R E P O R T R E S U M E S

ED 014 566 VT 003 208

TRADE, INDUSTRIAL, AND TECHNICAL EDUCATION. RCU RESEARCH SUMMARIES.

CALIFORNIA COORD. UNIT FOR OCCUP. RES. AND DEV.

PUB DATE MAR 67

EDRS PRICE MF-$0.25 HC-$2.12 51P.

DESCRIPTORS- *RESEARCH REVIEWS (PUBLICATIONS), *ANNOTATED BIBLIOGRAPHIES, EDUCATIONAL PROGRAMS, POST SECONDARY EDUCATION, *TRADE AND INDUSTRIAL EDUCATION, *TECHNICAL EDUCATION, *EDUCATIONAL RESEARCH, APPRENTICESHIPS, INDUSTRIAL EDUCATION, RETRAINING, TRAINING,

RESEARCH REPRESENTATIVE OF THE TYPE RECENTLY COMPLETED IN THE FIELD OF INDUSTRIAL AND TECHNICAL EDUCATION IS SUMMARIZED. STUDIES IN VOCATIONAL-TECHNICAL EDUCATION AT THE POST-HIGH SCHOOL LEVEL ARE CONCERNED WITH SCHOOLS AND STUDENTS, TEACHING TECHNIQUES, AND CURRICULUM EFFECTIVENESS. RESEARCH RELATING TO TRAINING AND RETRAINING CONCERNED LEGISLATION, EMPLOYMENT INFORMATION, THE AREA REDEVELOPMENT ACT, THE MANPOWER DEVELOPMENT AND TRAINING ACT, EMPLOYEE CHARACTERISTICS AND THE UNEMPLOYED WORKER, AND TEACHING. INDUSTRY AND APPRENTICESHIP RESEARCH INCLUDED STUDIES ON AUTOMATION, APPRENTICESHIP, AND INDUSTRY TRAINING. A BIBLIOGRAPHY OF THE RESEARCH REVIEWED INCLUDES 81 RESEARCH STUDIES COMPLETED BETWEEN 1959 AND 1966. (HC)

RCU

RESEARCH SUMMARIES

RESEARCH COORDINATING UNIT

California State Department of Education • Vocational Education Section • Sacramento

MARCH 1967

Trade Industrial and Technical Education

CALIFORNIA STATE DEPARTMENT OF EDUCATION
MAX RAFFERTY - Superintendent of Public Instruction

P R E F A C E

Industrial and technological development is placing increased pressures upon the school and its curriculum. The blue collar worker of today can no longer receive his training in a few days on the job. Our society needs good craftsmen as well as professional personnel.

Training activities are being carried out through a variety of educational programs and by a number of different organizations using a variety of financial support.

This summary has been prepared to provide a brief description representative of the type of research recently completed in the field of industrial and technical education.

Increased emphasis must be placed upon occupational instruction as a means of combating poverty through reducing unemployment and increasing productivity and earning power. Research will play an important role in developing the best instructional methods and media to meet the needs for occupational instruction.

C O N T E N T S

TRADE, INDUSTRIAL, AND TECHNICAL EDUCATION PROGRAMS

VOCATIONAL - TECHNICAL

Post-High-School Schools and Students

Wold (1962) studied the practices employed in selecting students for technical curricula in public and private schools. It was found that, in general, institutions required one or several of the following: high school graduation or its equivalent, average high school grades, and pre-requisite courses in English, algebra, and plane geometry.

There appeared to be no significant relationship between the rate at which students completed the technical curricula and entrance requirements, selection methods and devices, type of school control, or whether or not the school is accredited by the Engineering Council for Professional Development. It appears that applicants who, generally, are being attracted to technical curricula are below the caliber capable of satisfactory performance in technical studies. It also appears that applicants are not well oriented as to their personal qualifications and the qualifications required for entrance into these curricula. The investigator suggested that in the screening of applicants and selection of students, the schools make "better" use of tests and interviews.

High school records in predicting success in specific business, trade, and technical schools were studied by Livers (1964). In general, academic factors such as high school grade point average and rank in class were the most consistent, single predictor of performance in the various trade and technical training courses. Grade point average of

selected high school subjects was found to be the best predictor of performance on the job. Employer ratings were used as the measuring device for job performance. Success in trade and technical schools can be predicted better than success on the job when student characteristics taken from high school records are used as predictor variables.

Millet (1965) in a study of five vocational schools in Alabama found that high school standing was not an efficient predictor of success in vocational schools. Millet also found that there was no significant difference in the success of subjects in post-high-school vocational schools when comparing high school graduates with high school drop-outs. Nor did he find a significant difference between white and Negro students in the importance of high school graduation to their success in vocational school.

Dennard (1965) studied the administrative organization of 15 selected vocational-technical schools from throughout the United States. The majority of the schools studied had evolved from vocational high schools or trade schools to their present vocational-technical status. Many of these schools were closely aligned with the local school district and thus the organization and school year was similar to the local school system. Despite the phenomenal progress being made by technical innovations, modern teaching technology was almost nonexistent in vocational-technical schools. Dennard also found that vocational-technical teachers were employed at higher beginning salaries than were academic teachers.

Roney (1965) studied 12 institutions offering technical institute curricula accredited by the Engineers Council for Professional Development. Thirty-five curricular areas were analyzed in three technology

areas: civil construction technology, electronic technology, and mechanical design technology. The mathematics requirements ranged from a three-credit-hour course in applied mathematics to a 13-credit-hour sequence including differential equations. The typical curricula involved courses in algebra, geometry, and selected topics of analytical geometry and calculus. The technical course work made extensive use of algebra and trigonometry. Analytic geometry and calculus were used less frequently. Physical science courses emphasized electrical physics and applied mechanics. Physics and mathematics principles were selected and scheduled to meet specific needs in the technical study in each curriculum.

Post-High-School Teaching Techniques

Two groups of airmen, each studying a different course, were given programmed instructional material in the middle phase of their instructional program (Neidt, 1966). The attitudes of these airmen were measured by five parallel forms of a 26-item Likert scale. The student attitudes in both courses were more favorable during the programmed unit than during conventional instruction. Changes were more pronounced with the higher ability students. Neidt suggested that special attention to student attitudes by the instructor is warranted during the transition from programmed instruction to conventional instruction.

