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

ED 012 341 VT 002 936

COMPILATION OF TECHNICAL EDUCATION MATERIALS.

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OHIO STATE UNIV., COLUMBUS, CENTER FOR VOC. EDUC.

PUB DATE 66
EDRS PRICE MF-$0.27 HC-$7.36 184P.

DESCRIPTORS- *RESOURCE MATERIALS, INSTITUTES (TRAINING PROGRAMS), *LEADERSHIP TRAINING, *TECHNICAL EDUCATION, *SUBPROFESSIONALS, CURRICULUM DEVELOPMENT, PROGRAM DEVELOPMENT, EDUCATIONAL FACILITIES, TEACHER AID, EDUCATIONAL RESPONSIBILITY, INSTRUCTIONAL PROGRAMS, EMPLOYMENT TRENDS, BIBLIOGRAPHIES, *INSTRUCTIONAL MATERIALS, COLUMBUS

THE MATERIAL WAS SELECTED AND PREPARED FOR USE IN THE NATIONAL LEADERSHIP DEVELOPMENT INSTITUTES IN TECHNICAL EDUCATION CONDUCTED BY COLORADO STATE UNIVERSITY, OKLAHOMA STATE UNIVERSITY, RUTGERS STATE UNIVERSITY, THE UNIVERSITY OF FLORIDA, AND THE UNIVERSITY OF ILLINOIS AND COORDINATED BY THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT IN VOCATIONAL AND TECHNICAL EDUCATION AT OHIO STATE UNIVERSITY. THE MATERIAL IS GROUPED INTO 12 AREAS RELATING TO THE NEEDS, RESPONSIBILITIES, ORGANIZATION, AND IMPLEMENTATION OF TECHNICAL EDUCATION. ARTICLES ARE INCLUDED ON (1) THE SKILLS, KNOWLEDGE, AND PROFESSIONAL LEVEL OF TECHNICIANS, (2) THE RELATIONSHIP TO OTHER OCCUPATIONAL FIELDS, (3) THE TYPES, CONTENT, AND ENROLLMENT OF PRESENT TRAINING PROGRAMS, AND (4) AVAILABLE EMPLOYMENT. OTHER ARTICLES SHOW THE RESPONSIBILITIES AND ROLES OF GOVERNMENT AGENCIES, STATE DEPARTMENTS OF EDUCATION, LOCAL BOARDS OF EDUCATION, VOCATIONAL EDUCATORS, ADMINISTRATORS, AND OTHERS IN ESTABLISHING QUALITY PROGRAMS. PROBLEMS AND PRINCIPLES OF CURRICULUM DEVELOPMENT ARE PRESENTED. MATERIAL IS PROVIDED ON FACILITIES AND EQUIPMENT, TEACHER QUALIFICATIONS, FINANCING, AND OTHER TOPICS. "TECHNOLOGY-RESOURCE CENTER FOR VOCATIONAL-TECHNICAL EDUCATION," PREPARED BY RUTGERS STATE UNIVERSITY, AND A BIBLIOGRAPHY ON TECHNICAL EDUCATION ARE INCLUDED. THERE ARE TWO SUPPLEMENTARY VOLUMES (VT 002 930 AND VT 002 938). (HC)

ED012341

COMPILATION OF TECHNICAL EDUCATION MATERIALS

Prepared for the

National Leadership Development Institutes

in

Technical Education

Conducted by

COLORADO STATE UNIVERSITY
OKLAHOMA STATE UNIVERSITY
RUTGERS - THE STATE UNIVERSITY
UNIVERSITY OF FLORIDA
UNIVERSITY OF ILLINOIS

These institutes are a cooperative effort of the five universities coordinated by THE CENTER FOR RESEARCH AND LEADERSHIP DEVELOPMENT IN VOCATIONAL AND TECHNICAL EDUCATION, The Ohio State University, Columbus, Ohio. This work was performed pursuant to a grant from the U. S. Office of Education, Department of Health, Education, and Welfare.

VT 02936

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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ACKNOWLEDGMENT

We wish to acknowledge the efforts of Dr. Lynn Emerson, Professor Emeritus of Cornell University, who has served this project as consultant for instructional materials development. Dr. Emerson selected and/or prepared most of the original materials which have been duplicated for this compilation.

We also wish to acknowledge the cooperation and assistance provided by the following members of the Department of Vocational and Technical Education, Rutgers - The State University. For permitting members of his staff to serve as project consultants, we wish to thank Dr. Carl J. Schaefer, Chairman. For coordinating the instructional materials development, we are grateful to Dr. Milton E. Larson, Adviser for Technical Education. For supervision of the composition and duplication processes, we are indebted to Mr. Benjamin Shapiro, Director, Curriculum Laboratory.

Robert E. Taylor, Director
The Center for Research and
Leadership Development in
Vocational and Technical Education

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and Project Director for the
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Institutes in Technical Education

I. THE TECHNICIAN

INTRODUCTION

The training of technicians is now emerging as an important phase of public education. For many years we have had programs for the training of engineers and of skilled craftsmen. The technician--whose work resembles that of the engineer on the one hand and that of the skilled craftsman on the other--has received relatively little attention in the public educational systems. Rapid advances in technology are forcing the development of technician training.

This pamphlet attempts to provide a brief description of the technician, his place in industry, and his training. It should be useful to the educational administrator in providing a broad overview; to the counselor in giving some information about a relatively new field; and to the potential student--male and female--who needs help in selecting the field of work which he desires to enter.

OCCUPATIONAL CHANGE IN INDUSTRY

More technological change in past ten years than in many previous decades.

Automation is now entrenched in American industry.

Computers are at work in hundreds of installations.

Jet aircraft circle the globe.

Atomic energy is furnishing power for ships and for industry.

More than 100 man-made satellites are now in orbit.

Transistors operate our radio receivers, and control satellites.

Electronic equipment controls our machines and tools.

Man has encircled the earth in a satellite.

The need for technical knowledge and skill far beyond that of the years just past is placing new burdens on our industrial and technical schools.

CHANGES IN OCCUPATIONS

CAUSED BY:

NEW SCIENTIFIC DISCOVERIES
NEW SOURCES OF ENERGY
NEW MATERIALS AND PRODUCTS
NEW PROCESSES
INCREASED PRECISION
INCREASED MECHANIZATION (Automation)
COMPLEXITY OF MACHINES & INSTRUMENTS
HIGHER LIVING STANDARDS

INDUSTRY NEEDS VARIOUS TYPES OF WORKERS

Industry needs engineers, technicians, skilled craftsmen, skilled operators.

All these occupations require manipulative skills and technical skills.

Some require much more technical skill than do others.

The engineer's work is largely technical in nature; he needs litte manipulative skill.

The technician needs some manipulative skill, but more than half of his total effort deals with technical skill - the ability to utilize technical knowledge in practical situations.

The skilled craftsman needs considerable technical skill but most of his effort is expended in manipulative effort.

The semiskilled worker uses mostly manipulative effort, and his technical skills are quite limited.

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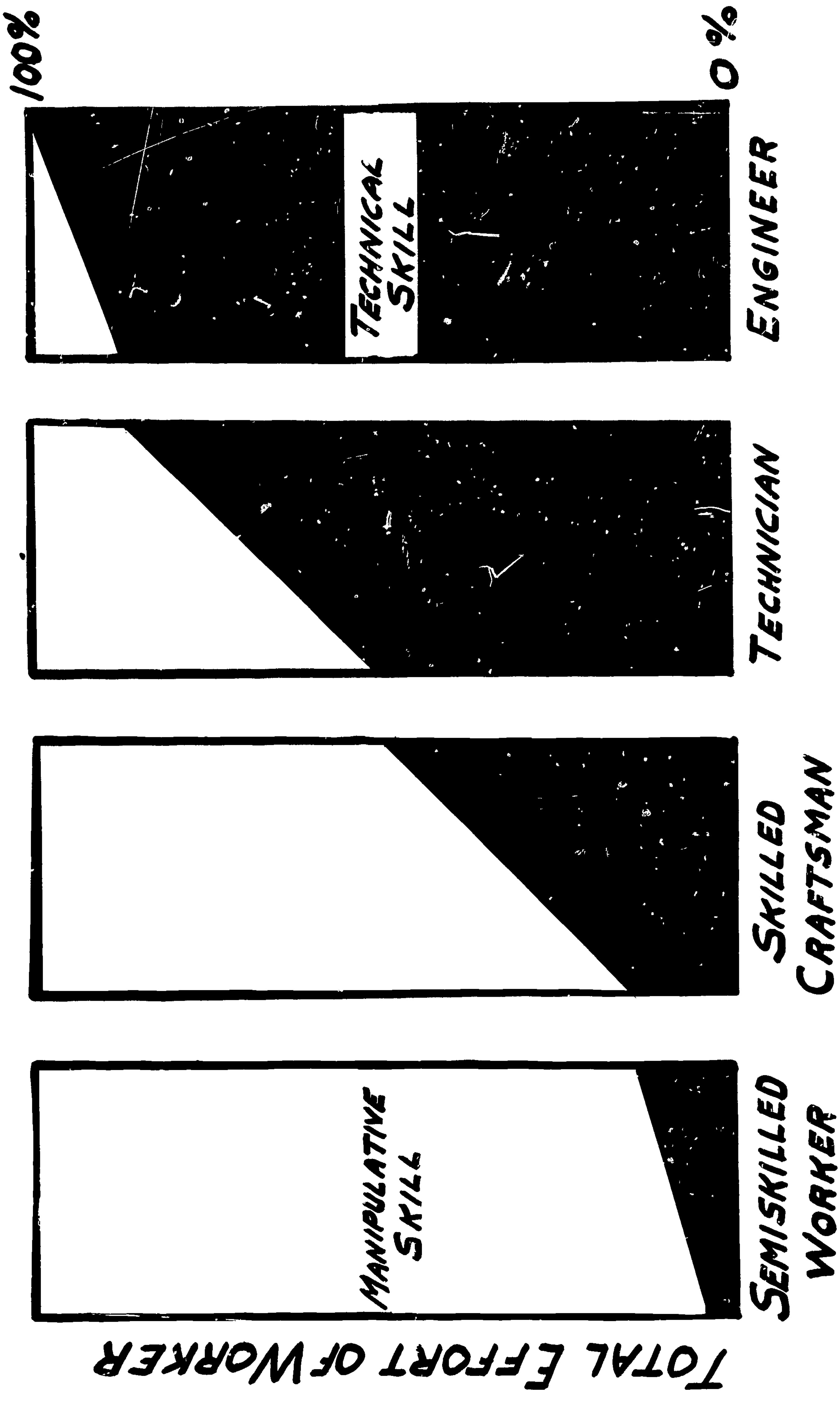
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TECHNICAL SKILL
ENGINEER
TECHNICIAN
SKILLED CRAFTSMAN
MANIPULATIVE SKILL
SEMISKILLED WORKER
TOTAL EFFORT OF WORKER

TECHNICAL OCCUPATIONS BELOW THE PROFESSIONAL LEVEL DIFFER IN THE SCOPE AND LEVEL OF ABILITY NEEDED

Some occupations, although technical in nature, have a narrow scope or range of content, and a low level of ability needed. Such occupations might include some types of inspection or of routine testing.

