence to the point where it would transfer significantly to job reading tasks. Accordingly, the FLIT objective was specified to be that of producing a student capable of using job reading materials with the effectiveness of a person having a general reading ability of grade seven or higher, as indexed by performance on a job reading task test. This was to be accomplished by ensuring that all job reading training would be conducted using the concepts, content, and reading materials of the student's own job area. Parallel training curricula and materials were developed for each of six job clusters: cook, clerk, communications, combat, mechanic, and medic.

Entry. Entry into the program was governed by a series of screenings designed to eliminate most cases of testing artifact. All recruits scoring in the military's lowest aptitude categories were screened on a standardized reading test in the Reception Station during recruit processing. Those failing to reach the sixth-grade reading level were rescreened 5 weeks later in basic training. Using both a general and a job reading test, those again scoring below the sixth-grade reading level were screened once more upon entering the reading training at the end of basic training. Only those students who failed all three screenings were admitted to the job reading training program.

Program overview. The functional literacy training program consisted of three curriculum strands, each of which occupied about one-third of each training day. Strand I was designed to provide training in the application of existing general reading skills to job-specific Army job reading tasks. Strand II was designed to improve basic reading skills and job knowledge by using simplified versions of Army job reading materials and special "information representation and transformation" procedures described later. Strand III was a free reading period allowing students to read from job-related materials of their choosing. Strand III is not discussed further in this report.

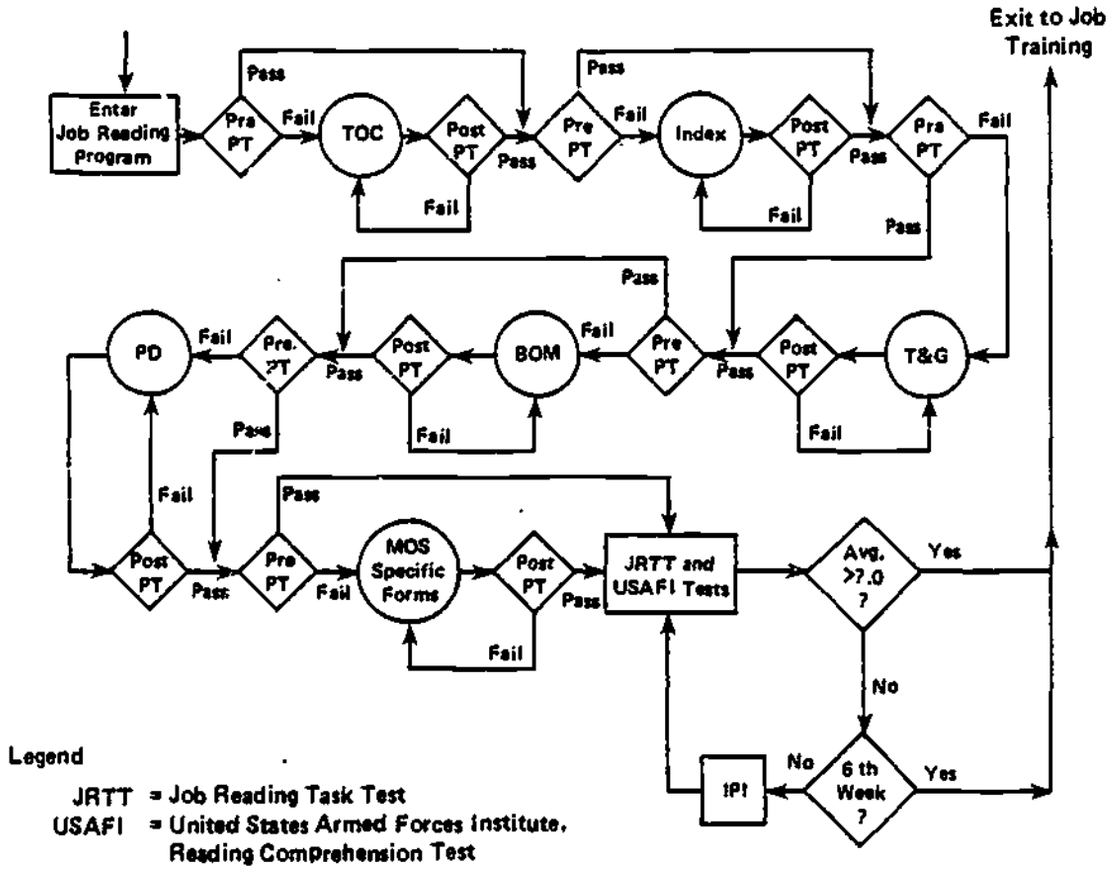
Strand I. Strand I training was designed to give the student drill and practice in applying existing reading skills to the job reading tasks and the job reading materials that were encountered in entry-level job training and job performance. This strand was a modular, self-paced, mastery-based program of job reading task training. Training was conducted in six modules, each addressing one of the six fundamental job reading tasks identified as common and essential to MOS training and performance. These modules provided training in six job reading tasks: using a table of contents, using an index, using tables and graphs, using the body of the manual to look up facts, following procedural directions, and filling out forms.

Students began a module on the bssis of a pretest score. Students meeting both time and accuracy criteria on a module pretest advanced to the next module. Those failing the pretest entered the module's successive blocks of individualized instruction until they could pass a module posttest. Figure 1 depicts the modules and their sequence in Strand I.

Strand II. In contrast to the individualized, self-paced program of Strand I, Strand II was a teacher-oriented program designed to improve comprehension and learning skills using job reading materials. To read for learning, people must be prepared in at least two ways: they must have the knowledge base to comprehend the material to be learned, and they must possess knowledge of skills for studying materials and relating what they read to what they already know.

To promote the acquisition of a relevant knowledge base that would help literacy students learn better from their job training materials, Strand II curriculum included specially developed materials that were written at a lower difficulty level than those encountered in job training and that incorporated the basic concepts and topics within a given job. The basic concepts for the six job fields in the functional literacy program were identified through study of job skills training program curriculum guides and consultation with job training instructors. In each job reading program, 12 major concepts were identified, and specific knowledge objectives were developed for each concept area. Figure 2 shows the knowledge objectives for three concept areas in the cooks' job reading program.