Johnston (1966) studied team versus individual training using a transfer task that required teamwork. Some findings were:

1. Individual performance is related reciprocally to the demands on teamwork.
2. Team performance is retarded by team communications.
3. Team communications are limited to a team context.

4. Training on coordination skills is most beneficial and can be acquired about equally well in individual and team contexts.

Two methods of instruction, programmed instruction-demonstration and lecture-demonstration, used in teaching students engine lathe principles and operating procedures were studied by Aguirre (1966). No significant difference was found between the two student groups studied in their achievement of engine lathe principles and procedures or in their proficiency of operation whether taught by lecture-demonstration or by programmed instruction-demonstration. In addition, there was no significant differences between the two groups in retention whether taught by illustrated lecture-demonstration or by programmed instruction-demonstration methods.

Schamelhorn (1965) studied the current thinking of educators and engineers regarding suitable curricula content of engineering graphics. The engineering graphics educators identified four important primary areas: descriptive geometry, engineering drawing, graphic representation, and problem-solving and applications. Practicing engineers considered the following areas to be important: basic skills, dimensioning, visualization, working drawings, and pictorial drawing and modern graphical approaches. The investigator recommended the following course time breakdown: engineering drawing 60 percent, descriptive geometry 17 percent, problem-solving and applications 15 percent, graphical representation 6 percent, and modern graphical approaches 2 percent.

Froehlich (1965) studied approximately 500 naval trainees receiving remedial electronics instruction. They were subjected to three instructional methods: the lecture, linear programmed instruction, and nonlinear programmed instruction. Froehlich found the linear program was

best for students with low prior achievement scores. The lecture method proved best for students with high prior achievement scores. The average student using either of the two forms of programmed instruction completed the remedial training in 30 percent or less time than those students instructed by the lecture method.

Fowler (1965) compared the quick-connect and project methods for providing laboratory activities in an introductory electricity course. He found that there was no significant difference in the relative effectiveness of the two methods in terms of retention or student attitudes towards either method. The quick-connect method was judged to be more effective as an aid to understanding electrical theory, while the majority of the students preferred the project method.

The effect of the use of programmed material versus the lecture method for a basic electronics instructional course was studied by Weffenslette (1965). He found that there was no significant difference in the learning between methods, groups, or previous industrial arts instruction.

Junior college and university instructors in accounting were surveyed by McCormick (1965) as to their opinions concerning new media, such as instructional television, programmed instruction, and projective media as instructional aids. A majority of the instructors surveyed were of the opinion that projective media are important tools in extending the instructor's range and in improving the effectiveness of instruction whether in the small classroom, large lecture hall, or the television studio. In the opinion of instructors, the projective media most readily adaptable to accounting instruction were transparencies and the

overhead projector.

Curriculum Effectiveness

Information concerning seven hundred and fifty junior college students who were formerly enrolled in technical curricula were analyzed. (Elmgreen, 1963). The student completion rates for various majors were: drafting, 33.7 percent; electronics, 35.4 percent; and welding, 13.3 percent. The drafting and electronics students were slightly above average in IQ but below average in SCAT scores and high school rank. Welding students were below average on all three measures. Industry anticipates an expansion of from 25 to 50 percent in workers performing jobs in drafting, electronics, and welding. The employers thought that the technical knowledge required by these workers will increase over the next ten years. They indicated that above-average intelligence or natural ability should be present in 50 percent of the drafting and welding students and in 75 percent of the electronics students. This indicates that problems are to be expected in hiring sufficient workers with adequate preparation. The investigator recommended the encouragement of a higher student completion rate and the enrollment of more capable students in these curricular areas.

Seventy businesses employing technically trained individuals in the Deer Park Washington area were interviewed by Long. It was found that employers were willing to participate in training programs. The problems of minimum wage laws, time necessary to train work experience students for new jobs, and liability insurance coverage were principal obstacles to a directed work experience program.

Moss (1966) studied the influence of high school industrial arts experience on the grades earned in the post-high-school trade and technical curriculum clusters of automotive, drafting, electrical, and machine shop. The study was intended to estimate the relation between industrial arts experience, as part of a pattern of senior high school preparation, and success in certain post-high-school trade and technical curriculums and to determine, in part, the existence of "pre-vocational" value that justifies the offering of industrial arts. The students involved in the study had varying amounts of high school industrial arts training ranging from none to more than six semesters. It was found that differences in amount, content, and objective of the high school industrial arts experience had no observable influence on the grades achieved by the students enrolled in any of the four curriculum clusters. No relationship was found between graduating from or dropping out of school and the amount of senior high school industrial arts taken. Students whose high school industrial arts grades were low had a higher dropout rate than students with high industrial arts grades. Furthermore, high school academic courses, particularly the physical sciences, appeared to be equally effective in preparing the students for post-high-school trade and technical curriculums. The investigator cautions that the superior performance of the physical science prepared student does not take into consideration the aptitudes of the students, but warns that the study does raise serious questions about the pre-vocational value of high school industrial arts. This is indicated by the fact that no differences were found in the scholastic achievement of students enrolled in any of the four post-high-school trade and technical curriculum

clusters studied that were attributable to the following:

1. No senior high school industrial arts.
2. Industrial arts courses that were directly related to the curriculums in which they were enrolled.
3. Industrial arts courses that were not directly related to the curriculums in which they were enrolled.

Further, there was no difference in the proportion of students in the above three groups who graduated from any of the curriculum clusters.

Information from vocational machine shop teachers and skilled tradesmen were obtained by Sams (1961) to determine if automation had any real influence on the skill requirements of two groups of skilled tradesmen, toolmakers and machinist-repairmen. The rating on the technical information taught by the machine shop teachers was in basic agreement with the importance rating given by tradesmen. Notable exceptions included hydraulics, electricity, electronics, and pneumatics.

The investigator concluded that:

1. There is no indication that automation has brought about a change in the skill requirements for these tradesmen.
2. Automation brings increased importance on technical knowledge.
3. There is a close relationship in the training of the two groups, toolmakers and machinist-repairmen, as about 60 percent of the skills are practiced by both groups.

TRAINING AND RETRAINING

Legislation

The U.S. Committee on Education and Labor (1965) presents a chronological listing of congressional legislation pertaining to education and training. The period of time covered by this listing is from April 1961, to November 1965.