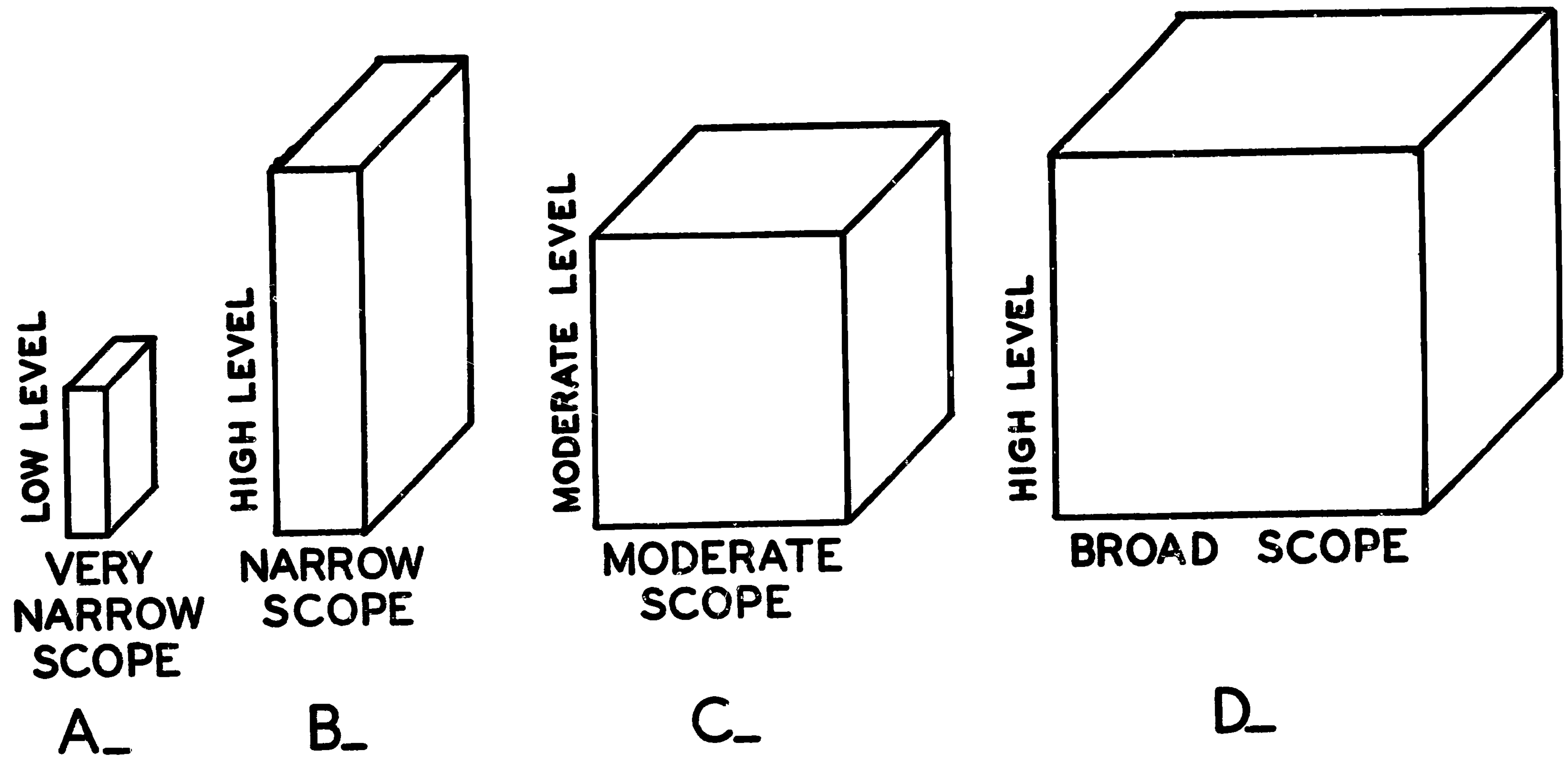
Some technical occupations have a relatively narrow scope but require a high level of technical skill. These would include radio/TV servicing, or jobs such as inspection of a limited range of technical equipment. Such occupations might be classified as <u>technical specialists</u>.

Technical occupations which involve a moderate scope and moderate level of ability are sometimes classified as <u>industrial technicians</u>, and include such jobs as time-study man or quality control technician.

The highest level of technician occupations - with a broad scope of activity and a high level of ability - are usually classified as <u>engineering technicians</u>. Workers in these occupations assist engineers and scientists, or work independently in a comprehensive field of technical activity.

Training for technical specialist occupations may be obtained in one year or so of appropriate technician training, in full-time study.

Training for engineering technician occupations requires the equivalent of two years of full-time intensive training.



A. Low-level narrow-scope technical occupation, not classified in the technician group.
B. Technical Specialist)
C. Industrial Technician) May be classified as technician occupations.
D. Engineering Technician)

TYPES OF TECHNICAL OCCUPATIONS BELOW THE PROFESSIONAL LEVEL

TECHNICIAN ACTIVITIES CUT ACROSS MANY FIELDS OF INDUSTRIAL LIFE

THE TECHNICIAN:

Assists the scientist in his research concerning new products.

Helps the engineer in designing the product, through detailed calculations and details of design.

Assists the engineer in making up models and prototypes, testing them in the laboratory and in the field.

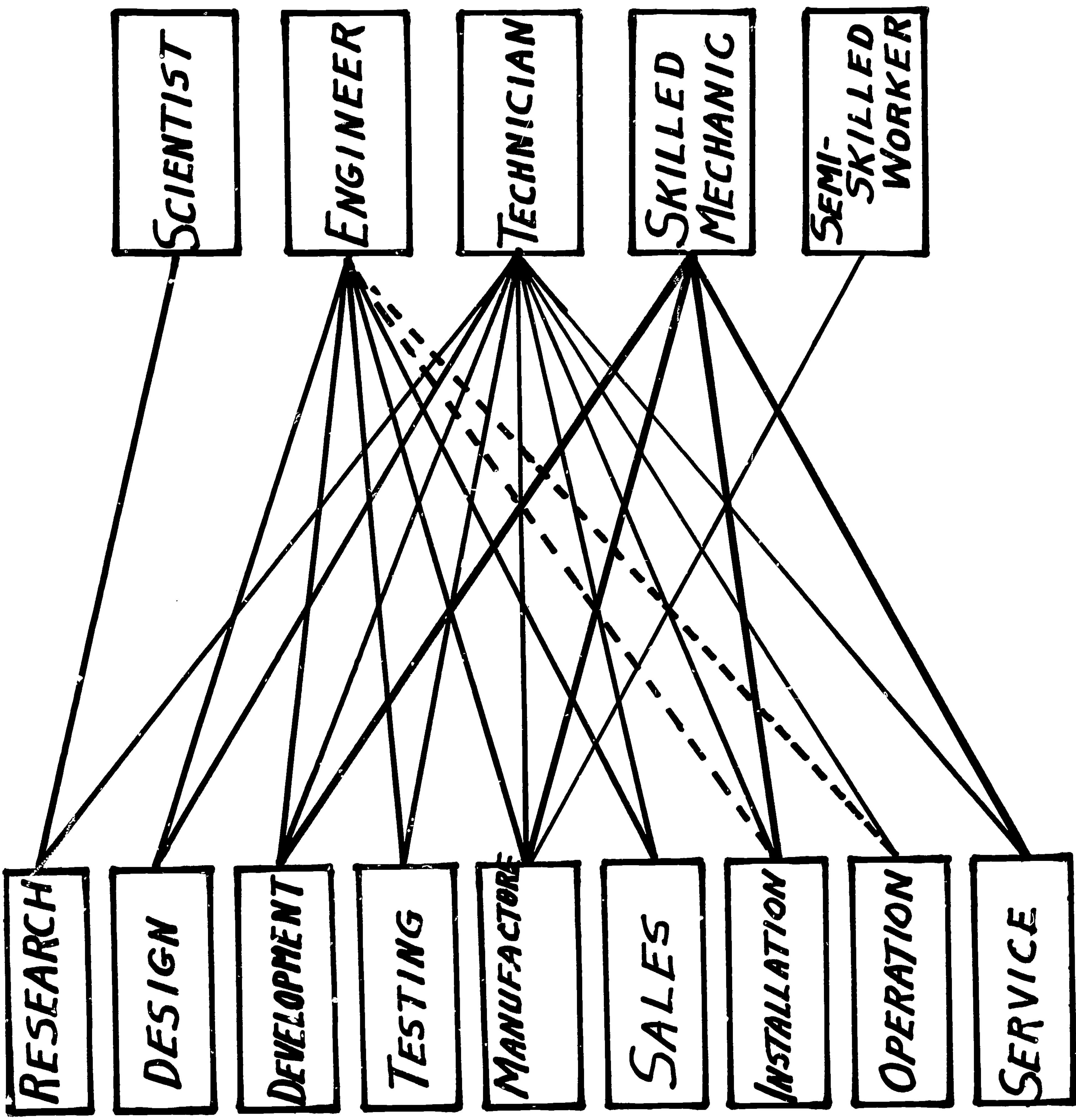
Helps plan the production processes, and carries on or supervises these production processes.

Sells highly technical equipment, assisting the customer in determining equipment appropriate to his needs.

Supervises the installation of technical equipment, making necessary adjustments to get the equipment into satisfactory working condition after installation.

Operates complicated technical equipment, such as a power station or an automated unit of a manufacturing plant.

Services complicated technical equipment, or supervises such maintenance work.


SCIENTIST
ENGINEER
TECHNICIAN
SKILLED MECHANIC
SEMI-SKILLED WORKER
RESEARCH
DESIGN
DEVELOPMENT
TESTING
MANUFACTORE
SALES
INSTALLATION
OPERATION
SERVICE

TECHNICIAN ACTIVITIES HAVE MANY FACETS

In Research and Development the technician:
- serves as a scientific or engineering aide
- works as a programmer with data-processing equipment
- sets up and tests materials and equipment in the laboratory
- makes sketches and drawings
- performs various calculations

In the field of Design the technician:
- does detailed designing under the direction of the engineer
- designs jigs, fixtures and other tools
- makes equipment and other layouts
- makes drawings of various sorts

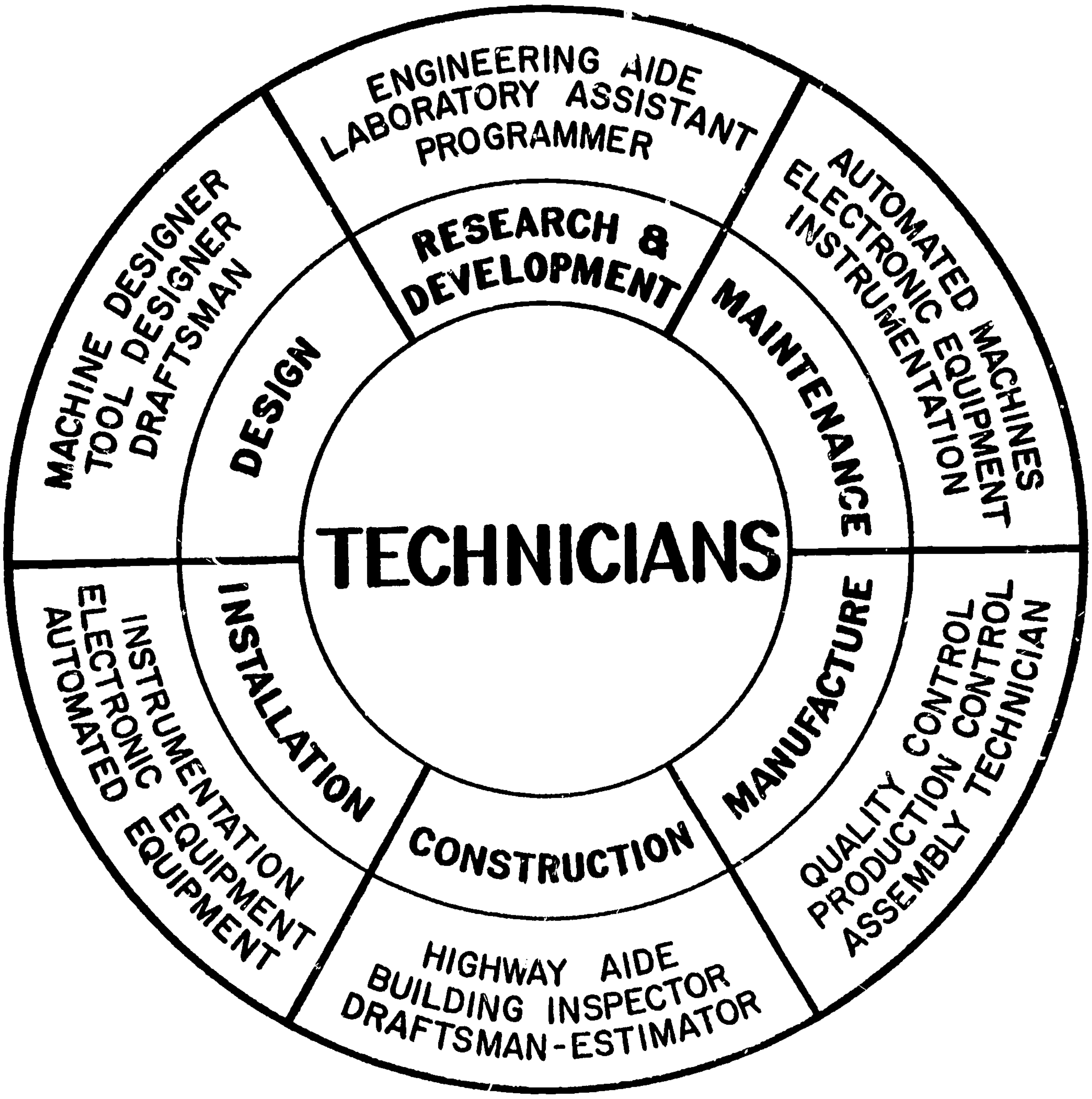
In the Installation field the technician:
- supervises the installation of automated machines
- inspects the installation of instruments and miscellaneous electronic equipment
- supervises installation of power wiring circuits