For each of the 12 job concept areas, a 300-400 word passage was written that included the knowledge objectives for the concept. These passages were written at the seventh- to ninth-grade level, as determined by the FORCAST readability index. The concept passages were written without the redundancy and elaboration usually needed to explicate concepts in written materials, because in the Strand II activities each student performed repeated readings of the materials and constructed various representations of messages in the passages. For instance, in some cases students read the concept passages and then drew pictures of what they had read. In other cases, students read the concept passages and produced classificstion tables or flowcharts representing the major concepts presented in the passages. Having transformed concept passages into pictures, classification matrixes, or flowcharts, students then discussed their newly developed representations, thus producing another representation transformation.



Legend

JRTT = Job Reading Task Test
USAFI = United States Armed Forces Institute, Reading Comprehension Test
PT = Proficiency Test
TOC = Table of Contents
T&G = Table and Graphs
BOM = Body of Manual (Extracting Information)
PD = Procedural Directions
IPI = Individually Prescribed Instruction

Figure 1. Strand I of the Job Functional Literacy Program

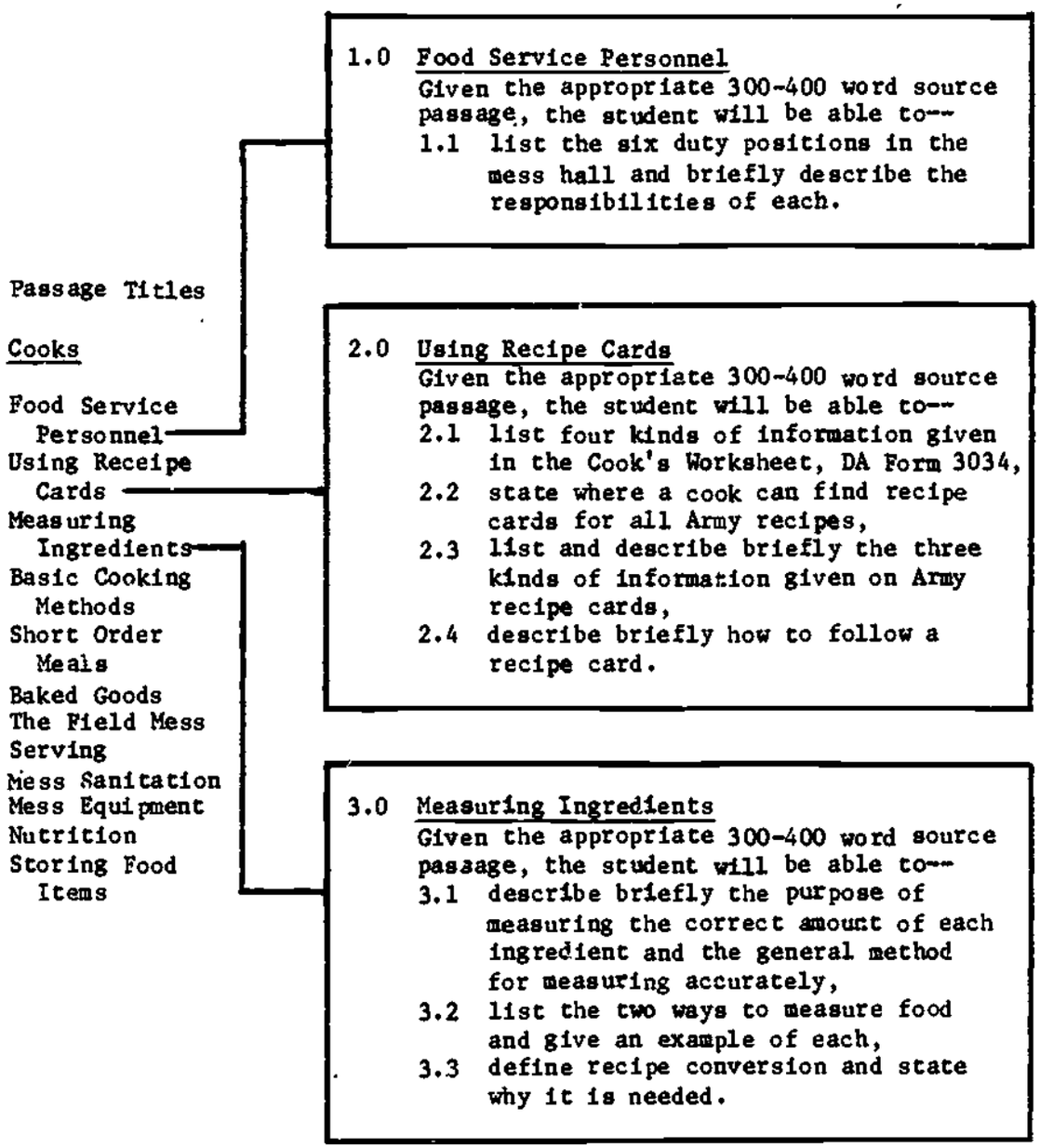


Figure 2. Strand II knowledge objectives for cooks' job reading program.

By means of this representation transformation process, cognitive elaboration of job concepts was produced, which helped in learning the job knowledge that could then be used to comprehend job reading materials. At the same time, analytical tools were acquired for dissecting written materials and reorganizing them by superordinate and subordinate categories, in the case of classification tables, and by sequential steps and decision branching points, in the case of flowcharts. These analytical techniques helped to clarify what the written passage was all about.

In addition to the representation transformation activities, the Strand II program included special instruction in how to analyze sentences to determine the main idea and more about the main idea. The instruction in analysis was developed for the lower-level Army readers when it was discovered that many of these students had difficulty in figuring out who was doing what to whom or what in many sentences.