87th 1st Session (1961)

Practical Nurse Training Extension Act	87-22
Establishment of Howard University Hospital	87-262
Training of personnel for juvenile deliquency control	87-274
Training for teachers of deaf persons	87-276
Promotion of education for the blind	87-294
Extension of NDEA (815, 874, and 10 titles)	87-344

87th 2nd Session (1962)

Manpower Development and Training Act	87-415
Revision of School Lunch Act	87-823

88th 1st Session (1963)

Higher Educational Facilities Act of 1963	88-204
Vocational Education Act of 1963	88-210
NDEA amendments and extensions, 1963	88-210b

88th 2nd Session (1964)

MDTA amendments	88-214
Library services and construction	88-269
Educational and training aspects of Economic Opportunities Act.	88-452
NDEA extension, 1964	88-665

89th 1st Session (1965)

Elementary and Secondary Education Act, 1965	89-10
Manpower Act of 1965	89-15
National Institute for Deaf Act	89-36
Educational aspects of Older Americans Act	89-73
815 and 874 Amendments	89-77
Correctional Rehabilitation Study Act, 1965	89-178
National Vocational Student Loan Act, 1965	89-287
Higher Education Act of 1965	89-329
Vocational Rehabilitation Act amendments, 1965	89-333

In a Senate report on the research and development activities sponsored by the Federal government (1965), Federal spending in research and development were indicated as seventy-four million in 1940, three billion in 1956, and 15 billion in 1964. Federal spending varied from state to state. California received 3.5 percent of all the funds in 1962, while 20 states in the Midwest received 14.7 percent during the same period. In 1964, 38 percent of research and development personnel were employed in business and industry, 35 percent in educational institutions, and 15 percent in various governmental agencies. The relationship between research and development and the economic growth and employment is not yet known, but factors in addition to economic ones are involved. Large research and development centers such as found in Houston have stimulated business growth and increased employment opportunities. The Federal government pays for 70 percent of all research and development personnel in the United States, and large cutbacks usually have dire effects on the regional economy and its supporting labor force.

Employment Information

Prater (1963) studied the probable supply and demand for technicians in Missouri from 1960 thru 1970 and interpreted findings in terms of implications for vocational and technical education. During the decade, Missouri will need 7,139 industrial technicians; the supply of these technicians is predicted to be 4,512. The state's need for health service technicians will be 4,120; the supply is predicted to be 3,340.

Haase (1966) contends that manpower changes that are the result of innovations can be foreseen with a fair degree of accuracy for five or, in most cases, for ten years ahead. For example, innovations in the telephone industry such as electronic central office, satellite communications, push-button telephones, and computerized information services will continue to result in productivity increases and occupational shifts. In spite of an increase of nearly 75 percent in the number of telephone calls between 1964 and 1975, the number of telephone industry employees is expected to rise by only 11 percent during the 1965 and 1975 period. Technological developments that will affect health services during the next 10 years fall into the following categories:

1. Equipment and techniques used in diagnosis and patient care
2. Changes in hospital supply and services
3. Improvement in hospital information handling
4. Improvements in the organization and design of health facilities.

In spite of "productivity" increases, health services employment is expected to rise by over 30 percent.

Design and drafting is expected to increase about 5.2 percent annually , as it has for the past few years, for an 84 percent rise over the

1963 - 1975 year period. However, experimental systems make it impossible to project the total number of draftsmen that will be required between 1970-1975.

Secretary of Labor (1966a) reports on a survey conducted in 1964-65 of employers in 16 metropolitan areas, of the number and times of jobs that were currently vacant. It was found both feasible and practical to collect job vacancy information by detailed occupation. Approximately 80 percent of the employers surveyed were able to supply this type of data. Some of the findings from this survey showed that nurses accounted for one of every four professional vacancies. Sales persons and sales clerks accounted for two-thirds of the vacancies in merchandising. About one-half of the job vacancies in the service occupations were for waiters and waitresses.

Area Redevelopment Act

The U. S. Department of Labor (1964d), in an annual report of the area redevelopment activities covering the programs of operation, accomplishments, characteristics of trainees, and program evaluation, reported that in 1962 there were 9,074 trainees in 34 states, increasing to 13,314 trainees in 40 states in 1963. The largest segment of the trainee population fell in the 22 through 44 age bracket. Their educational attainment were as follows: 48 percent had graduated from high school; 29 percent had completed grades 9-11; and 17 percent had a grade school education or less. Levitan (1964) reported that approximately 70 percent of those completing training under the Area Redevelopment Act have succeeded in obtaining jobs.

Kunty (1964) reported on Oklahoma farm mechanics retraining schools for 255 unemployed or under-employed men under the Area Redevelopment Act to identify characteristics to use in selecting students. He found that 87 percent of the trainees were now employed and that 61 percent were employed in occupations related to their training. Students who were successful in obtaining jobs related to their training made significantly higher scores on the general intelligence, spatial aptitude, and finger dexterity portions of the General Aptitude Test Battery. Other GATB test scores were not significantly different. Scores made by successful trainees on the spatial aptitude portion of the GATB indicate that this score should be given more weight in the selection of trainees. A majority of successful trainees were married while a majority of the unemployed were single or divorced. Age was not found to be a significant factor in determining trainee success.

Manpower Development and Training Act

In a Manpower Evaluation Report (1964), institutional training programs under the Manpower Development and Training Act during the fiscal year 1964, were compared with those of the fiscal year 1963. Appreciable increases were found in the number of women trainees (a 41 percent increase), in youth participation (a 33 percent increase), and among non-white participants (a 28 percent increase). A noteworthy development was the greater proportion of trainee graduates who were placed on jobs. This figure increased from 70 percent in 1963 to 75 percent in 1964.

One of the most serious obstacles to qualifying for training under

the MDTA has been a lack of education.

The fourth annual report of MDTA covering the 1965 calendar year was made by the Secretary of Labor (1966b). The largest MDTA training program in 1965 was institutional training in public and private educational facilities. In 1965, there were 152,000 trainees, 15,000 less than the previous fiscal year. This drop is attributed to the increase of on-the-job training programs, which doubled during 1964. There were 69,000 trainees, with 30,000 completing training in 1965. That year, the average cost per trainee using the institutional training facilities was $1,900, and the on-the-job training cost was $520 per trainee. The number of youths participating in on-the-job training increased sharply in 1965; two out of every five were under 22 years of age.