In the Construction field the technician:
- estimates building costs
- surveys building sites or highways
- draws architectural plans and specifications
- supervises construction activities

In the Manufacturing field the technician:
- assists in planning production layouts
- supervises quality control processes
- lays out and supervises assembly processes
- makes time and motion studies

In the Maintenance field the technician:
- services complicated technical equipment
- supervises such maintenance

THE TECHNICIAN



IN INDUSTRY

SOME OCCUPATIONAL FIELDS AND TECHNICIAN JOBS

SKILLED CRAFTS AND TECHNICIAN JOBS IN THE CONSTRUCTION FIELD

Construction projects are carried out mainly through the efforts of skilled craftsmen and other skilled workers. Buildings take shape through the work of carpenters, bricklayers, concrete workers, tilesetters, plumbers, painters, electricians, and many others.

But the work of construction cannot go on without building plans, cost estimates, inspection and supervision of the work. These are the tasks of the technician. In highway work surveying needs to be done, topographical maps prepared, materials tested, and the work supervised and inspected. This is done by technicians.

THE NORTH CAROLINA MANPOWER SURVEY SHOWS GREAT NEEDS FOR BOTH SKILLED CRAFTSMEN AND TECHNICIANS IN THE CONSTRUCTION FIELD.

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TECHNICIAN JOBS IN CONSTRUCTION

SKILLED CRAFTS	CONSTRUCTION TYPES	TECHNICIANS
BRICKLAYER	HOUSES	ARCH. DRAFTSMAN
STONEMASON	STORES	STRUCTURAL DRAFT.
TILESETTER	SMALL FACTORIES	TOPOGRAPHICAL DRAFT.
CEMENT MASON	LARGE FACTORIES	ESTIMATOR
PLASTERER	OFFICE BUILDINGS	BLDG INSPECTOR
ROOFER	HIGHWAYS	EQUIPMENT SALES
LATHER	RAILROADS	AIR CONDITIONING T.
CARPENTER	BRIDGES	CONSTRUCTION SPVR
FLOORLAYER	SEWER SYSTEMS	MATERIALS MAN
PAINTER	WATER SUPPLY	HIGHWAY ENGINEERING AIDE
PAPERHANGER	POWER PLANTS	SURVEYOR
PLUMBER	AIR FIELDS	EXPEDITER
STEAMFITTER	HOSPITALS	SPECIFICATION WRITER
SHEETMETAL WORKER	SCHOOLS	TECHNICAL EQUIPMENT INSTALLER
STRUCTURAL STEEL WORKER	CHURCHES	ETC.
WELDER	ETC.	
ELECTRICIAN		
ETC.		

TYPICAL FIELDS OF TECHNICIAN TRAINING

Training programs for engineering technicians are aimed at the training of persons for groups or "clusters" of technician occupations which are distinct in themselves yet have many characteristics in common. Thus a cluster of occupations in the field of electronic technology might include radio/TV transmission, radar, electronic equipment testing, industrial electronics, and others.

To provide adequate training for such a cluster of occupations requires a comprehensive curriculum which takes two years of intensive full-time study (or equivalent time in part-time study). The curriculum includes the technology of the field, basic and applied mathematics, science and drawing, and some general education courses. Such a program requires students with good ability and aptitude in these various subjects.

Typical curriculums found in technical schools in various parts of the country are shown in the chart.

FIELDS OF TECHNICIAN TRAINING

AIR CONDITIONING TECH.	INDUSTRIAL SUPERVISION
AVIATION TECHNOLOGY	INDUSTRIAL TECHNOLOGY
BUILDING TECHNOLOGY	INSPECTION TECHNOLOGY
CHEMICAL TECHNOLOGY	INSTRUMENTATION TECH.
CIVIL TECHNOLOGY	MECHANICAL TECH.
COMPUTER TECHNOLOGY	METALLURGICAL TECH.
DIESEL TECHNOLOGY	OPTICAL TECHNOLOGY
DESIGN TECHNOLOGY	PETROLEUM TECH.
ELECTRICAL TECH.	PHOTOGRAPHIC TECH.
ELECTRONIC TECH.	PLASTICS TECHNOLOGY
FIRE PROTECTION TECH.	TECHNICAL ILLUSTRATION
GAS & FUEL TECH.	TECHNICAL SALES
INDUSTRIAL LABORATORY T.	TOOL TECHNOLOGY

HOW TECHNICIANS GET THEIR TRAINING

Technicians get their training in many different ways:

Many of them have learned on the job, supplementing their work experience with self study, correspondence courses, and evening classes.

Many present technicians have come from the ranks of the skilled craftsman, and have acquired their technical competency through various types of study.

In certain fields, such as electronics, many technicians have been trained in schools operated by the Armed Forces.

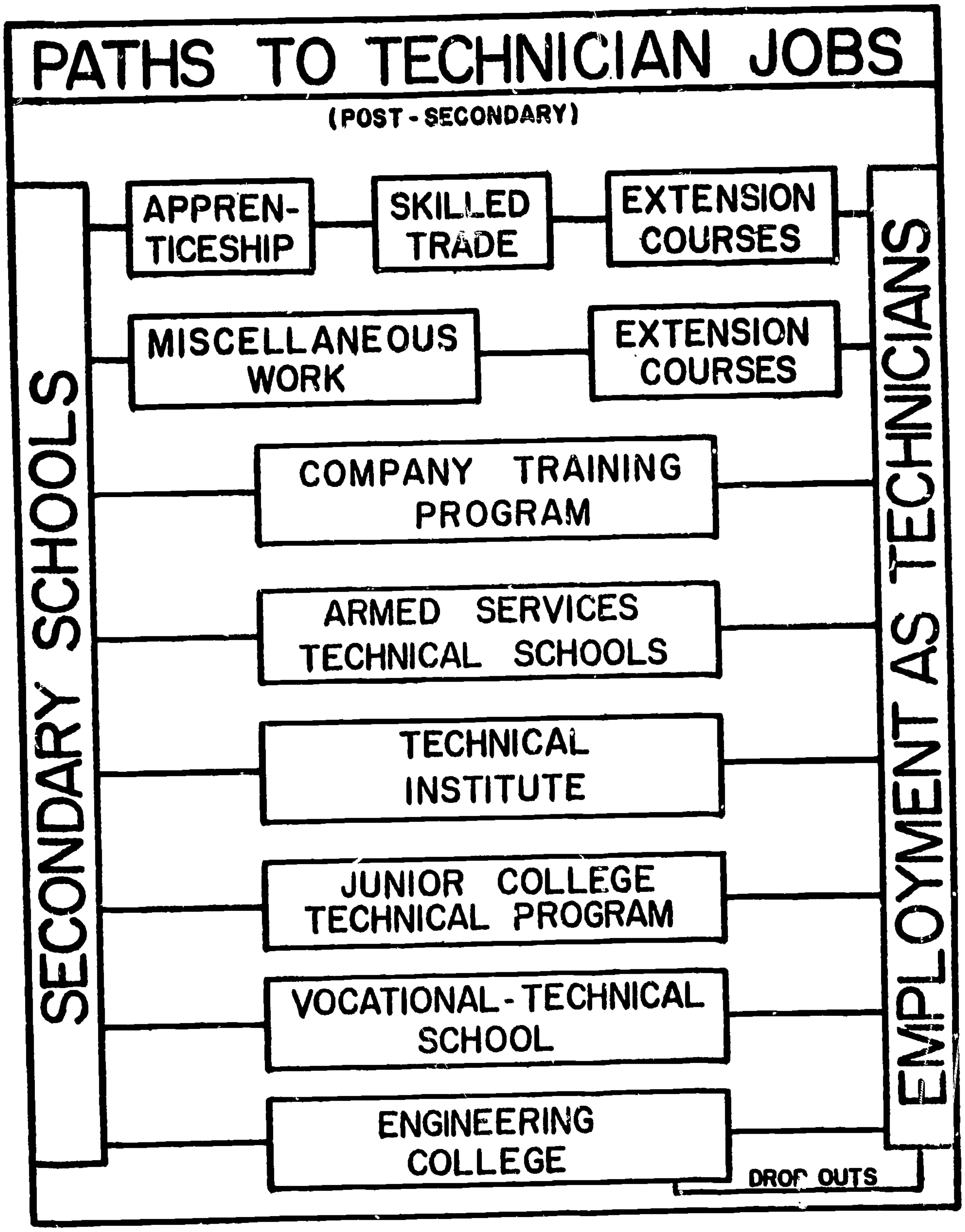
Some have started engineering courses and dropped out, getting into technician work.

Many with engineering degrees now occupy technician positions, on their way to engineering work, or as permanent jobs.

Increasing numbers are now coming from the programs specifically designed for technician training, found in technical institutes, junior/community colleges, vocational-technical schools.

Many technicians will continue to come from workers in industry who attend evening and other part-time technical courses. (THIS EMPHASIZES THE GREAT NEED FOR PART-TIME COURSES FOR EMPLOYED WORKERS.)

To meet the demands of industry for technicians will require many more than can be trained through part-time courses. (THIS INDICATES THE NEED FOR FULL-TIME TRAINING PROGRAMS IN MANY OCCUPATIONAL FIELDS.)



HOW TECHNICIANS GET THEIR TRAINING

TASKS PERFORMED BY TECHNICIANS

The kinds of technical ability found in the various technician jobs are of great variety:

Some jobs emphasize analysis and diagnosis.

Some require visualization of drawings, or a flair for creative design.

Some demand a high degree of applied mathematical ability.

Many require solid background of basic physics and its application to industrial procedures.

Some require a background of experience in the skilled crafts; others require good understanding of the crafts.

Most of them require precise methods of work - in measurement, adjustment of instruments, and the like.

Some require sales ability, or cost accounting ability.

Some require extensive understanding of industrial equipment and industrial processes.

Sometimes the job involves supervisory responsibility, and combines technological understanding with skill in dealing with people.

Some technician jobs require proficiency in the use of hand tools.

Many of them require the ability to prepare written reports.

No single technician job requires all of the abilities shown here and in the chart. A well-prepared curriculum for training technicians for a specific field will provide for the needs of that field.