Evaluation of the Job Functional Literacy Program

Evaluation of the job reading program consisted of several sets of test scores and the results of a limited amount of follow-up questionnaire data. Summative evaluation of the functional literacy program was obtained from the pre- and posttesting of performance in the general and job reading task test as indicated in figure 1 for Strand I. Finally, Strand II effectiveness was evaluated in a small-scale study in which specially constructed representation transformation tests were administered before and after training in the Strand II activities. In the following discussion, the Strand I formative data will be discussed first, followed by a discussion of the Strand II evaluation study. Finally, the summative evaluation and follow-up questionnaire data will be presented.

Training effectiveness of modules. Five of the Strand I modules yield data suitable for evaluating the instructional effectiveness of the separate modules: Table of Contents, Index, Tables and Graphs, Body of the Manual, and Procedural Directions. Table 2 presents the pre- and postproficiency test scores for these five modules. As indicated in the column--failed or did not complete--many people were not able to master the criteria for each proficiency test. They were moved into the next module anyway for practice in that skill. However, since the modules do not represent a hierarchy, no cumulative learning problem resulted from this practice as far as is known.

As table 2 indicates, the training effectiveness, which is the percentage of those reaching criterion divided by the percentage attempting the module, was better for the Table of Contents than for the other modules, indicating the relative ease of the Table of Contents tasks. The Procedural Directions module had the lowest success rate. It was also the last module with a pre- and postproficiency test, and many people did not have much practice in this task. Overall, though, these data indicate that considerable improvement was achieved by the students who worked in these job reading training modules.

Training effectiveness of representation transformation training. A small-scale study involving students in the job reading program was conducted

TABLE 2

STRAND I EFFECTIVENESS DATA

Module	N	Passed Pre-test %	Passed Post-test %	Failed or Did Not Complete %	Training Effectiveness %
Table of Contents	710	19	67	14	83
Index	710	16	56	28	67
Table & Graphs	710	20	53	27	66
Body of Manual	710	3	49	48	48
Procedural Directions	710	9	30	61	33

to evaluate the effectiveness of the representation transformation training of Strand II. To evaluate the training, tests were constructed that involved the student in transforming a prose passage into either a classification table or a flowchart.

Figure 3 presents an example of the test for the classification table. At the top of each test is an example of a text, below that is a representation of the text transformed into a table. Then there is another piece of text. Using this passage, the student is supposed to transform information in the passage into the type of display shown in the top half of the page. To score the classification table test, 4 points are awarded for constructing 4 appropriately labeled columns, and 1 point each is awarded for 4 correct entries per column, making a total of 20 possible points.

Figure 4 shows the layout for the flowchart transformation test. The layout parallels that for the other tests: at the top of the page is an example, at the bottom is a text to be transformed into a flowchart. Scoring is somewhat more complex for this test. First, the student gets one point for each correctly used symbol: for example, circles for start and finish, rectangles for operations, diamonds for decisions, and arrows (with heads) showing process flow (subtotal of four points). Then, the student receives 1 point for identifying each operation, including the start and finish operations designated by the circle symbols (a possible 11 points) and 1 point for correctly identifying and labeling the branching decisions. Thus, a total of 16 points is possible for the flowchart test.

Types of Bars

Crowbars are used for moving timbers and rocks. They are available in 4 and 5 foot lengthe with a diameter of 1 or 1 1/4 inches. Pinch bars are from 12 to 36 inches long and are used for prying out spikes and nails. Pinch bar diameters range from 1/2 to 1 inch depending on their length. Wrecking bars have diameters of 1/2 to 1 1/8 inches and are available in lengths from 12 to 60 inches. They are used for the same things as crowbars. Pry bars are used for prying out gears and bushings. They are 16 inches long and have a diameter of 1 1/16 inches.

Type	Use	Length	Diameter
Crowbar	Moving timbers and rocks	4-5 feet	1 or 1 1/4 inches
Pinch bar	Prying out spikes and nails	12-36 inches	1/2 to 1 inch
Wrecking bar	Moving timbers and rocks	12-60 inches	1/2 to 1 1/8 inch
Pry bar	Prying out gears and bushings	16 inches	1 1/16 inches