There were 100 experimental and demonstration projects in effect during 1965. Of these, 85 were operational; and 15 were developmental, with the focus being on the disadvantages. Private, community, civic, or social welfare organizations conducted 45 percent of the experimental and demonstration operations; 20 percent were run by universities; 15 percent by indigenous organizations of the disadvantaged; 10 percent were being operated by local public agencies; and the remainder were conducted by Federal or State agencies.

The U. S. Department of Labor (1964c and 1964d) reported on the perceptions of unemployed males in the north Norfolk-Portsmouth area who had rejected retraining opportunities offered under MDTA. Findings showed that the typical rejector of training was 35 years old, married, had four dependents, and had completed either 10th or 11th grade, and had a total income of $50 weekly. The following reasons for rejecting

training opportunities emerged from the study:

1. The training allowance of $25 a week was inadequate incentive.

2. The length of the training period was considered too long a period for men to support their families.

3. Communications problems hindered the recruitment of trainees and resulted in some misunderstandings concerning the natures of the program.

The rejectors of retraining did not lack ambition or initiative. Most rejectors seemed eager to find work and suggested that government retraining programs would be the best solution for unemployment.

Based on study information, the following conclusions were made concerning the change of attitudes of individuals in the acceptance of training programs.

1. Attitudes, once learned, are difficult but not impossible to modify.

2. New attitudes are learned through the experience of association, transfer, and need satisfaction.

3. New attitudes are more likely to be modified by face to face encounters rather than through impersonal lectures or mass media.

4. If a person realizes that it is to his advantage to change, the process will be facilitated.

5. Changes take place if arrangements are made for persons to learn new ways of feeling and reacting through association.

The U. S. Department of Labor (1964 f) reported the extent to which training programs established under MDTA are meeting the needs of unemployed women. The following findings were reported:

1. Women workers represent one-third of the work force and two-fifths of the nations' unemployed.

2. MDTA is contributing to the capability of women to become occupationally mobile.

3. Women receiving retraining for nursing, nursing aides, and other occupations in the professional-technical and semi-professional service categories, had employment rate of 72 percent. The placement record for women over 45 years old was 74 percent.

Employment trends and the status of MDTA training of jobs in the service occupations was reported in Manpower Research Bulletin No. 9 (1966). The following findings were included:

1. Enrollees in service training projects constituted 30 percent of all MDTA enrollees through May 1965.

2. As of 1964, service occupations provided work for 11 million employees.

3. Almost one-half of the service workers are employed in industries that provide personal, professional, and business services.

4. Service occupations enrollments through 1964 approached 60,000. Enrollments by selected areas are given in percentages: cook, 6.3 percent; housekeeper, .7 percent; waiter, 3.9 percent; janitor, 2.5 percent; automotive trades, 27.6 percent; and gardener, 1.4 percent.

The economic benefits of retraining the unemployed was studied by Borus (1965). The findings indicated that benefits of retraining are considerably greater than the cost, and that the government's and the economy's benefit-cost ratios for retraining are greater than the individual worker's ratio.

Page (1964) also concurs in this conclusion. He found that 64 percent of the workers completing training found employment and had greater life income potential than those who failed to complete retraining.

Yormark (1965) explored the effects of manpower training legislation. The investigators' proposition is that full utilization of education as a force to reduce unemployment and foster economic growth will be hampered unless new concepts of viewing education are evolved. The

investigator believes there should be greater training emphasis in the growing occupational needs of management, service, government, and marketing.

Ginzberg and others (1965) studied relationships between the nation's manpower and the level of economic activity. The following findings were obtained while exploring the expansion of employment in nonprofit institutions and government:

1. One-fourth of our gross national product is directly or indirectly attributable to the activities carried on by the nonprofit-making sector of the economy.

2. Not less than one-third of all employment is accounted for by the activities of the nonprofit sector.

3. An enlarged role of the Federal government in cold war and aerospace activities, and enlarged activities of state and local government in relation to education and other community services, accounted in part for nonprofit institutional expansion.

4. Out of a total labor force of 75 million, government employs 10 million persons. Government is second only to manufacturing as an employer of people.

5. Two out of three professional and technical personnel are employed directly by government or nonprofit institutions or indirectly in private enterprises supported by purchases made by government and nonprofit institutions.

6. Several suggestions were made for stimulation of the diminishing private sector of the economy.
   a) Government support of research for innovation in civilian production should be provided.
   b) The mechanisms for obtaining joint action by the two sections should be improved so that many existing barriers to private investment can be removed.
   c) The private sector should be encouraged through subsidies and other devices to start new enterprises, particularly in the service field, which would assist various groups of handicapped persons.

Employee Characteristics and the Unemployed Worker

Levine (1964) suggests that basic literacy programs are essential for the unemployables presently ineligible for retraining. Gurasiin and Roach (1964) also found that impaired intellectual functioning was a deficiency in many of the trainees. The following findings were reported:

1. Sixty percent of those completing training and being employed had a 12th grade education or over; whereas, only 37 percent completing training and being employed had less than a 12th grade education.

2. Factors exist that have precluded current training programs from reaching their goals of substantially reducing the size of the hard-core unemployed.

3. Lower-status persons were found to be impaired in intellectual functioning, deficient in conceptual skills, and inadequate in verbal skills, and were considered unemployable in automation-type jobs.

4. Training programs are faced with the dilemma: either a limited number of persons can be trained for highly skilled occupations, or training programs can be geared to the level of backgrounds and aptitudes of most of the unemployed preparing them for occupations in which there is already an oversupply.

The Upjohn Institute for the U. S. Department of Labor, in a report for the Secretary of Labor on Manpower Research and Training (Sheppard and Belitsky, 1965) reported on studies pertaining to blue-collar and white-collar workers unemployed in the Erie, Pennsylvania area. Workers who started their job search immediately after being laid off and who considered all possibilities were most successful in finding jobs.

Among the blue-collar workers who had been laid off and were not called back to old jobs, the older skilled workers were at no greater advantage in finding new jobs than were the older semi-skilled. However, in general, skilled workers were called back to work at a higher proportion

than workers without skills. The minimum wage figure below which they would not accept employment was higher for the skilled-unemployed than for those workers who did find employment. During the first month after becoming unemployed, male workers sought employment at far more companies than did women. Unemployed workers were asked to indicate job-seeking sources. The unemployed workers ranked sources in the following priority order: 1) friends and relatives, 2) direct company application, 3) unions, and 4) the employment service.

Kalish (1966) also found that friends and relatives were favorite employment sources of the unemployed in their search for job openings. He reported that checking with the State Employment Office was a job-seeking method for at least half of the least educated.