TECHNICIAN TASKS

Inspecting	Writing reports
Measuring	Using handbooks
Computing	Trouble shooting
Testing	Expediting
Analyzing	Controlling production
Diagnosing	Making experimental equipment
Interpreting	
Liaison	Supervising technical operations
Using instruments	
Using hand tools	Maintaining automated

Using hand tools	Maintaining automated equipment
Making drawings	Operating technical installations
Sketching	
Detail designing	Selling technical products
Recording data	
	ETC.

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SKILLED CRAFTS AND TECHNICIAN JOBS IN METAL PRODUCTS MANUFACTURE

Some persons find it difficult to differentiate between skilled crafts and technician occupations. The chart for metal products manufacturing shows some of the jobs in each group. Study of the jobs listed will reveal that the technician jobs require much more technical knowledge and skill than do the skilled crafts jobs.

This is reflected in the kind of training program needed to prepare persons for these jobs, with the technician training requiring much more science, mathematics, and technology.

For some of the technician jobs shown in the chart the technician is much more valuable if he has had appropriate experience in the craft allied to his job. For example, a tool designer or tool inspector profits greatly from previous experience as a toolmaker. And the draftsman who has had machinist experience is frequently desired.

The metal products manufacturing field lends itself well to extension courses as well as preemployment training.

METAL PRODUCTS MANUFACTURING

SKILLED CRAFTS	TECHNICIANS
Toolmaker	Tool designer
Machinist	Draftsman
Moulder	Tool inspector
Steamfitter	Time-Motion-studyman
Plumber	Assembly technician
Electrician	Expediter
Millwright	Automated machine maint.
Patternmaker etc	Technical supervisor etc.

COMPARISON OF SKILLED CRAFTS AND TECHNICIAN TRAINING

Training for the skilled crafts differs in certain important respects from that for the technician occupations.

Main goal of the training program:

Skilled crafts - a single craft (such as carpentry, or machine shop practice)

Technician - a group or cluster of closely related occupations (such as various types of electronics jobs)

Type of skill desired:

Skilled crafts - largely manipulative skills, with such technology as is directly related to the craft. (Such as mathematics for machinists, in machine shop training)

Technician - largely technical skills, with considerable breadth in basic and applied technology of the field, basic and applied science, etc.

Nature of the training program:

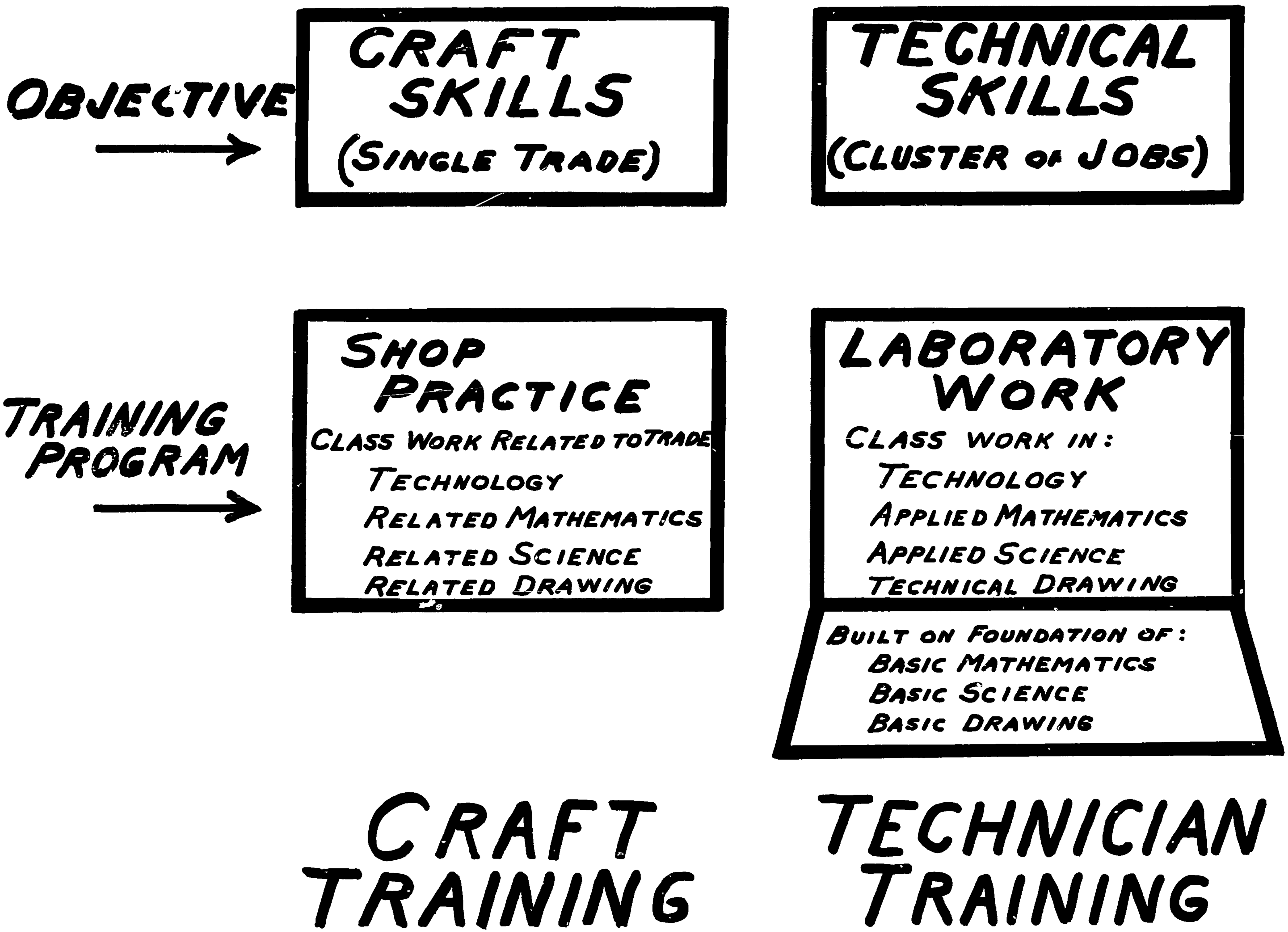
Skilled crafts - largely shop activities, with some related classroom instruction.

Technician - largely laboratory and classroom work, for developing understanding of principles and technical applications of the principles. Instruction is based on a foundation of appropriate mathematics and science.

Type of student required:

Skilled crafts - average or slightly below in academic ability, with aptitude for skilled crafts work.

Technician - somewhat above average in academic ability, with aptitude in the technical field.



COMPARISON OF TRAINING PROGRAMS FOR THE SKILLED CRAFTS AND TECHNICIAN OCCUPATIONS

COMPARISON OF TRAINING PROGRAMS FOR ENGINEERS AND TECHNICIANS

The training needed by the engineer covers a scope much wider than that for the technician. Typical engineering training programs are four years in length. A logical pattern for the engineering curriculum is to devote the first two years to basic mathematics, science, and drawing, together with a small amount of technology.

In contrast, the logical pattern for the technician is to get into the technology to some extent as early as is practicable, for the total program is usually only two years in length.

The chart compares the first two years of the engineering program with that of a technician program. It is evident that they are quite different.

The educational institution - usually a junior college - which offers the first two years of engineering training and also offers a program for the training of technicians is often tempted to utilize certain courses of instruction in both curriculums. A good program for the training of technicians is quite different from that for engineering, and the institution which attempts to merge the programs usually fails to attain its training objectives.

TRAINING PROGRAMS FOR TECHNICIANS NEED TO BE DESIGNED FOR THAT PURPOSE AND NOT PATTERNED DIRECTLY AFTER ENGINEERING TRAINING OR SKILLED CRAFTS TRAINING. THE OBJECTIVES ARE DIFFERENT AND THE TRAINING PROGRAMS NEED TO BE DIFFERENT.

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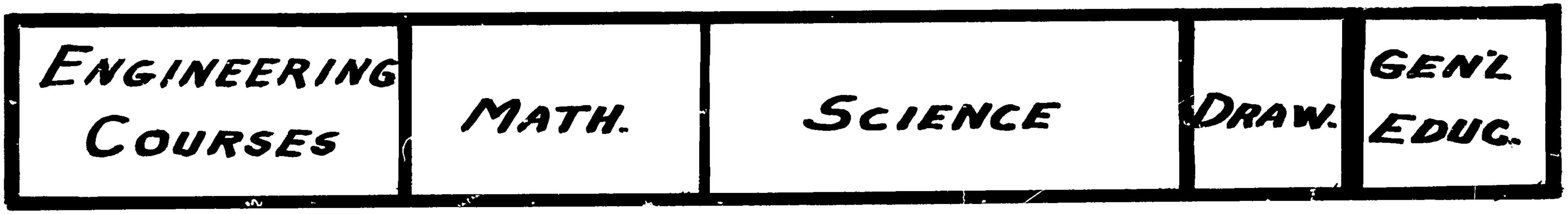
Junior College Curriculums

Technician Training - Mechanical Technology



Engineering Training - Mechanical Engineering
First Two Years

Sample Curriculums from same Junior College

INSTITUTIONAL PATTERNS FOR TECHNICIAN TRAINING

Different States and different institutions provide their technician training with differing institutional patterns.

> Some schools offer only technician training in a single field, such as certain private technical institutes.
>
> Some offer only technician training but in several different fields.
>
> Some schools combine agricultural and industrial technician training, with separate divisions in the same school.
>
> Some schools provide training in the skilled crafts and also in technician fields.
>
> Occasionally one finds a junior college limiting its work largely to skilled crafts and technician training.
>
> Sometimes the technician training is in a technical institute division of a community college, or a technical institute division of an engineering college or a university, with the program offered on the same campus or on a separate campus.
>
> In some cases a junior college and a high school share facilities for technician training.
>
> A few high schools offer technician training either in a separate technical high school or in a technical division of a comprehensive high school.

The pattern used is influenced greatly by the extent of the junior college movement in the State, the philosophy of the State-wide junior college personnel, the extent to which skilled crafts training is offered in the junior college, and the development of the "area vocational school" idea.

SOME POST-HIGH SCHOOL INSTITUTIONAL PATTERNS FOR TECHNICIAN TRAINING

MONOTECHNIC INSTITUTE	ACADEMY OF AERONAUTICS
POLYTECHNIC INSTITUTE	OREGON TECHNICAL INSTITUTE
AGRICULTURAL & TECHNICAL INSTITUTE	NEW YORK STATE AGRICULTURAL AND TECHNICAL INSTITUTE
TECHNICAL INSTITUTE & TRADES SCHOOL	MILWAUKEE INST. OF TECHNOLOGY BURLINGTON INDUST. EDUC. CENTER
TRADE & TECHNICAL JUNIOR COLLEGE	LOS ANGELES TRADE-TECHNICAL JUNIOR COLLEGE
TECHNICAL INSTITUTE DIVISION OF COMMUNITY COLLEGE	ORANGE COAST COLLEGE
TECHNICAL INSTITUTE DIVISION OF ENGINEERING COLLEGE	SOUTHERN TECHNICAL INSTITUTE (GEORGIA INST. OF TECHNOLOGY)
TECHNICAL INSTITUTE DIVISION OF UNIVERSITY	OKLAHOMA STATE UNIVERSITY PENNSYLVANIA STATE UNIVERSITY

ESTIMATED EMPLOYMENT OF ENGINEERING & SCIENCE TECHNICIANS IN THE UNITED STATES BY OCCUPATIONS

Occupations	Number	Percent
Draftsmen	220,800	26.9
Engineering technicians	298,800	36.1
Chemical technicians	64,000	7.7
Physics technicians	11,000	1.3
Mathematical technicians	5,500	.7
Other physical science technicians	47,100	5.7
Life science technicians	58,600	7.1
Other technicians	120,600	14.6
Total all technicians	828,400	100.0

Source: Technical Manpower - Bureau of Labor Statistics - 1965 (manuscript)

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II. LEADERSHIP ROLE

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Office of Education
Division of Vocational and Technical Education
Washington, D.C. 20202

THE FEDERAL GOVERNMENT'S ROLE IN THE TRAINING OF TECHNICIANS

by

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

An address prepared for the convention of the Industrial Research Institute at Boca Raton, Florida, May 3, 1965

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THE FEDERAL GOVERNMENT'S ROLE IN THE

TRAINING OF TECHNICIANS

The role of the Federal Government in educating highly skilled technicians is to promote and assist in the establishment of high quality programs in all of the States, wherever there is a labor force need for trained personnel or where there are persons who can profit from such specialized occupational education.