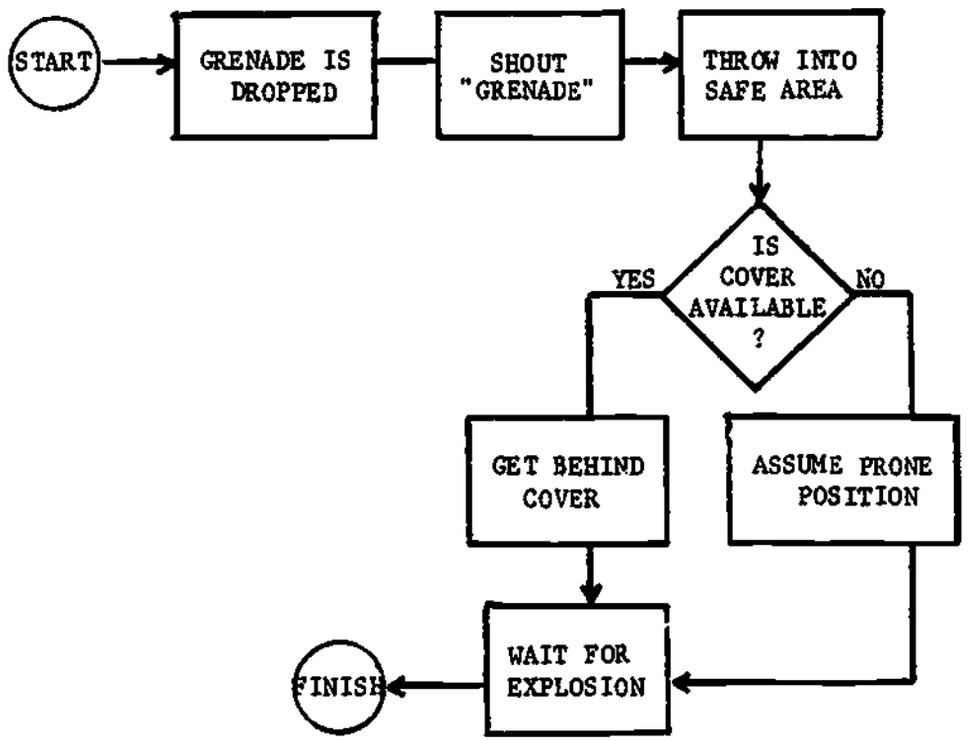
When You Are Lost - Eat Plants

If you are lost and out of food there are many types of plants that you can eat. Marsh marigolds are best during early spring. They are found in swamps and in streams. The leaves and stems are the only parts that you should eat. The leaves, stems, and flowers of the rock rose are all good to eat. You can find them along streams and lakes in early spring. Fireweed is also good to eat. It is usually found in burned-over areas during spring and summer. You can eat the leaves and flowers of the fireweed but not the stem. The roots of the mountain willow are also good to eat. Mountain willow is found in high mountains in early summer.

Figure 3. Representation transformation test: Classification table.

When a Hand Grenade Is Dropped

When a hand grenade is dropped accidentally after the safety pin is removed, shout "Grenade." Then pick up the grenade and throw it into a safe area. The individual should then get behind any available protective cover until after the grenade explodes. If no protective cover is available, assume the prone position until after the explosion.



Throwing a Grenade

The first step in throwing a grenade is to remove it carefully from the box. Remove the protective cover, hold the grenade carefully, and walk to the throwing area. Before you throw the grenade you must grip the grenade in the right way. If you are right-handed, grip the grenade in the right hand with the top pointing up, and put the safety lever under the thumb. If you are left-handed, hold the grenade in your left hand and point it toward the ground, and put the safety lever under the thumb. When you have thrown the grenade, get behind protective cover.

Figure 4. Representation transformation test: Flowchart

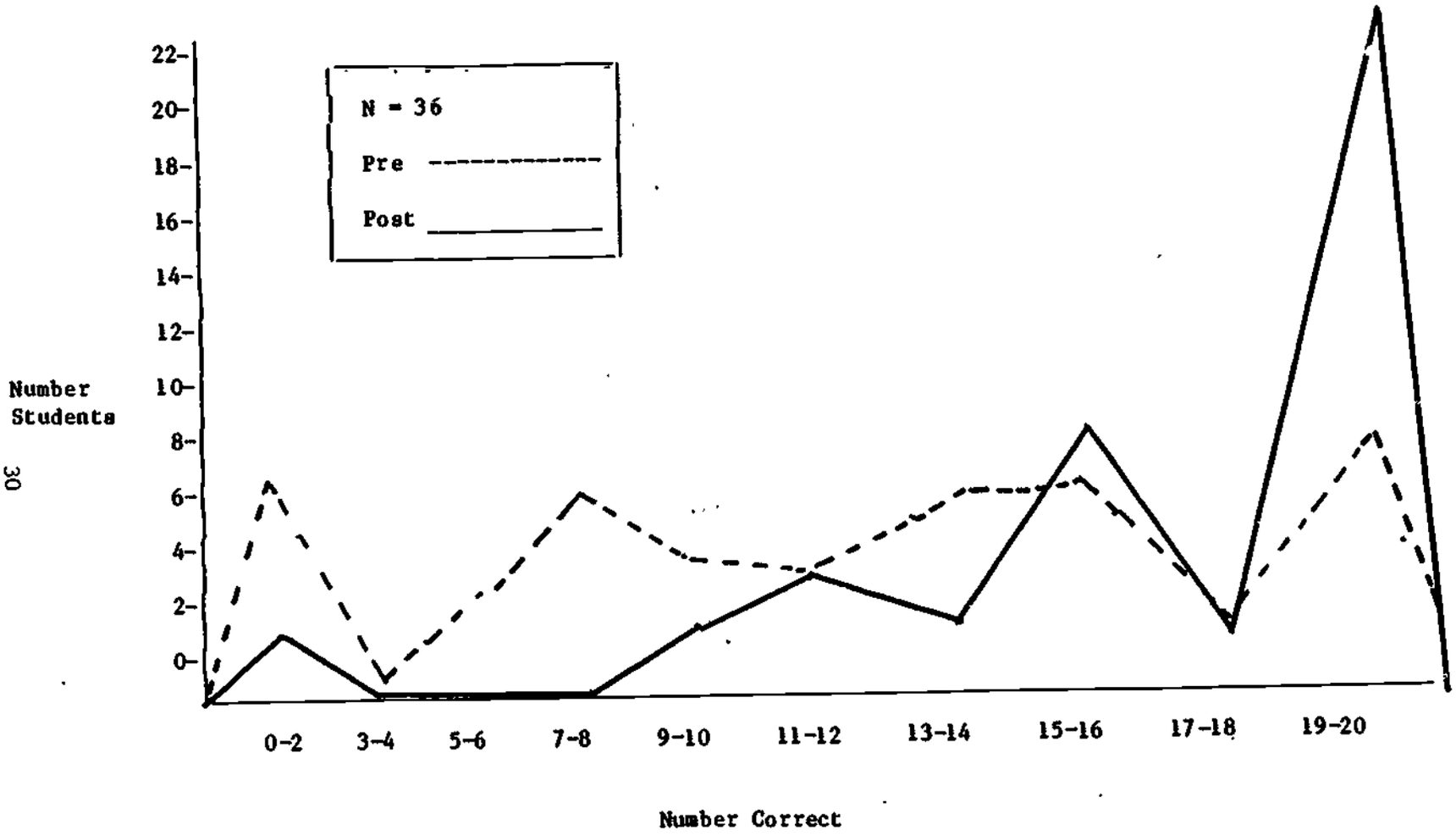
The 36 students who participated in the evaluation study took the above tests as pre- and posttraining tests. The results are shown in figures 5 and 6. Clearly there was some improvement in representation transformation skill from the first to the second testing, which was separated by not less than 4 weeks. On the other hand, there was nothing like 100 percent mastery of these skills! In particular, the flowchart data indicate that considerably more practice would be needed to move all students to the mastery level. Nonetheless, these data do suggest that students improved their skills in performing these types of tasks, with mean improvement scores moving from 65 to 95 percent in the pre- and postclassification tests, and from 37 to 61 percent in the pre- and postflowchart tests.