There was evidence of down-grading for those workers who made job changes. The principal reasons given for this down-grading was lack of adequate education and training. In reference to persistence of employment problems, Kalish found the 15 percent had not worked at all during the past year.

In an analysis of employment among professional engineers and scientists, Mooney (1966) obtained usable questionnaire responses from 290 unemployed engineers and scientists from the Boston area in 1963 and early 1964. He found that engineers over the age of 49 suffered longer periods of unemployment than younger engineers and that engineers not holding degrees faced longer periods of unemployment than did engineers who held degrees. Engineers and scientists with the best mathematical background (as measured by a skill index score obtained from mathematics courses taken) suffered little or no unemployment.

The unemployment problem of the engineer with no degree was aggravated by the fact that they tended to be older than those engineers holding degrees. The older engineers with no degrees who found employment took a reduction in salary more often than did younger engineers or engineers holding degrees. Engineers working toward advanced degrees had less unemployment than engineers holding bachelors degrees who were not enrolled in advanced degree programs.

Wilensky (1959) reported on the "skidder," that is, a person who has suffered downward occupational mobility. He found that the "skidder" was more conservative in values and beliefs regarding stratification order than "nonskidders." Skidders because of adherence to the success idiology are more interested in escape from the factory than movement within it.

An investigation of certain components of ego-strength to distinguish vocational rehabilitable and nonrehabilitable workers was conducted by Solomos (1965). The population included vocationally handicapped individuals with a variety of disabilities who entered a rehabilitation workshop during a three-year period. The findings from this study suggest that personality factors are involved in the vocational rehabilitation process. The investigator used seven test instruments to measure the components of ego in relation to the vocational rehabilitation process. He found that no one single instrument was adequate in providing the discriminating psychological factors, but that a positive relationship did exist between total ego-strength, as measured by Barron's Ego-Strength Scale, and vocational rehabilitation success.

The Secretary of Labor (1966 b) presented a report on manpower

research and training under MDTA on training in correctional institutions and the problems of vocational rehabilitation of the prison inmates. The prison population was predominantly male, under the age of 35, and were poorly educated. The preprison work experience of the prison inmates was usually in the least skilled areas, and most unstable work experience of the prison inmates was usually in the least skilled and most unstable jobs. During the first three months after release from prison, only four out of ten had been employed as much as 80 percent of the time. A pattern of failure was evident in family life, in school, and as productive individuals. Approximately one-half of the Federal prison population in 1963 received some vocational training, usually on-the-job training in prison industries. It was noted that few inmates received advanced vocational training. Typical vocational training subject areas include auto mechanics, body and fender work, radio and T.V. repair, office machine repair, welding, plumbing, drafting, and courses for waiters.

The National Committee on Employment of Youth (1965) prepared a report of a study of practices and policies on youth employment in industry focused on the variables of types of training and patterns of skill requisition of male workers. The study findings showed that the caliber of the local labor supply influenced the opportunities for employment for inexperienced workers. Barriers to youth employment are: age, education, experience, economic conditions of the area and the particular industry, and knowledge of where to apply. A majority of workers acquire occupational skills through formal on-the-job training; a large majority, and especially blue-collar workers, learn on the

job through observation, trial and error, and irregular assistance from colleagues and supervisors.

A typology of employment opportunity emerged from the study composed of five types:

1. Female white-collar dominant; prototype, insurance company.
2. Separation of the unskilled from the skilled by female blue-collar workers; prototype, electrical manufacturing.
3. Male organizations with undifferentiated low-skilled jobs; prototype, moving and warehouse company.
4. Predominantly male organizations with undifferentiated high-skilled jobs; prototype, tool and die shop.
5. Preponderance of professional and technical workers; prototype, manufacture of machinery.

Luy (1965) reports on 224 youth who were unemployed and enrolled in the MDTA in the area of St. Louis, Missouri. The purpose was to investigate and describe the social, economic, and educational backgrounds as well as the occupational aspirations and attitudes of the unemployed MDTA youth. Interview information showed that three-fifths of the youth were living with their parents. Almost one-third of the parents of the youth had completed the eighth grade level or less, and the average formal grade level was 9.6 years. Over one-fourth of the fathers of the youth had been unemployed for three months or more during the three years preceding the study. Approximately one-half of the youth came from homes in which both parents were not living together. Slightly over 80 percent of the youth were school drop-outs, and 91 percent had scholastic aptitudes placing them below the 50th percentile. Three-fifths of the youth believed it necessary to have some college education in order to get along well in the world. Only 12 percent of

the youth had previous vocational training, and three-fifths of them stated that they would select vocational curricula if they were to return to school. Sixty-seven percent aspired to jobs of a "skilled" nature. Four-fifths indicated willingness to move from the area to gain employment. Slightly over one-third of the youth reported that they believed that their teachers had no interest in them as individuals. The interviewed youth believed that prompt, regular attendance and the ability to get along with others were the most important factors in maintaining job success.

The Stanford Research Institute (1965) evaluated the Oak Glen Camp for unemployed youth. The camp provided work experience and educational instruction in kitchen work and related tasks, camp office and related tasks, building and grounds maintenance, camp laundry, and automotive and equipment maintenance. The trainees were representative of all ethnic groups, products of disadvantaged backgrounds, and generally had histories of consistent failure. The trainees made dramatic reading achievement gains (about two grade levels). The camp drop-out rate was 58 percent, but the more education the trainee had, the less likely he was to terminate his training experience. The trainees who stayed and graduated were more likely to find employment after leaving camp than were those who terminated their training experience prior to completion.

The Department of Labor (1964 b) reported on the experiences of workers who were laid off their job due to technological advancement. The effects of job displacement were:

1. The majority of displaced workers accepted reduced wages when they found re-employment.

2. The number of wives who were working increased substantially after the lay-off.

3. One of the most serious effects of the lay-off was the loss of employee benefits, such as health and accident coverage.

4. As a consequence of the lay-off, workers generally experienced a down-grading of skills.

Measures that minimize displacement of workers include early retirement and the spreading of available work. Measures to help displaced workers find employment include providing early notice, placement services, and interplant transfers.

Gordon (1964) studied unemployment patterns in six representative years within the 1948-1963 period. He found that there were no major changes in the percentage of total unemployment attributed to any particular industry. The belief that nonwhite unemployment accounts for more and more of the total unemployed is false. Since 1956, the percentage of unemployed workers who had 12 years of education or more has increased, while unemployment of persons with less than 12 years of education has declined.