Technicians are persons who have the scientific knowledge and competencies in some recognized branch of science to support the work of professional scientists or engineers. They are usually educated in rigorous 2-year post secondary education programs designed to provide them with knowledge, skills, and attitudes required to enable them to perform as highly skilled technicians.

There are many kinds of technicians, just as there are many kinds of professional scientists. Many are employed in the physical sciences and related engineering fields. Examples are chemical, metallurgical, mechanical design or production, civil, electrical and electronics, and architectural technicians. Many others are skilled in the applied life sciences--particularly in the medical field and in the broad spectrums of agricultural research, processing, and utilization.

Examples of life science technicians are medical laboratory, dental hygiene, dental laboratory, radiological, agronomy, horticultural, food processing, oceanographic, animal science, soil science, agricultural production equipment, and forestry or specialized plant science technicians. Some combine life science and physical science disciplines--such as sanitation, pharmaceutical, or special clinical or hospital equipment technicians.

The objective of preparatory programs for educating technicians is to provide a broadly based competency in the field of sufficient depth that the graduate technician may be employed in one of a cluster of related work opportunities in his field. Upon employment, a brief period of orientation to his particular duties in the employer's organization, together with continued on-the-job study, permit him to advance rapidly to high levels of productivity and increased responsibility.

Education programs to prepare technicians for their work as assistants to scientists must provide them with an understanding of the basic principles of their field of science, and of the related science and mathematics which support their main field. They must also absorb a comprehensive knowledge of the procedures, materials, devices, techniques, equipment, and processes used in that scientific field and learn facility in the use of them. They must develop the ability to communicate with the professional scientists or engineers with and for whom they work.

The technician must learn to employ the mode of thinking and intellectual discipline embodied in the scientific method, the ability to seek and find pertinent information, and the capability to work with both the scientist and the skilled workman or other aides to accomplish a variety of work assignments.

Programs for educating technicians are characterized by intensive classroom and laboratory learning. About 50% of the curriculum is the study of science in classroom and laboratory work. A planned sequence of courses emphasizes scientific principles and provides practice with procedures, processes, materials, apparatus, equipment, and skills as they are currently used.

Mathematics, as required, is taught early in the technical program to obtain maximum utilization of its support of the study of the applied science. Communication skills and reporting are taught and practiced; and an elementary study of economics, organizations, and human relations provide a frame of reference to the student technician as a member of society and as an employee of a working organization.

Several types of schools offer technical and related vocational education. Of these, the greatest growth has been in junior colleges, community colleges, technical institutes, and area vocational and technical schools. Technical and comprehensive high schools also offer such programs; and their orientation toward the needs of technical and related vocational education is of great importance since they prepare students to enter technical education programs either in high school or upon graduation from high school.

The need for educating highly skilled technicians was first recognized and implemented by Federal legislation with the passage of Title VIII of the National Defense Education Act of 1958. Under this Act the U.S. Office of Education was directed by Congress to administer grants of funds to the States to be matched by the States dollar for dollar, to train highly skilled technicians "necessary for national defense."

A heading was inserted into the Act which read: "Area Vocational Education Programs." The language below that heading amended the Vocational Education Act of 1946 (which we know as the George-Barden Act) to add a new title (Title III)--and it reads as follows: to authorize". . . grants to States to assist them in training individuals for employment as highly-skilled technicians in occupations requiring scientific knowledge in fields necessary for the national defense."

The Act provided Federal funds beginning with $3.75 million in 1959 and growing to $15 million in 1963 and 1964 for the purchase of laboratory equipment, for teacher salaries, and for providing materials and other services for programs for technical education.

There were several reasons for the enactment by Congress of Title VIII of the NDEA.

-First of all, the highly skilled technician was becoming an increasingly essential part of the scientific and management team in modern scientific research, development, production, and services. The team is composed of professional scientists, engineers, specially trained technicians, supervisors, and skilled production or laboratory workers.

-A second reason: technicians are in short supply. The ratio of technicians to scientists or engineers at present is usually less than 1 to 1, but there is need for 2 or more technicians to support each engineer or professional scientist. For many years the number of new technicians formally prepared to work with physical scientists and engineers had been limited to about 16,000 graduates of a relatively few publicly supported institutions and a number of private, nonprofit technical institutes. Studies of the physical sciences and related engineering fields indicate a need for at least 100,000 new technicians each year. These figures show that a considerable effort to educate more technicians was needed to meet the Nation's need for accelerated research, development, and productive effort.

-A third factor contributed to the passage of Title VIII. The explosion of scientific knowledge was creating changes in scientific education so that the professional scientist or engineer received little laboratory experience. He functioned more as a theoretical scientist than he had in the past. Thus, a vacuum was developing in the area of applied laboratory knowledge which had to be filled by highly skilled technicians.

Since the passage of NDEA, enrollment of full-time students in technical education programs, most of them post high school, grew from fewer than 20,000 in 1958 to more than 90,000 in 1964. In 1958, some 260 schools provided education of this type for highly skilled technicians under Title VIII, and the number had grown to nearly 800 by 1964. Many of the new schools have been built primarily to train technicians and other skilled personnel.

Federal funds expended for technical education programs from the beginning of the program in 1959 through fiscal year 1964 total $54,704,605. Added to this figure are the States' matching contributions of $30,162,487 and local expenditures of $46,429,204, making a grant total of $131,314,296.

In fiscal year 1964, a total of 221,241 students were enrolled in 881 institutions offering technical training. This is an increase of 236% since the inception of the program.

The largest number of enrollments are found in extension courses especially designed to upgrade the skills of employed adult technical workers. More than 128,000 persons took advantage of such courses in fiscal year 1964.

Some 72,000 student technicians were enrolled in 2-year post secondary programs and more than 20,000 in secondary programs during fiscal year 1964.

The 16,000 or so technicians who have been graduated each year for the past decade, are the product of about 60 to 70 private, nonprofit or proprietary technical institutes and public State or locally supported technical institutes. A few are divisions of 4-year colleges or universities. Some of these institutions are expanding their programs, particularly the public technical institutes in New York State which have been in operation for 20 to 40 years.

The excellence of the programs in these established and successful institutions provide a reservoir of experience and success which proves the practicability of establishing programs to educate technicians. These programs provide examples of what good technicians are, and also provide patterns for establishing and advertising good technical education programs.

The leadership of the group of educators in these institutions has been a major element in establishing high quality standards for such programs. They have become an active division of the American Society for Engineering Education. In 1962, it published the results of a comprehensive nationwide study of technical institute education entitled "Characteristics of Excellence in Engineering Technology Education." It is a major contribution to the literature in the field.

The Engineers' Council for Professional Development, which accredits professional engineering education, also accredits technical education programs within engineering-related technologies. In 1964 there were 127 accredited curriculums in this field in 33 institutions throughout the United States.

In recognition of the growing importance of this type of education, Congress, in the Vocational Education Act of 1963, made permanent the provisons of Title VIII of the National Defense Education Act for training highly skilled technicians. The new Vocational Act also provides substantially increased funds to meet the vocational and technical education needs of greater numbers of people of all ages in all communities.

Funds under the Act of 1963 may be used for construction of facilities, as well as for teacher salaries, libraries, laboratories and equipment, and needed materials and services for educating technicians. The 1963 Act requires a dollar-for-dollar matching of Federal funds with State and/or local funds. Technicians of all kinds may be educated--both those in the physical sciences and related engineering fields, and those in the life sciences, especially those needed for the medical and health fields and for agricultural occupations.

Research funds for vocational and technical education were, for the first time, authorized by the Congress in the Vocational Education Act of 1963. Ten percent of all funds appropriated under the Act are designated to be used for research, demonstration and experimental projects in the field. The funds are substantial: $11.85 million in fiscal year 1965, $17.75 million in 1966, and $22.5 million for every year thereafter.

These funds are used for grants by the U. S. Commissioner to colleges and universities, and other public or nonprofit private agencies and institutions, to State boards, and with the approval of the appropriate State board, to local educational agencies, to pay part of the cost of research and training programs and of experimental, developmental, or pilot programs developed by such institutions, boards, or agencies, and designed to meet the special vocational education needs of youths, particularly those with academic, socioeconomic, or other handicaps. Thus, the value to be gained from organized research, so amply demonstrated by groups such as yours, now is directed by the Congress to be used to improve vocational-technical education.

Among the key ways in which the new research and planning program in vocational education can be of great assistance to technical training are these:

- It can help to define some of the emerging technologies, identify probable future ones and make meaningful estimates of the number of technicians needed in such fields.

- It can help develop better and more efficient ways to prepare technicians through advances in methods of teacher training, ways to provide more pertinent laboratory experience, better use of visual and audio teaching aids, and the development and perfection of the applied use of programmed learning techniques.

- It can help to develop more useful curriculum and other instructional materials.

- It can help plan and design facilities for the teaching of technicians.

In addition, the research programs now being Federally supported in the occupational field should be of special benefit in setting up pilot and demonstration projects in training for the new technologies. We certainly hope that the occupational research program will achieve a breakthrough in the badly needed new methods and programs for the education of teachers of technicians.

Funds may also be used under Section 4(c) of the Vocational Education Act of 1963 (the research section) to provide for teacher institutes as a means of preparing or upgrading teachers in these special fields.

An excellent example of what can be done with such institutes is provided by an experience of two years ago when a critical shortage of teachers of electronic data processing was identified by the U.S. Office of Education in States from one coast to the other. As a result, cooperation was obtained from five State boards and five institutions to set up special teacher institutes during the summer of 1963.

From these institutes came about 100 teachers of computer programming and business application analysis, easing a demand so heavy that State and local educators throughout the country had decided to abandon any idea of waiting for the usual teacher education programs to produce these specialized instructors.

In addition to the Acts discussed above, Congress enacted the Higher Education Facilities Act of 1963, authorizing $1.2 billion for construction of facilities for public and nonprofit private colleges. Of these funds, 22% are earmarked for construction of facilities for public community colleges and public technical institutes which meet the requirements specified by the Act. These latter institutions are eligible for Federal funds in the amount of 40% of their improvements for the stated purposes -- while other institutions qualifying under Title I of the Act are entitled to Federal shares of up to one-third. This clearly indicates the importance attached by the Congress to improved facilities for institutions which offer programs to train highly skilled technicians.

In the administration of these Acts the U.S. Office of Education directs its advisory, consultative, and financial assistance through the States, strengthening the long-established and effective Federal-State-local relationship which recognizes that decisions and actions which shape the destiny of educational programs in the States must be with the States themselves. Although training programs for technicians are implemented by the States, leadership and assistance is provided by the Division of Vocational and Technical Education. This assistance takes the form of conferences, consultative advice, legal interpretations, suggestions as to the use of funds, the provision of suggested curriculum guides and similar materials, and in other ways.

Federal legislation has emphasized education as an important investment in people, and as a major element in the structure of our society. The education of skilled technicians is an essential part of such a program because the technician, with the scientist or engineer, is at the forefront of the technological developments which have made, and will probably continue to make, the greatest changes in our social and economic structure.