Summative evaluation of the overall program. Summative evaluation of the Functional Literacy (FLIT) Project was accomplished through pre- and posttraining administration of alternate forms of the reading comprehension portion of the U.S. Armed Forces Institute (USAFI) Intermediate Achievement Test and the FLIT Job Reading Task Test (JRTT). Effectiveness of the FLIT reading training program can be assessed by the gain on these composite measures of general and of job reading performance over the 6-week period of FLIT training.

Table 3 presents the data on the mean USAFI and JRTT reading grade level (RGL) of FLIT students. In these data, which are free of the regression artifact that has flawed the assessment of so many remedial reading training programs, students enter FLIT performing both general and job reading tasks equally well (or poorly)--low in the fifth-grade reading level. After 6 weeks of FLIT training in general and in job reading, students have gained 2.1 RGL years on the JRTT measure of job reading (3 times the gain made in general reading) and the end-of-course average JRTT score exceeds slightly the targeted course objective of RGL 7.0. The .7 RGL gain on the USAFI measure of general reading is in full accord with typical findings of adult general reading training programs of from 50 to 100 hours of instruction.

Additional evaluation test data. Additional evaluation data were obtained that compared the job literacy training achievements to reading improvement by a group of Army personnel who received job technical skills training, but no literacy training. Results showed superior gains in job-related reading for the reading training group. Similarly, comparisons of the functional-literacy-trained students to students in Air Force and other Army literacy training programs indicated that the functional literacy training produced two to four times the amount of improvement in job reading as the general literacy programs did, while the job reading program equaled the general literacy programs in the amount of general reading test improvement accomplished.

Questionnaire data. Further indication of the effectiveness of the job reading program was obtained through feedback from graduates who had gone on to job skills training. Of 353 questionnaires sent out, 74 (20 percent) were returned completed. Of these, 8 out of 10 felt that the job reading training helped them in their job training. Several suggested modifications to the functional literacy program. Thus, though such low return rates are not satisfactory to warrant elation, the questionnaire data lend slightly more evidence for the effectiveness of the FLIT program.



30

Figure 5. Pre- and posttest distributions for the classification representation transformation reading task test.

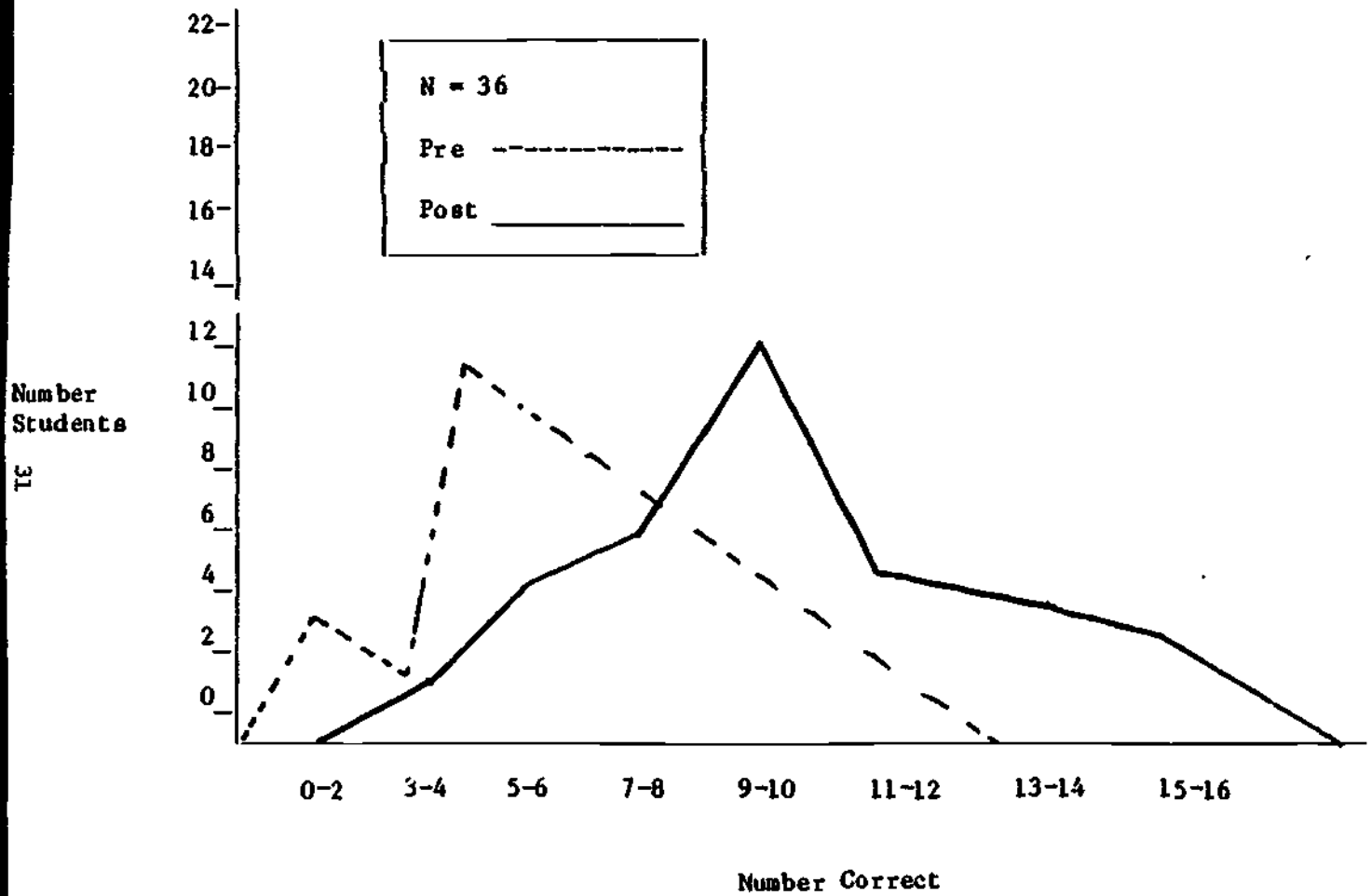


Figure 6. Pre- and posttest distributions for the flowchart representation transformation reading task test.