Solie (1965) studied Area Redevelopment Act retraining programs in two counties of Tennessee to determine their effectiveness. He found that the earning benefits of the training program was greatest for society and the smallest for government. The costs were highest to the government and lowest for the individual. The estimated payback period was zero months for the individual (due to no cost), 14 to 20 months for society, and 62 to 511 months for government. Training appeared to help the drop-out as much as the average individual.

Teaching

Alderman (1964) studied the influence of local physical fatigue on performance of two types of motor tasks. He found that heavy physical work during the learning of each of the motor tasks seriously impaired the performance of that task but had no effect on the amount of learning in that task.

A hypothesis that training time can be reduced by means of programmed instruction, without loss of training quality was tested by Mayo (1965). Over 200 Navy and Marine Corps trainees received instruction in electronic fundamentals using programmed and conventional instruction. In a matched group design, the group receiving programmed instruction completed the course 31 percent faster, and the programmed instruction group did significantly better on the criterion test than the conventional instruction group.

Melching and others (1964) evaluated an auto-instructional program in the first week of a basic electronic course. There were two separate evaluations of the auto-instructional program. In the first study, daily assignments were made and the incomplete lessons were completed as home work. In the second study, students were permitted to proceed entirely at their own rate. Students using self-instructional material and proceeding at their own rate did better than students who had limited self-pacing of the instructional material.

Tomlinson (1963) studied four methods of presenting complex technical material in written form. The methods used were inductive, inductive-discovery-confirmation, deductive, and inductive-discovery. The findings showed the inductive method to be superior to all other methods and the inductive-discovery to be superior to the inductive-

discovery-confirmation method for initial learning when measured immediately after presentation. All methods investigated were equally effective when success was measured in terms of retention and transfer one week after instruction. The inductive-discovery-confirmation method is inferior to all other methods when success is measured in terms of retention and transfer at five weeks after instruction. An expository method, inductive or deductive, stating the generalizations, was superior to methods including questions to stimulate the student to form his own generalization, when success was measured by retention and transfer at five weeks after instruction.

Murrell and Kingston (1966) compared speed and accuracy of reading of standard and digital micrometers. It was found that untrained apprentices performed very badly on the standard micrometer, but that on the digital micrometers, the untrained apprentices were substantially more accurate than were either trained apprentices or journeymen when these two groups were using standard micrometers. Using the standard micrometer, journeymen made an average of 3.7 percent more errors, but made only .05 percent more errors using the digital micrometer. The manipulation and reading time of the digital micrometers was less than on the standard micrometer. Contrary to expectations, the performance of the older journeymen between the ages of 50 and 64 years, did not improve more than did that of younger subjects. In fact, the older group improved the least by use of the digital micrometers.

INDUSTRY AND APPRENTICE

Automation

The nature of automated jobs and their educational and training requirements was studied by Fine (1964), who reported the following findings:

1. Automated production feeding, tending, and automatic testing jobs require about the same or less education than the hand assembling or testing jobs they replace, and require less training.

2. Machine attending, including set up, operation, and minor maintenance requires significantly higher education than for nonautomated production.

3. Jobs involving major responsibility for set up, operation, and product quality of automated machines require some training of a technical nature, in addition to previous broad experience, because of a need to understand the interacting components of a feedback, self-correcting, automatic system.

4. Technical education beyond the high school is required for maintenance repairmen of automated equipment in order to interpret a variety of technical instructions, complex diagrams, blueprints, and manuals.

One conclusion of the study was that automation tends to be engineered to eliminate low functional level jobs occurring in mass production and assembly situations.

Faunce (1965) concurs with Fine's conclusion. He stated that automation could decrease the division of labor in four fashions. It could:

1. Reduce the variety of tasks to be performed.

2. Require a recombination of the main remaining tasks.

3. Reduce the need for middle management.

4. Affect long-run employment opportunity.

He stated that the big change element in automation is job enlargement, that is, obtaining a greater share of the production process.

Markham (1964) and the Department of Labor (1964 b and 1964 a) also found that automation tends to decrease the demand for workers with little training and increases the demand for workers with specialized training. As automation spreads, it does not provide as many new jobs as it is displacing. Additional findings of the Department of Labor (1964 b) were:

1. The ratio of low functional level jobs to high functional level jobs in production is approaching equality.
2. A tendency exists in light industry to employ women in low functional level jobs.
3. Automation at both low and high functional levels is requiring more education for job entry.
4. Jobs in automated production are more interesting and challenging but are also more tension producing.
5. Displaced workers of low functional level jobs show less inclination toward further training and education than do displaced workers of high functional jobs.

The Committee of the Center for Democratic Studies (1964) reports that cybernation, a combination of the computer and the automated self-regulated machine, has created the following situations:

1. Increased productivity.
2. Altered the distribution of goods in an economy geared to the concept of scarcity of goods.
3. Created surplus capacity.
4. Contributed to a greater degree of unemployment.
5. Given rise to a permanent impoverished and jobless class.

This Committee proposed massive build-up of the educational system, massive public works, extension of the program of low-cost housing, a major

revision of the tax structure, and a public power system to stimulate the depressed coal industry.

A U. S. Department of Labor (1964 d) publication points out other problems associated with automation. It reported that highly mechanized operation and automatic control procedures increased the need for intense mental concentration and lead to perceptual fatigue, and that high capital expenditures for automated equipment usually bring around-the-clock production and shift work that disrupts family and social life habits, which may create resentment and both physical and mental stress.

Rosenberg (1964) examined workers' perceptions of the major issues related to automation and the interpersonal factors that determine agreement or disagreement between individuals. Workers were most concerned with the impact of automation on the individual. They believed job satisfaction would decline, and the worker would become less of a worthwhile, imaginative individual than he was before automation. Identification of the job, and the integral unit in relation to work, was perceived as threatened by technological automation. This factor was closely related to the general pessimistic attitude toward supervisory control in the era of automation. Workers believe automation will make work physically easier, take away fatigue, and thereby reduce accidents. Workers favored retraining programs as a solution to automation problems as long as they did not have to pay for the retraining. The worker's level of education, his belief about how many persons will be laid off in his plant because of automated installation, and the number of persons he was supporting contributed to a matrix of intercorrelations used as a basis for the study findings. The higher the worker's education and

the lower the number of persons he perceives as being laid off due to automation, the more positive the worker's attitude toward automation. The worker who supports more than four persons is pessimistic toward retraining as a solution to the problems created by technological displacement. Those workers who wanted to obtain the affection of their co-workers had a negative attitude toward the impact of automation while workers low on "wanted affection" had a positive attitude toward the impact of automation on working conditions.