It follows that as more technicians are needed, <u>and are employed</u>, the number of good technician education programs must increase. I have mentioned that both Federal and local tax funds already support institutions which educate skilled technicians. However, the task of providing enough well trained technicians has just begun. Vocational educators cannot carry this new and tremendous burden alone. The guidance and assistance of the future employers of these trainees are needed if we are to succeed. Walter F. Carey, President of the Chamber of Commerce of the United States, said in a speech at Salt Lake City last October:

> "The businessman is the key element in this whole education picture. Far better than any educator or government administrator, he is in a position to know what his company's skilled manpower requirements will be for the next five years, the next ten years.

And the smartest thing he can do is to let the educators in his community in on the secret so they can adjust their program accordingly....Some communities that now are operating effective vocational-technical schools have as many as 43 advisory committees involving up to 500 businessmen. Here trained management men put their knowledge and experience to work on the real core of the problem: How best to prepare men and women for productive jobs that exist today and for new opportunities that will open before them as our technological revolution progresses."

I call upon you members of the Industrial Research Institute, as individuals or through your companies, to support technician programs and to help us provide the kind of employee you will want to hire. Really high quality is a mandatory requirement for successful technician education programs. A competent, trained teaching staff, laboratories well equipped with apparatus representative of that used in the most up-to-date industrial establishments, a good library, adequate classrooms and an administrative direction sincerely dedicated to quality occupational education are essential. It takes a minimum of 5 years and many thousands of dollars to establish a new program, assemble the staff, equip facilities, and graduate the first class or two. When these graduates are successfully employed and confidently advertising their success to their peers and parents, the program is well started.

A poor program is by far the most expensive of all because it costs almost as many dollars, wastes the time and the effort of students and school staff; and, worst of all, disappoints potential employers, and disillusions students and their parents. We can't afford programs of less than high quality!

The most important service you can render is to become involved as advisors, consultants, and supporters of technician educating institutions and programs in your locality, and the State and local organizations which administer them. The writers of the Vocational Education Act of 1963 clearly saw the necessity for knowledgeable employers to advise, counsel and support vocational educators if we are to provide high quality trainees for their future employees; and the Congress made such advisory services a mandatory part of the administration of the legislation at all levels.

I hope that some of you are already serving on such advisory groups; and that others will be moved to do so if called upon. In some situations it would certainly not be amiss to let it be known that you are available for such duty -- since there is a clear advantage to many of you to know exactly what goes on in this field from the inside.

Those of you who have no connection -- and expect none -- with advisory councils for vocational-technical education, nevertheless will need to know where to go for information on such programs and who to contact when you have business with vocational educators.

Broadly speaking, there are three levels of contact. I represent one of these levels as Assistant United States Commissioner for Vocational and Technical Education and Director of the Division of Vocational and Technical Education. The Division is divided into a headquarters staff in Washington and a field staff in 9 regional offices throughout the country. These staffs are always available directly to the general public for advice and assistance in connection with problems having to do with occupational training. You are invited to write directly to me or phone my office at any time -- or to contact the nearest regional office of the Department of Health, Education, and Welfare for the same service from the regional representatives of my office.

At the State level, the State directors of vocational education are the chief administrators. Through their State boards for vocational education, these men exercise the main control over State and Federal funds for vocational and technical education in their States. Usually, their staffs at the State capitols include a director of technical education and one or more specialists in this field whose major chore is to work directly with the local educational institutions on such programs. They are, however, also available to provide information and assistance to the general public.

At the local level, your best contact would be with the chief administrators of the local schools, colleges or other institutions which offer -- or in some cases, I'm afraid -- which should offer technical education programs. These people work with their State officials, of course, to receive and use Federal and State funds, and to get advice and assistance on program problems which arise from time to time. Through these State officials, they also have available the resources of the regional and headquarters personnel of the Division of Vocational and Technical Education in the U.S. Office of Education.

The directors of research in the Nation are in a peculiarly important position to provide knowledgeable and effective counsel. Their professional and corporate efforts have changed almost every facet of American life in the past few decades, and will continue to do so on an accelerating scale. Their estimates and predictions of what skills, knowledge, and capabilities will be needed and in what quantity they will be needed in years to come should be deeply perceptive because they are nearest to the genesis of change. We need this counsel and guidance.

The character, effectiveness, and economic value of capable technicians is still not universally appreciated in American industry. This is probably because there are few institutions educating highly competent technicians; and because the rewarding employment opportunities in the areas near the school keep the best technicians from going elsewhere. Thus, some employers have never had a chance to hire a really good technician, much less appreciate him.

Research directors are in a unique position to recognize and utilize the skills of technicians because of the very nature of research processes, which are not subject to the clearly structured organizational patterns of production work. It is in a research environment that the highly skilled technician, with his competency in assembling research apparatus, performing experiments with the assistance of skilled workers or aides, gathering and reporting significant data, and entering into interpretation can be of greatest service. He becomes a leader in the pilot tests and production processes of research, and fills an essential place in the production service or distribution of the product.

I suggest that you encourage and welcome local technical subject teachers and department heads to join in your scientific and technical society activities. Active participation helps keep teachers up to date technically, broadens their perception of the practical realities and needs of employers and is reflected in the attitudes and activities of their students. Whenever possible, local student chapters of scientific or technical societies should be encouraged as a means of providing maximum technical and educational experience for teachers and students.

The image of the technicians' attractive occupational opportunities should be promoted and publicized vigorously, particularly to parents -- many of whom may be employed by local industrial firms. The best conceived high school counselors' guidance for many youth who could become excellent technicians is made fruitless because the youth's parents, girl friends or buddies don't understand the dignity, challenges, and rewards available to the competent technician. For many able youths a high quality technician preparatory program is the most attractive available avenue to early employment, and one which often leads to further education and professional attainment.

The problem of expert guidance and counseling for young people entering occupational training is one of the most difficult being faced today in the education field. All of us are deeply concerned that better methods be developed to help steer these people in the right direction. It seems certain that many potentially fine technicians, for example, never enter the field because they don't know it exists.

Ten days ago I met with the Committee on Specialized Personnel -- a Federal inter-agency group -- and the entire session of its 106th meeting was devoted to the problems of guidance and counseling.

The Committee on Specialized Personnel is attempting to find solutions to the overall problem of the shortage of highly skilled people -- the same problem which is facing nearly every one of you.

Another Federal agency which has been devoting a great deal of time and effort in the same area is the Panel on Scientific and Technical Manpower of the President's Science Advisory Committee. I hope to see this panel publish very shortly, under White House auspices, a paper on "Engineering Technician Training." Among other things, this paper will probably recommend an increase in the number of graduates of technical programs from the present 16,000 to at least 50,000 annually by 1970.

The development of institutions to educate technicians also provides adequate laboratories, libraries and staff competencies which are useful to employers in another very important way. Today's graduate technician will find tomorrow that he needs to update his skills if he is to keep his job. Many people now on the job are finding that they need more basic mathematics, physical science or specialized laboratory training. Knowledge in these fields can best be obtained in an organized school program. They are not likely to be learned adequately in an in-plant training program.

The establishment of high quality vocational programs for technicians pays an extra dividend by providing facilities for such upgrading programs on a part-time or evening basis. It is already true that schools which offer these programs enroll a larger number of already-employed adults in such special courses than they do full-time young people in preparatory technician curriculums.

While this discussion is primarily one dealing with technicians, it is important to point out that there is a whole spectrum of specialized occupational education objectives designed to support and assist professional management, of which technical education is only one. In addition to technicians who support professional scientists and engineers, their equivalent in the financial and administrative management sector of business is also required -- as are the marketing, transportation, and servicing of the products of industry. Educating these specialized management-supporting personnel is also a part of the task of our local educational institutions, whose programs must meet and serve the needs of all employers.

We are all in this endeavor together. As leaders in industry and in vocational and technical education, we are being called upon to provide realistic, high quality occupational education to meet present and future manpower needs at the lowest net long-term cost. Modern America requires technicians -- and their counterparts in management, marketing and servicing -- with better basic training at the start of their careers than ever before. The pattern of the past, which was based on a high school education only, is not good enough, largely because of the impact of research on all facets of modern living. Educators alone cannot perform the task, but together we can meet the challenge in a truly American tradition of cooperative accomplishment.

We in education know that you in industry believe as we do -- and as President Kennedy so poignantly stated it a few short years ago:

> "We believe in human dignity as the source of national purpose, in human liberty as the source of national action, the human heart as the source of national compassion, and in the human mind as the source of our invention and our ideas."

III. ADMINISTRATIVE STRUCTURE

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The Function of the Administration and The Board of Education in School Plant Planning

A. ADMINISTRATIVE RESPONSIBILITIES

1. To conduct and direct research that will determine the relationship of new or altered buildings to a forward looking educational program and to interpret research to the board of education, the staff, and the community.

2. To furnish pertinent facts in guiding the policy formation of the board in its many basic decisions in school plant planning.

3. To establish and maintain, for each building project, a chronological schedule and record of all decisions, transactions, and steps taken from its inception by the board of the dedication of the building.

4. To secure cooperative planning of the principals, teachers, and community in developing the total building program and in the immediate planning of a school project.

5. To convey to architects and other specialists a clearly stated program to be implemented by the building.

6. To consult with the architect and other specialists on interpretations of the agreed upon program and on the educational evaluation of proposed solutions to the problems presented.

7. To assist the board of education in preparing an effective presentation of the building program to the community and in developing a financial plan for servicing the building program.

8. To develop plans for the maximum utilization and preservation of the building by the staff and the community.

9. To translate all planning in all facilities into a creative and constructive program of education.

B. STEPS TO BE TAKEN BY THE BOARD OF EDUCATION

1. Arrange for a school citizens study. In most communities the study should involve a larger area than the local school district. Thus, a reorganization of school districts may be considered in terms of a comprehensive K-12 program based upon adequate resources and a sufficient enrollment.

2. Consider the findings within the citizen's report and determine a course of action. A decision to try a building program should be by unanimous vote of the board of education.

3. Acquire the services of a competent adviser.

4. Visit other communities for the purpose of observing new school facilities. Comparable factors relating to reorganization, architectural services, and the functional qualities of the units should be observed.

5. Select a qualified registered architect. It is suggested that several reputable firms be interviewed prior to the selection of the architect.

6. With the aid of the citizen study recommendations, develop educational specifications for the architect. The administration, teaching and non-teaching staff, pupils and citizen committees should be given joint responsibility in this step.

7. Select site or sites. In doing this, consideration should be given to the survey recommendation and to the opinions of the architect.

8. Arrange for the preliminary drawings and specifications, together with an estimate of the cost. This is the first major assignment for the architect following the completions of the educational specifications.

9. Plan the publicity program. Here the various local planning committees should be used to as great advar age as possible.

10. Have the architect submit preliminary plans and cost es imates to board of education for consideration and approval.

11. Determine the financial program to be followed. Estimate the funds needed for the actual construction, equipment and landscaping. Set up a financial plan which includes the bond program, voting funds, sale of bonds, bond redemption program, insurance and other liabilities.

12. Select a date for a special election to approve the bond issue.

13. Following a favorable election, instruct the architect to proceed with the final drawings and specifications. Set a target date for their completion.

14. Approve the final drawings and specifications. Members of the study committee and other educational specialists may be utilized in the final review of plans -- prior to board acceptance.

15. With the guidance of the architect, call for bids on construction and equipment. A specified date must be set for receiving bids.

16. Let contracts following final review of all bids.

17. With the aid of the architect and legal adviser, prepare and execute contracts, time schedules, payments, performance and surety bonds.

18. Begin actual construction of the building.

19. Select furniture and equipment; install as construction conditions permit.

20. Clean school building and site. All landscaping and plantings should be be completed previous to occupancy.

21. When construction of the building is completed, have it inspected. This should involve the administration, board of education, architect and contractors.