TABLE 3

SUMMATIVE DATA FOR THE FUNCTIONAL LITERACY (FLIT) PROGRAM

Type of Reading	N	Reading Grade Level		
		Entry	Exit	Gain
General Reading (USAFI)	714	5.3	6.0	.7
Job Reading (JRTT)	714	5.2	7.3	2.1

Summary and Conclusions

A program of research and development was summarized that (1) developed methodologies for the study of literacy requirements of jobs within a specific organizational setting, the United States Army, and applied these methodologies in determining the reading requirements of a set of Army jobs and (2) designed, developed, evaluated, and implemented an operational, job-related, functional literacy (FLIT) program for the Army.

Results of the above activities indicate that in the job reading training program, job reading of job materials showed larger gain than general reading. This is important because it indicates that people are learning what they are being taught in a very specific manner. In many evaluation studies, standardized reading tests are used to evaluate programs with no good rationale as to why it is believed the test scores should improve. Usually, there is no demonstration that the standardized test scores reflect what is being taught. Clearly, the present results show that "reading" is not altogether a general skill, assessable by any test of "general" reading. The job reading task tests show that specific literacy skills can be developed and assessed for generalizability in the domain area that corresponds to what was taught. The latter point was demonstrated in the present research by the fact that performance in the job reading task tests (JRTT) improved considerably, even though the specific content and questions asked were not included in any training module.

The fact that general competency in a specified domain was improved in the job-related reading program suggests that if reading training is given in a well-specified domain, then skill in that domain should improve. If enough domains are developed, and if competency is assessed in these domains using appropriate domain-referenced assessment tests, then a person's "general"

literacy should increase in proportion to the domains in which competency is achieved. This way, "general" ability is improved through the aggregation of "specific" abilities. It remains to be determined whether domains that cut across a number of other domains of specialization can be identified and directly taught as superordinate, generic skills of "general" literacy.

GUIDELINES AND METHODS FOR DEVELOPING OCCUPATIONALLY RELATED BASIC SKILLS PROGRAMS

Experience in research and operational projects to develop and operate basic skills training programs in business and military settings, such as those described in the case studies, has led to the emergence of several conceptual and procedural factors that should be considered by those wishing to work further in this area. This section discusses the need for a conceptual model of adult basic skills development, four principles for program development, and the Instructional Systems Development (ISD) procedures developed by the U.S. Department of Defense as guidance for developing basic skills or other technical training in work settings.

A Conceptual Model of Adult Basic Skills Development

Anyone assuming the responsibility for developing an adult basic skills program should acquire an understanding of the person as an information processing system that develops new capabilities over time using prior knowledge and skills as the means for acquiring new knowledge and skills. In the FLIT basic skills program discussed earlier, reading was construed as a psycholinguistic process (Goodman 1968) involving the combined use of fundamental psychological processes (perception, cognition) and linguistic processes (phonology, grammar, semantics). The psycholinguistic conception of reading emphasizes a developmental sequence in the acquisition of reading skills that proceeds as follows. First, early in life infants adapt to their world by means of the basic processes of perception and cognition. Eventually, in the usual case, these processes are brought to bear on the acquisition of oral language skills. The latter are typically acquired through the processes of speaking and auding (listening to and comprehending speech), or the oracy skills. Following the acquisition of oracy skills, reading skills may be acquired if the person is in a literate society. The literacy skills consist of reading and writing and represent alternative modes of expression and reception of the same language base developed through listening and speaking. Writing is the visual form of the spoken language. Additionally, however, the graphic system permits the use of visual symbol systems like charts, tables, and figures, which demand special literacy skills for use.

The psycholinguistic conception of literacy followed in the FLIT work emphasized both cognitive and language skills, as well as the more specific perceptual skills involved in using the written symbol system. In order for FLIT students to achieve higher levels of literacy skills through this approach, they needed to achieve higher levels of cognitive (reasoning) skills used in conjunction with language. In order for reading comprehension to occur, students needed to have a body of job knowledge that could be expressed

and comprehended in oral and written language. Working within the psycholinguistic framework provided a heuristic for program development that emphasized (1) relationships of oral to written language and (2) the role of knowledge of the job content in developing higher levels of reading skill.

The FLIT Project was also premised on a conception of the learning process. In that project, learning was construed as an information processing activity. The information processing conception of learning emphasizes internal mental processes involved in learning as the result of an active, constructive process on the part of the learner. This differs from a strict behavioristic conception of learning in which the person is viewed primarily as a mindless emitter of responses that are shaped through the contingencies of reinforcement and whose learned responses are the result of some more or less automatic process of association among stimuli and responses. For the FLIT developmental program, the most important aspect of the information processing perspective of learning was the emphasis upon the active, construing nature of the learning person. This suggested that instruction should be designed to stimulate (1) active information seeking and processing, particularly of the type indicated in prior research to be important and (2) job-related functional literacy (or numeracy) skills, for example, learning how to locate information in job manuals, how to follow procedural directions in a manual, and how to manipulate text information actively to produce matrices and flowcharts.

Additional discussions of adult basic skills models are found in Sticht et al. (1974) and in the many research publications concerned with reading (e.g., Pearson 1984), mathematics (Resnick and Ford 1981), and cognitive science (Sticht, Chang, and Wood 1984). The major point to be understood here, however, is that it is important for the prospective developer of a job-related reading program to have a sound conceptual model of the basic skills of adults. Such conceptual models are useful in the design of needs assessments, program materials and approaches, and evaluation techniques. They also provide a means of conceiving of the program development effort in an organized manner.