In a study of the functions of ignorance in introducing automation, Karsh and Siegman (1964) found that the introduction of new types of technical staff in modern organizations adds instability and tension between the old line and staff functions. Specialists dealing with automated equipment tend to "protect their jobs" by providing the subordinates only with the amount and kind of information they regarded as "safe." The ignorance of formerly superior specialists relative to subordinates can be used as a "power mechanism" to thwart formal authority. The greater the superiors dependence upon the subordinates' knowledge, the more control over the superior, for example, the supervisor and programmer.

McLanalan (1965) studied the landing of pilots using automated equipment in powered aircraft. He found that men using automated equipment were superior in performance to either man or machine alone. Man can work effectively with the automated equipment and accepts and has confidence in machine assisted and controlled functions when provided with a quick, simple, and natural means by which they have final authority over equipment. They also wanted adequate information for assessing

system status and performance and for making inputs when desired.

The United States Civil Service Commission (1964) reports on the effects of automation on employees of seventeen agencies of the United States Government. Digital computer growth in governmental agencies increased from 45 in 1954, to 1,565 in 1964. The automated equipment displaced 5,171 employees, automation equipment operations increased by 7,252 employees, and other technical occupations increased by 3,066. Approximately 76 percent of the displaced clerical employees were reassigned, and 86 of the reassignments were to the same grade.

The U. S. Department of Labor (1965) reports on the effect of automation in six gray-iron foundries. Automation in the iron foundries accomplished the benefits looked for in the original decision to automate; in fact, results showed there was a tendency to underestimate expected benefits. Increasing wage rates encourages automation, but the ultimate investment decision seems to be made almost independent of wage rates. A benefit other than increase in efficiency is improved customer relations; that is, customers enjoy doing business with a "modern" firm. Mechanization also improves employee relations by elimination of more difficult jobs and by making jobs physically easier.

The United Steelworkers Research Department (1962) reporting on automation stated that employment in the steel industry over the period from 1937 through 1957 rose 4.3 percent, as compared to a rise in steel shipments of 108 percent. The average weekly number of hours for the steel industry in 1957 was 37.2 hours. In 1960, the average weekly hours were 35.7. The union suggested the following six points to protect workers in automated industry:

1. Careful advance planning and notification regarding technological innovations.
2. Transfer rights.
3. Retraining programs.
4. A progressive system for protecting seniority.
5. Negotiated fringe benefits.
6. A negotiated reduction in the work week.

Apprenticeship

The U. S. Department of Labor (1966) reported on a study of apprenticeships in eight European countries. Most of the countries follow a highly traditional pattern of apprenticeship dating back to the second half of the Nineteenth Century. Release-time instruction was rapidly becoming the accepted instructional format for apprentice training in the countries surveyed. Under this system, the apprentice attends classes 8 to 12 hours per week.

An investigation of factors considered in the selection of apprentices by manufacturing companies in Michigan was made by Hagemeyer (1961). His conclusions were:

1. Neither seniority nor family relationships were prime requisites for apprenticeship training.
2. Possession of manipulative skills were considered important; a good work experience was a valuable asset.
3. Hobbies that reveal interest and aptitude in mechanical things were considered important.
4. Companies in four of six geological apprenticeship areas in Michigan considered recommendations furnished by the applicant's school to be important in the apprentice selection.
5. Recommendations from previous employers were considered very important in both large and small companies.

6. Recommendations from friends were not considered important by large companies. Small companies in two regions did consider recommendations of friends important.

7. High school graduation was practically a requirement to being selected. A record showing applicants relative success in school, as evidenced by his grades, was considered of less importance.

8. High school students planning to apply for apprenticeship in Michigan's manufacturing industries should be encouraged to take courses in algebra, geometry, shop mechanics, and industrial education while in school.

9. Apprenticeship training is not limited to youth.

10. Michigan's manufacturing companies generally used a probationary period as a final phase of the selection procedure.

11. Standardized tests were used by many large companies, but most small companies did not use standardized tests in the selection procedure.

12. Companies using standardized tests had established minimum standards.

13. Only 3.6 percent of small manufacturing companies in Michigan maintained apprenticeship programs.

Parrish (1965) studied certain personal and educational characteristics of apprentices who were enrolled in Nebraska schools for 144 hours of instruction each year. It was found that:

1. A majority of the apprentices placed a greater value on secondary school industrial education courses that were developed for a cluster of occupations than for courses that were representative of a single skill occupation.

2. A majority of the apprentices placed more importance on secondary school mathematics as a basis for apprenticeship than for industrial education.

3. A majority of the apprentices were not informed about apprenticeship through the secondary school.

4. The evidence indicated a lack of counseling in terms of information for apprenticeship.

5. Apprenticeship in Nebraska is not being restricted to relatives of journeymen to the degree it was in the past.

6. It was noted that no special time credit for the secondary school program was considered for apprenticeship.

In a study of skill utilization and its impact upon apprenticeship programs in the home building industry, Dailey (1965) found that because of the tremendous utilization of manufactured components in the building of homes, particularly by home builders who built more than 500 per year, the apprenticeship training program for carpenters was unrealistic. He claimed that carpenters were overtrained for the performance of jobs in the home building industry in which labor specialization is becoming a reality.

Hatalsan (1963) conducted a follow-up study of graduates of apprenticeship programs in the San Diego area from 1947 through 1955 in 19 different apprenticeship training groups. It was found that these apprentices changed status readily, moving from journeymen to supervisory and to business-ownership. It was also found that they experienced little unemployment, tended to remain with one employer, and remained in the trade for which they had trained. The hourly rate of the apprentice graduates was higher than prevailing rates received by journeymen in the area, and average annual incomes were higher than those of skilled workers in the state and in the nation in comparable industries. A large portion of the graduates took additional training after apprenticeship, primarily for the purpose of occupational advancement. They participated actively in labor, management, and professional organizations.