22. Arrange for the school staff and student body to be instructed in the use and operation of the building. This phase of the program deserves increased attention if the features of a modern school plant are to be fully utilized and enjoyed.

23. Have the building formally dedicated and presented to the public. Here is a magnificent opportunity for a public relations effort to boost better education.

STATE DEPARTMENT OF EDUCATION

Tallahassee, Florida

ALTERNATIVE PLANS OF ORGANIZATION AND OPERATION OF GENERAL ADULT AND VOCATIONAL EDUCATIONAL SERVICES IN AREAS SERVED BY COMMUNITY JUNIOR COLLEGES

A statement for the guidance of local boards of public instruction prepared jointly by the Division of Vocational and Adult Education and the Division of Community Junior Colleges.

A junior college is defined (Section 228.14, Florida Statutes) as an institution which offers general education, terminal courses of a vocational and technical nature and courses for adults.

Since most counties offer at least some adult and vocational education as a part of their regular school programs, the addition of a junior college which is also concerned with these services makes it necessary that the county board adopt policies assigning specific responsibilities for these services to the various components of the public school systems under its jurisdiction.

As an aid to county boards and superintendents in developing such policies, the Division of Vocational and Adult Education and the Division of Community Junior Colleges have identified four general plans for the organization and operation of vocational and adult education in counties having junior colleges.

The initiation of any plan of operation will require the following:

A. The board and superintendents of cooperating counties must establish a policy of educational services for which the public school system including grades 1-12 and the community junior college is to be responsible.

B. The community junior college administration, faculty, and advisory committee must accept and support the role and responsibilities of the community junior college as envisaged in the plan of operation adopted.

C. When the community junior college assumes responsibility for programs of general adult and/or vocational education, the personnel who are assigned administrative or supervisory responsibilities for

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these services must become familiar with the principles and procedures involved in the initiation and operation of such programs. Such individuals should establish working relationships and liaison procedures with appropriate divisions and sections of the State Department of Education, and avail themselves of opportunities made available for in-service orientation and education.

Following are listed the four organizational patterns, the pre-existent conditions at the county level which would make it feasible to adopt a particular pattern, and the conditions which will need to be met if the pattern is to operate efficiently. The most efficient implementation of any of these patterns is dependent upon appropriate policy decisions at the local and/or state levels.

PLAN I

If (A) there is real evidence of a philosophical commitment to the value and purposes of general adult and vocational-technical programs existing within the college administration and faculty, and

(B) there are educational needs not being met because of limited existing programs of general adult and/or vocational education; and/or there is good evidence to indicate that by administering these existing programs through the community junior college they will be expanded and improved to meet more adequately the needs of the community.

If this pattern is to operate efficiently, the following conditions must be met at the local level:

(A) A competent person qualified under existing regulations to head each of these programs, i.e., the general adult education (community services) program and the vocational-technical program, is placed on the staff of the college at a level comparable to that occupied by other major program heads, thus affording comparable opportunities and encouragement for the development of these programs within the college framework, and

(B) funds accruing to the county board of public instruction for the support of general adult and vocational-technical programs assigned to the community junior college are transferred to the budget of the college.

PLAN II

If (A) programs of general and/or vocational education as an existing part of the county school system are serving the basic needs in these areas, and

(B) there exist unmet needs for certain types of offerings which it may be desirable to provide, and

(C) there is evidence of a genuine desire on the part of the college to serve the general adult and vocational needs not otherwise being met in the county, and

(D) the college has certain resources (physical plant, staff, organization, etc.) which may be used in serving general adult and vocational-technical needs, and there is reason to believe that such needs can better be met by the community junior college than by other agencies of the school system,

then it is recommended that the community junior colleges have responsibility for associate degree and certificate programs plus certain other offerings for adults not provided in the general adult or vocational-education program in the county school system.

If this pattern is to operate efficiently, the following conditions must be met at the local level:

(A) A coordinating committee is appointed to identify areas of responsibility of the community junior college and of other agencies for general adult and vocational education so that unwarranted duplication may be avoided. This committee should include representatives of the general adult education program, the vocational education program, the community junior college administration, and the county superintendent or a member of his staff, and

(B) A competent person qualified under existing regulations is appointed on the community junior college staff with responsibility for development and operation of such adult and/or vocational programs as may be the responsibility of the college; provided that, the certificate regulation may be waived upon recommendation of the coordinating committee when the responsibility assigned to the college in these areas is of such limited nature as to require only a minor part of the time of the administrator assigned to direct these programs, and

(C) funds accruing to the county board of public instruction for the support of general adult and vocational technical education programs assigned to the community junior college are transferred to the budget of the college.

PLAN III

If (A) excellent programs of general adult and/or vocational education are existing and serving basic needs in these areas, and

(B) there is widespread feeling in the community and among the college faculty that the college should offer only college level work or work leading to an associate degree, and

(C) there exist unmet needs for certain types of short courses, institutes, etc. similar to college credit courses which the community junior college by virtue of its physical and faculty resources is uniquely able to fill,

then it is recommended that the community junior colleges have responsibility only for associate degree and certificate programs plus certain short courses, institutes, etc. related to existing programs of the college and similar to college credit courses.

If this pattern is to operate efficiently, the following conditions must be met at the local level:

(A) a coordinating committee similar to that described in PLAN II above is appointed to make such decisions regarding program responsibility as are necessary to avoid unwarranted duplication of effort, to carry on a continuing review and study of the educational needs of adults in the area, to examine periodically the offerings of the various institutions and agencies, to encourage these institutions to meet the educational needs for which they are primarily responsible, and, when necessary to recommend changes in the assigned program and responsibilities among the institutions and programs.

PLAN IV

If (A) there exist strong general adult and vocational education programs, and the school administration and community are satisfied with these existing programs, and

(B) the prevailing philosophy and the expectation of the community is that the community junior college should offer only college credit programs,

then it is recommended that the community junior college have responsibility only for programs for which college credit is awarded.

IV. THE STUDENT

ESTIMATED NUMBERS OF NEW ENTRANTS INTO TECHNICIAN JOBS IN THE UNITED STATES ANNUALLY FROM ALL SOURCES, FOR SELECTED YEARS

Entry Source	1963		Average 1963-74	
	Number	%	Number	%
Post-secondary pre-employment technician training program	16,200	19.1	36,200	35.2
Programs under Manpower and Training Act	---	-	3,700	3.6
College degree in engineering, science or architecture	2,200	2.6	3,400	3.3
College degree in fields outside science and technology	1,100	1.3	1,600	1.6
Engineering college dropouts	2,000	2.4	2,700	2.6
Science college curriculum dropouts	800	1.0	1,300	1.3
Armed Forces training	1,000	1.2	1,300	1.3
Formal training within industry	21,600	25.4	19,400	18.9
Upgrading from skilled mechanic and other occupations	40,000	47.0	33,000	32.2
	84,900	100.0	102,600	100.0

Source: "Technician Manpower" Bureau of Labor Statistics, Dep't of Labor

The Bureau of Labor Statistics study considered the technical education programs offered in high schools, and has this to say concerning such programs:

> "Because of the relatively small number of advanced technical courses offered in these schools, graduates generally cannot enter technician jobs directly upon graduation. However, many graduates eventually enter technician jobs after receiving additional academic training from one of the other sources of technician training or after obtaining experience in related work. Therefore, pre-employment secondary school technician training plays a much more important role in the overall picture of technician education than is indicated by the number of graduates going directly into technician occupations."

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ESTIMATED NUMBERS OF NEW ENTRANTS INTO TECHNICIAN JOBS IN THE UNITED STATES ANNUALLY FROM FORMAL EDUCATIONAL SOURCES, FOR SELECTED YEARS. (Data do not include entrants through upgrading)

Technician training program	1965		1974		Average 1963-1974	
	Number	%	Number	%	Number	%
Post-secondary pre employment technician training program	21,400	41.0	53,500	60.5	36,200	52.0
Programs under Manpower and Training Act	1,800	3.5	4,600	5.2	3,700	5.3
College degree in engineering, science or architecture	2,600	5.0	4,600	5.2	3,400	4.9
College degree--fields outside science and technology	1,300	2.5	2,100	2.4	1,600	2.3
Engineering college dropouts	2,000	3.8	3,200	3.6	2,700	3.9
Science college curriculum dropouts	900	1.7	1,800	2.0	1,300	1.9
Armed Forces training	1,300	2.5	1,400	1.6	1,300	1.9
Formal training within industry	20,800	40.0	17,300	19.5	19,400	27.9
TOTAL	52,100	100.0	88,500	100.0	69,600	100.0

Source: "Technician Manpower" Bureau of Labor Statistics, U.S. Dep't of Labor
Note that the numbers included in the above table do not include persons entering technician jobs through upgrading from skilled mechanic or other occupations.

Sources under the title "Post-secondary preemployment technician training programs" include all types of 2-year technician training programs in technical institutes, community colleges, area vocational schools, and the like, and include private as well as public institutions.

ENROLLMENT IN TECHNICAL EDUCATION PROGRAMS IN THE UNITED STATES, BY STATES, BY TYPE OF PROGRAM - 1963

	Secondary	Post-secondary	Adult supple-mentary
Alabama	169	527	832
Alaska	-	-	-
Arizona	58	326	1379
Arkansas	14	-	682
California	1180	22919	41290
Colorado	-	505	1251
Connecticut	815	1469	3343
Delaware	76	-	308
Florida	977	2416	5102
Georgia	-	1070	542
Hawaii	-	92	294
Idaho	-	297	153
Illinois	122	1092	868
Indiana	39	104	1142
Iowa	204	411	1090
Kansas	263	1003	666
Kentucky	119	198	248
Louisiana	1454	252	914
Maine	-	91	28
Maryland	1029	272	81
Massachusetts	355	279	932
Michigan	398	4703	1191
Minnesota	-	719	4252
Mississippi	184	333	1692
Missouri	36[illegible]	139	1262
Montana	103	95	271
Nebraska	49	433	-
Nevada	384	622	904
New Hampshire	-	-	987
New Jersey	829	489	5285
New Mexico	-	83	288
New York	5257	-	951
North Carolina	126	1525	1607
North Dakota	-	510	-
Ohio	470	697	-

	Secondary	Post-secondary	Adult supple-mentary
Oklahoma	575	1604	1010
Oregon	-	965	84
Pennsylvania	2384	188	3668
Rhode Island	31	-	110
South Carolina	131	292	-
South Dakota	-	12	184
Tennessee	427	352	915
Texas	485	1669	6195
Utah	-	856	960
Vermont	67	151	312
Virginia	52	711	685
Washington	-	1780	11980
West Virginia	194	-	187
Wisconsin	-	3750	2433
Wyoming	-	16	-
Dist. of Columbia	173	-	41
Puerto Rico	-	209	108
TOTAL	19662	56226	1087[illegible]

Source: U.S. Office of Education - Bulletin 80008-63 - Vocational and Technical Education

SECONDARY SCHOOL PREEMPLOYMENT TECHNICAL EDUCATION ENROLLMENTS IN TITLE III PROGRAMS IN THE UNITED STATES - 1963

New York	5257
Pennsylvania	2384
Louisiana	1454
California	1180
Maryland	1029
Florida	977
New Jersey	829
Connecticut	815
Oklahoma	575
Texas	485
Ohio	470
Tennessee	427
Michigan	398
Nevada	384
Missouri	369
Massachusetts	355
Kansas	263
Iowa	204

States included in the chart enrolled more than 200 pre-employment secondary school technical students.