Principles for Program Development

In addition to revealing the importance of conceptual models of the adult learner in occupationally related basic skills program development, work on such programs has suggested the importance of four principles for program development: (1) maintaining an orientation to the mission of the business, industry, or government organization for which basic skills programs are to be developed; (2) providing training in basic skills within a functional context; (3) arranging program conditions to maximize active learning time; and (4) using a competency-based, mastery learning instructional approach where possible. These principles are discussed next.

Organizstional Mission Orientation

Professional educators most often become engaged in the development of basic skills programs for adults in business settings. Such professionals have ordinarily been taught to regard the individual and his or her needs as the major focus of concern. However, when working within the context of a particular work setting, it becomes necessary to consider the mission and goals of the organization, be it a business, industry, or government agency, as the primary concern. The approach, then, is to determine how an effective basic skills program can be developed that will help the business or agency achieve its goals in a cost-beneficial manner. In this regard, for instance, if it can be demonstrated that basic skills and technical skills training can be integrated and both taught at a fraction of the cost of separate types of programs, then a company is more likely to become engaged in basic skills training. In this way, the undereducated person who seeks to become employed will have his or her needs best served by attending to the employer's needs during program development.

Functional Context Training

The functional context principle states that skills and knowledge are best learned if they are presented in a context that is meaningful to the person. Thus, rather than teaching students who need job-oriented basic skills to read and write and compute using general literacy materials, it is better to use job reading and numeracy materials and tasks. The more similar the basic skills training tasks are to the actual job tasks, the greater will be the likelihood that the training will pay off in improved performance of job literacy tasks. Thus, for youth and adults aiming at work in a given industry or organization, the use of job-related materials serves two purposes. On the one hand it provides a functional context for the learner--that is, he or she can see that the materials are relevant to the employment goal--and hence motivation to use the materials is elevated. On the other hand, the organization can see thst the training is relevant to its needs and that there is some likelihood of the trainees actually becoming competent in the performance of job-relevant skills. Thus organizational motivation to participate in the training is gained.

Increasing Time on Task

As indicated previously in the discussion of the person as an information processor, learning occurs best when the person is actively engaged in information processing, that is, seeking, transforming, and representing information. The principle of increasing time on task means that program developers and operators should seek to arrange the conditions of learning so that the greatest amount of time possible is spent with each trainee actively engaged in a learning task. Learning time is a much more precious commodity for both organizations and adults than for children, whose main preoccupation is schooling and learning through play. Adults, on the other hand, have responsibilities that place demands on their time, such as shopping, working, and other duties associated with their multiple life roles. Therefore, whatever

time is found for goal-oriented learning should be well managed to ensure that active time on learning tasks is kept at the highest level possible. Because organizations count training time against productivity, any activities that will reduce training time contribute to productivity (other things being equal). Thus, to the extent that trainees are kept actively learning, and to the extent that this results in more efficient training, then organizational functioning in the training area is improved, and the performance of the organization is improved. Through these means, increasing time on task contributes to both the person's and the organization's goals.

Competency-based Mastery Learning

This principle actually contains two main ideas. One of these, "competency based," refers to the idea that the skills and knowledges to be taught in the basic skills program should be derived from domains relevant to the person's occupational setting. Further, in competency-based learning, a person's learning goals ought to be stated in terms of acquiring the competencies needed to perform the tasks of the job literacy, oracy, or numeracy domains, rather than in terms of some external referent such as a grade school level or percentile score. For instance, in the case of the wastewater treatment workers project discussed earlier, vocabulary learning was not defined in terms of fifth- or sixth-grade levels but, rather, in terms of the domain of technical terms the workers needed to know and to be able to read and use on the job.

The second main idea contained in the competency-based mastery learning principle, "mastery learning," has to do with setting standards of competency. In job-oriented basic skills programs, where the domain of competencies can be delimited to a degree beyond that appropriate to general education, it may be possible to set standards at the mastery level, at which 100 percent of trainees learn to perform 100 percent of the basic skills tasks that indicate competency in the job literacy domain. However, while the concept of mastery is useful as a goal for program operations, it frequently happens that, due to various factors such as limited time, not all trainees can be expected to learn all tasks to the mastery standard. In such cases, it is important to know whether mastery is underachieved due to lack of relevant knowledge about how to accomplish the task, the requisite knowledge needed to do the task, or to a slowness of skill in accomplishing the task. Only in the latter case should the mastery standard be relaxed to permit the trainee to move on to learn other critical basic skills needed for the job.

Another factor to consider when adjusting standards of mastery is whether a particular knowledge/skill area must be learned before other tasks in the program can be started. If so, then the mastery standard should probably not be relaxed, with the exception that the slowness of skill may not pose much of a hindrance to acquiring the procedural and declarative knowledge needed to learn the next task. (In some cases, though, quickness of skill application may be an important prerequisite for some later performance, such as being able to do mental addition rapidly in certain job tasks.)

Although there is a fair amount of uncertainty likely to be encountered in applying the competency-based mastery learning principle (including standards

of accuracy and speed), it has nonetheless emerged from both work reported and the experiences of others (e.g., Berlin 1983) as an important goal to be sought in the development of basic skills programs for youth and adults.

Instructional Systems Development (ISD)

In developing job-related basic skills programs, it is important to use a systematic procedure that ensures that the basic skill tasks to be taught are actually representative of the job. One such set of systematic procedures is the Instructional Systems Development (ISD) process identified in military research and development. Thorough discussions of the ISD procedures are found in O'Neil (1979a, 1979b).. Here, an overview of the five major processes is provided, with some comments regarding the application of the processes to basic skills programs that are job related. The ISD processes of analysis, design, development, implementation and evaluation are discussed serially in the next sections. It should be understood that, in fact, the processes are interactive and they each may occur on an interactive basis.