The American Machinist (1965b) contained a report by the National Tool Die and Precision Machining Association in cooperation with the United States Department of Labor of an eight weeks' pretraining program for apprentice tool and diemakers. Apprentices who had completed the

pretraining program scored an average of 12 points higher on the graduate apprentice examination than did apprentices who had taken the conventional four-year course. Participating shop owners claimed that the apprentices who had the pretraining were from six to twelve months ahead of those taking the conventional apprenticeship program. (Another innovative pretraining program was a twelve week, seven hours a day, five day week, program held in a local vocational school.)

A report on programmed aids for apprentice training in the American Machinist (1965a) indicated that the Timken Roller Bearing Company uses programmed instructional aids in teaching apprenticeship programs. Timken claims the following advantages of programmed learning:

1. It lets the student proceed at his own pace.
2. It frees the teacher from routine.
3. It lets the apprentice think for himself.

Industry Training

Somers (1965) reported on employer attitudes concerning government subsidized on-the-job training. He stated that employers who are generally opposed to Federal programs were not opposed to on-the-job training. A somewhat larger group of employers preferred government-aided institutional training programs than preferred subsidized on-the-job training, however, the preference for government-subsidized on-the-job training increases with the size of the responding firm. The following are advantages to on-the-job training as listed by employers:

1. Greater company control over the training.
2. Training intended for specific company jobs.
3. Immediate job placement.

Striner (1966) in a study of the employers in the Erie Pennsylvania area found that a remarkably small percentage of the employers were aware of the provisions of the Manpower Development and Training Act. A notably high percentage of the employers were quite interested in on-the-job training provisions with partial subsidization. However, they were not asked if this were preferred to institutional training as was the case in Somers study.

Walker (1965) reported on an evaluation made of training methods and their characteristics by training experts for the Martin Company. A panel of technical training specialists was asked to evaluate 16 techniques in terms of 34 selection criteria. The following chart shows the ranking of these training techniques.

Training Technique Ranking by Technical Training Specialists

Training Technique	Ranking when imposed criterion are considered*	Rankings when all criteria are considered***
On-the-job training	1	1
Job experience training	2	2
Discussion	3	4
Lecture	4	8
Laboratory	5	6
Tests	6	5
Slides and Audio	7	10
Filmstrip and Audio	8	11
Sound Films	9	13
Programmed instruction	10	3
Telephone instruction	11	12
Radio, Tape or Record	12	15
Texts	13	9
Simulators	14	7
Sleep Teaching	15	14
Closed Circuit T.V.	16	16

*Evaluated in terms of nine selection criteria, essentially program-management centered, for example, both theory and motor skills have to be taught.

***Criteria include student-centered as well as program-management criteria.

The DuPont Company's development of programmed instructional materials was reported by Altmaier (1965). One of the first programmed instructional courses developed by DuPont was entitled "Reading Engineering Drawings." Individuals who received the programmed instruction method were compared with those receiving conventional instruction. On the average, those taking the programmed instruction method completed the course in 25 percent less time and scored 13 percent higher on final examinations. On a re-test 18 months after the completion of the course, the programmed instructional group had a score 11 percent higher than those who had received conventional instruction.

Zaner (1966) conducted a study to determine the extent programmed instructional materials were used by public service agencies (Federal, State, and municipal). Questionnaires were sent to 25 public service agencies with a return of 16. The nine who did not respond were queried by telephone. All indicated that they were totally disinterested in programmed instructional materials. Of the 16 who responded, 10 reported no use at all, four reported actual use, and two reported the intention of using programmed materials. The four who were using programmed instruction reported that the material was a helpful supplement to the teaching process, but they were unable to identify specific improvements in training.

McNamara (1963) reported on retraining of industrial personnel whose jobs, because of advancing technology, had become surplus or obsolete. It was found that learning ability did not present a major obstacle but that the educational background of the employees, and particularly their knowledge of mathematics and technical subjects, was a definite limiting

factor. The company selected employees with ability below the companies selection criteria for an experimental group in the computer electronics technician course. From the results of work with this group, it was found that many employees were qualified to learn the course for which they had not previously been considered. Employee acceptance of the opportunity to enroll in the retraining program seemed to be influenced by their interest in the work, confidence in their ability to succeed, and the climate created by management. The number of employees considered not suitable for any type of retraining was estimated to be very small, but that training time, when necessary, should be increased. It was recommended that the employees obtain preparatory training on their own time and that the length of the regular course be extended in time to facilitate the instruction of this lower ability group.

Sandoz (1962) obtained information pertaining to educational activities of 119 Louisiana companies representing more than 74,000 employees. Some of the findings of this study were:

1. Over 23 percent paid wages to the employees for the time they spent participating in in-company training programs.

2. Over 70 percent of the instructional staff were full-time employees who taught and had other duties.

3. Foremen comprised the largest group of employees to study under in-company training programs.

4. Ninety-two companies representing sixty-two thousand employees had tuition refund plans.

5. Over 20 percent of the companies paid 50 percent of the tuition costs.

6. Over 40 percent required a passing grade in the course in order to obtain a refund.

7. More than 63 percent of the companies had employees enrolled in colleges and universities in Louisiana.

Lincoln and Cahill (1966) studied the detection of out of tolerance conditions with meter and digital display systems. The response of detecting out-of-tolerance conditions was faster using the digital display system than it was using meters. The error rates of the two display panels were essentially the same.

Engelbrecht (1966) of the Illinois section American Waterworks Association reported on an evaluation made by an education committee of the training needs of operators in Illinois. The responses on questionnaires indicated:

1. Seventy percent of the operators wanted the courses offered at selected locations throughout the state rather than at a centralized location.

2. Nearly 65 percent of the operators preferred evening courses, with 70 percent of those wanting to attend only one night a week.

3. Operators were willing to travel up to 50 miles to attend the course.

4. Eighty percent of the operators showed interest in correspondence courses.

Current programs of cooperative engineering education in the United States was studied by Jones (1963). One hundred percent of the college coordinators, 94 percent of the engineering faculty members, 90 percent of the industrial coordinators, and 86 percent of the engineering supervisors felt that cooperative engineering education programs had greater long-range value for the students than did conventional programs. Furthermore, 96 percent of the students stated that regardless of financial or other considerations, they prefer the cooperative plan. Factors on which cooperative students were compared with students of conventional curricula were independent study, work habit attitudes, academic achievement, academic ability, class participation, attendance, supervisory

ability, problem solving, technical achievement, and general engineering competence. In every instance, the cooperative students were rated equal to or better than the conventional curricula students.

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