Analysis

The analysis process of the ISD system is concerned with (1) determining that a training need exists, and (2) if required, identifying what the content of training should be. Regarding basic skills training development, the analysis process should establish that an organization needs to conduct basic skills training, perhaps due to the inability to find sufficient numbers of qualified job applicants, because new technology has changed the requirements for basic skills, or some other reason. What is important is to establish that the organizational problem is due to some basic skills requirements that are not being met, rather than some other factor, such as logistical problems in obtaining supplies and materials, inadequate assignment procedures, poor management, and so forth.

During the analysis activity, the basic skills requirements of the organization's job training system (if any) and job duties should be established. This is not a straightforward activity. Rather, because all of the cognitive processing that goes on in job training and job performing is hidden within people's minds, the analyst can only infer processing from tasks that people perform in job training or performance. The analyst must operate from some conceptual understanding of the basic skills of interest and the cognitive processes they involve. Examples of conceptual frameworks were given in the case studies reported previously. For instance, the basic skills of reading to do something in contrast to reading to learn something were distinguished on the basis of the information processing differences involved in the two types of tasks. Detailed methods for basic skills analysis are given in Smith (1973), Diehl and Mikulecky (1980), and Sticht et al. (1976).

In determining basic skills requirements of work, two aspects of requirements may become of concern. On the one hand, managers and others who are primarily concerned with basic skills so that screening and job classification may be more effectively accomplished would be concerned with knowing the

general level of reading or mathematics required for successful performance in training or on the job. Thus, they will desire some sort of summary index number, such as a reading grade level, that characterizes the basic skills requirements of jobs. Trainers, on the other hand, are more concerned with knowing the basic skills tasks that must be performed so that curricula for basic skills training can be developed. Because of these dual approaches to analysis of basic skills requirements (i.e., summary index numbers and task statements), the analyst may find the approaches described in the Army case study of interest.

Design

Given the need for basic skills training and an understanding of the basic skills tasks to be learned, the next activity is to design an instructional program. In this regard, a factor of special importance for basic skills training for business or industry is to simulate the job requirements to the greatest extent possible. This will ensure the most rapid learning of the job basic skills and their transfer to the job setting, whether that is a training or performance station.

The design of basic skills programs should proceed on the basis of the four principles discussed. Where very low literacy is of concern, the design of learning activities should proceed from experience with the materials that are to be used, accompanied by oral language learning of vocabulary, concepts, and job principles and rules. Reading assignments should build on this prior experiential and oral language base of knowledge. Extended practice should be designed into all activities for adequate levels of skill to be attained.

Development

The development process includes the specification of the actual learning activities in which the trainees will engage and the organization of the activities (including tests) into an overall systematic program of basic skills training. For lower skill levels, it may be necessary to develop simplified approximations of real job materials, such as simplified prose passages from technical manuals, partial forms (some industrial forms are very long and complex), and procedural directions with only a few steps per page to be read and performed. Eventually, however, the materials should become as difficult as those to be used on the job.

Tests should be developed that measure the actual performance of job reading, oral language, or mathematics tasks, and the instruction should be such that the tests are sensitive to it. That is, one ought to test to determine if what is being taught is being learned and if what is being learned are skills actually needed to perform job basic skills tasks. To the extent possible, the principles of time on task and competency-based mastery learning ought to guide the development activity.

Implementation

During the implementation phase, the curriculum materials are tried out and revisions are made where necessary. It is important that the entire curriculum and training management system be allowed to operate for some time in order to determine how well materials and procedures are working out.

In addition to permitting the tryout and revision of materials and methods, the implementation activity may extend to the actual operationalization of the new program. If so, chen considerable attention should be given to establishing the social networks within and outside the organization that will have to support the program. Within the organization, this means that all parties involved, from highest-level management to the potential students, must be informed of the program and its purposes. Any effects of the program on various organizational departments, such as, the personnel department, should be made explicit. Outside the organization, agencies such as schools, government offices, and community-based organizations that may act to support the program through referrals, follow-up, and so forth should be contacted and given a briefing on the program and its purposes. These activities may reveal important factors that need to be incorporated into the design of the program, so implementation activities should not be postponed until a program is completely developed. Rather, planning for implementation should occur as one of the earliest activities.

Social networks should be taken into consideration in yet another sense. Employees constantly draw upon each other's knowledge and expertise to solve problems. Research has shown that workers on the job ask questions of each other nearly twice as often as do students in school (Mikulecky 1982). Trainees in all three case studies sometimes worked cooperatively in both study and job performance and developed social networks as a result. These useful social networks, which provided both intellectural and emotional support, can be built into the job simulations and training programs.

For either job skills programs such as the CETA word processing program that prepared new workers, or for retraining programs such as the wastewater program described earlier, it is essential that the individual workers be informed about the program and that social networks for encouraging individual participation be established. Many lower-skilled adults may feel reluctant about entering into a basic skills program, so it is better to refer to the program as a job skills training program and to build the social support networks that will aid in the recruitment and support of trainees.

Evaluation

If there is one point at which most program developers fall short, it is in determining the value of the program. Very few basic skills, or, for that matter, technical skills training programs gather adequate quantitative and qualitative information to determine whether or not the program is cost-beneficial; that is, whether the benefits of the program outweigh the costs of developing and conducting the program. While this is admittedly difficult to do, program developers should attempt to do the best evaluation they can. At

a minimum, a program that purports to develop certain cognitive skills in trainees should demonstrate the extent to which such skills are, indeed, acquired. Thus, for instance, if the program purports to improve job literacy or numeracy skills, then the evaluation method should include procedures for indicating that trainees can perform reading and mathematics tasks at the end of training that they could not perform at the beginning of training. Such demonstrations should be possible if the principle of competency-based mastery learning is followed. The case studies reported earlier contain examples of evaluation methods that may be of use to those desiring to develop and evaluate occupationally oriented basic skills programs.

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