Source: U.S. Office of Education, Bulletin OE-[illegible]08-63 Vocational and Technical Education

POST-SECONDARY PREEMPLOYMENT TECHNICAL EDUCATION ENROLLMENTS IN TITLE III PROGRAMS IN THE UNITED STATES - 1963

California	22919
Michigan	4703
Wisconsin	3750
Florida	2416
Washington	1780
Texas	1669
Oklahoma	1604
North Carolina	1525
Connecticut	1469
Illinois	1092
Georgia	1070
Kansas	1003
Oregon	965
Utah	856
Minnesota	719
Ohio	697
Nevada	622
Alabama	527
North Dakota	510
Colorado	505
New Jersey	489
Nebraska	433
Iowa	411
Tennessee	352
Mississippi	333
Arizona	326
Idaho	297
South Carolina	292
Massachusetts	279
Maryland	272
Louisiana	252
Puerto Rico	209

States included in the chart enrolled more than 200 pre-employment technical students

Source: U.S. Office of Education
Bulletin OE-80008-63
Vocational and Technical Education

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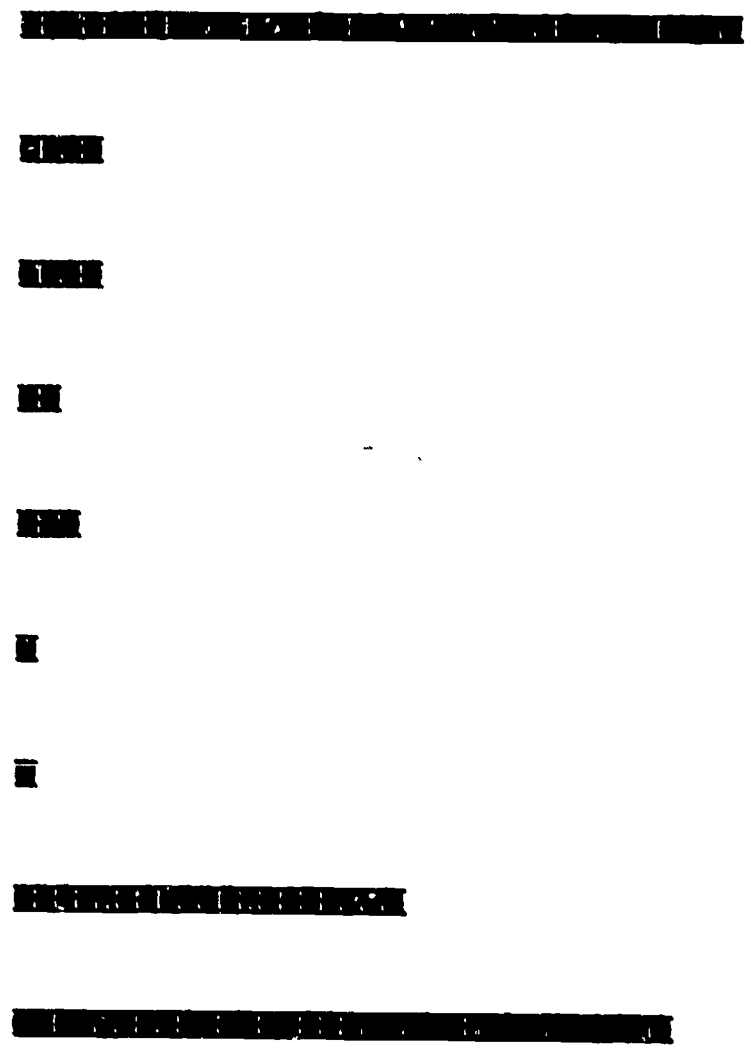
ESTIMATED PERCENTAGE DISTRIBUTION OF SOURCES OF NEW ENTRANTS INTO TECHNICIAN JOBS IN THE UNITED STATES - 1963-1974

Post-secondary preemployment technician training program	35.2%
Programs under Manpower and Training Act	3.6%
College degree in engineering, science or architecture	3.3%
College degree in fields outside science and technology	1.6%
Engineering college dropouts	2.6%
Science college curriculum dropouts	1.3%
Armed Forces training	1.3%
Formal training within industry	18.9%
Upgrading from skilled mechanic and other occupations	32.2%



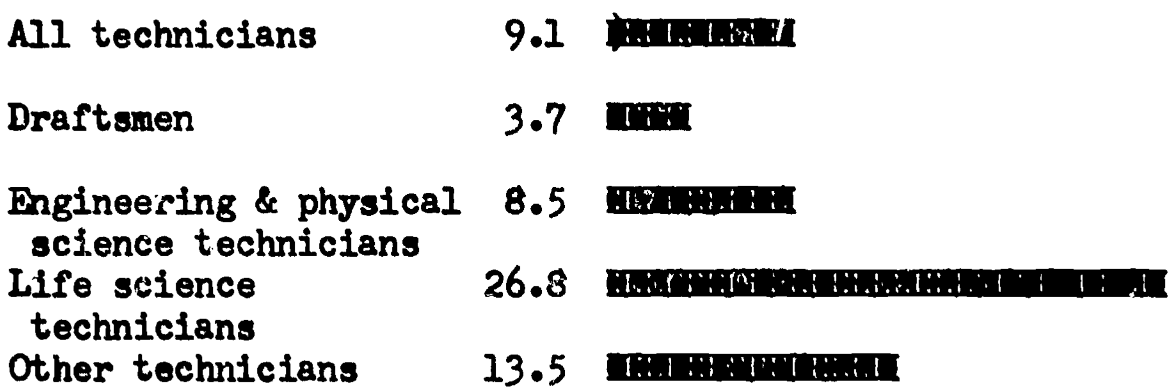
Source: "Technician Manpower" - Bureau of Labor Statistics (manuscript) 1965

ESTIMATED EMPLOYMENT OF TECHNICIANS BY SEX AND OCCUPATION

1963

	All technicians	Drafts-men	Engineering & physical sci-ence technicians	Life science technicians	Other technicians
NUMBER:					
Total	844,800	232,000	439,000	58,100	115,700
Male	767,700	223,400	401,700	42,500	100,100
Female	77,100	8,600	37,300	15,600	15,600
PERCENTAGE:					
Male	90.9	96.3	91.5	73.2	86.5
Female	9.1	3.7	8.5	26.8	13.5

PERCENT FEMALE:



Source: "Technician Manpower" - Bureau of Labor Statistics, 1966

LEVEL OF EDUCATION OF TECHNICIANS, BY OCCUPATION - 1963
Percentage

ALL TECHNICIANS

	%
Less than high school	12.2
High school graduate	24.6
Some college 1/	53.1
Bachelor & bachelor plus	10.0

DRAFTSMEN

	%
Less than high school	6.7
High school graduate	21.6
Some college	64.5
Bachelor & bachelor plus	7.2

ENGINEERING & PHYSICAL SCIENCE TECHNICIANS

	%
Less than high school	14.5
High school graduate	25.8
Some college	51.0
Bachelor & bachelor plus	8.7

LIFE SCIENCE TECHNICIANS

	%
Less than high school	12.7
High school graduate	28.2
Some college	37.7
Bachelor & bachelor plus	20.9

OTHER TECHNICIANS

	%
Less than high school	14.5
High school graduate	24.5
Some college	46.0
Bachelor & bachelor plus	14.9

1/ Includes technicians without any degree and those with an associate degree but no bachelor's degree.

Source: "Technician Manpower" - Bureau of Labor Statistics, 1966

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PERCENTAGE DISTRIBUTION OF TECHNICIANS BY OCCUPATIONAL FIELDS

NEW YORK STATE DEPARTMENT OF LABOR STUDY - 1962 (All technical occupations)

Technical occupation group (New York State)	Percent
Draftsmen	14.1
Structural design technicians & related specialists	1.7
Electro & mechanical engineering technicians	28.3
Mathematics technicians	0.6
Physical science technicians	6.0
Biological, medical, dental & related science technicians	17.1
Industrial engineering technicians & related specialists	4.7
Civil & construction technicians & specialists	9.1
Sales & service technicians	1.3
Technical writing & illustration specialists	2.0
Safety & sanitary inspectors & related specialists	2.7
Product testing & inspection specialists	5.4
Data-processing systems analysis & programming	4.1
Airway tower specialists & flight dispatchers	0.9
Broadcasting, recording & motion picture specialists	2.0
	100.0

BUREAU OF LABOR STATISTICS STUDY - 1963 (Engineering-related occupations)

Technical occupation group (United States)	Percent
Draftsmen	26.9
Engineering technicians	36.1
Chemical technicians	7.7
Physics technicians	1.3
Mathematics technicians	0.7
Other physical science technicians	5.7
Life science technicians	7.1
Other technicians	14.6
	100.0

When comparing the percentages in these two groups of data it is well to keep in mind that the New York study covered a much wider range of technical occupations than was encompassed in the BLS study.

NEW YORK STATE COMMUNITY COLLEGES - Enrollments, Fall 1963.

Number of community colleges: 25 (including 3 with only first-year enrollments)

Distribution of full-time enrollments by curriculum fields:

	Enrollment	Percent of Total
Medical & health curriculums	2734	12.0%
Advertising & business	6401	28.0
Industrial & technical	6364	28.0
Liberal arts	7282	31.8
Miscellaneous	68	.2
	22849	100.0

Distribution of enrollments by sex:

Male	14773	64.7%
Female	8076	35.3
	22849	100.0

Total full-time enrollment per college:

Maximum - - - - - - - - 2582
Minimum - - - - - - - - 73 (first year)
Median - - - - - - - - 962

Percentage of liberal arts students:

Maximum - - - - - - - - 77% (Onondaga)
Minimum - - - - - - - - 0 (Erie, Fashion Institute, and Mohawk Valley offer no transfer curriculums)
Mean - - - - - - - - - 31.8%

Enrollment first and second years (21 colleges with second year students):

First year - - - - - - 14362
Second year - - - - - 7773

Ratio second year to first year - - - 54.2%

Source: Compiled from data made available by State University of New York

NEW YORK STATE AGRICULTURAL AND TECHNICAL INSTITUTES
Enrollments, Fall 1963.

Number of institutes: 6

Distribution of fulltime enrollments by curriculum fields:

	Enrollment	Percent of Total
Agricultural curriculums	1415	21.8%
Medical and health	751	11.6
Advertising & business	2289	35.3
Industrial & technical	1840	28.4
Liberal arts	- -	-
Miscellaneous	192	2.9
	6487	100.0

Distribution of enrollments by sex:

Male - - - - - - - - - - - - - -	4391	67.7%
Female - - - - - - - - - - - - -	2096	32.3
	6487	100.0

Total full-time enrollment per institute:

Maximum - - - - - - - - 1875 (Farmingdale)
Minimum - - - - - - - - 684 (Delhi)
Median - - - - - - - - 874

Enrollment first and second years:

First year - - - - - - 4090
Second year - - - - - - 2397

Ratio second year to first year - - - 58.6%

Source: Compiled from data made available by State University of New York

COMMUNITY COLLEGES AND AGRICULTURAL AND TECHNICAL INSTITUTES IN NEW YORK STATE. Curriculum Offerings and Enrollments, by Institutions, Fall 1963.

Institution	Number of curriculums offered	Enrollment full-time students	Liberal arts enrollment Number	Percent of total
AGRICULTURAL & TECHNICAL INSTITUTES:				
Alfred	25	1491	—	—
Canton	12	689	—	—
Cobbleskil	12	871	—	—
Delhi	16	684	—	—
Farmingdale	27	1875	—	—
Morrisville	15	877	—	—
Total	49	6487	—	—
COMMUNITY COLLEGES:				
Adirondack	8	326	138	42%
Auburn	7	656	434	66
Bronx	10	1200	409	34
Broome	11	962	220	23
Corning	8	700	295	42
Dutchess	14	1022	405	40
Erie	11	1874	—	0
Fashion Institute	7	1336	—	0
Hudson Valley	16	1535	275	18
Jamestown	6	434	268	62
Jefferson (first year)	5	114	49	43
Mohawk Valley	8	922	—	0
Monroe	11	1220	717	59
Nassau	5	998	686	65
New York City	18	2582	—	0
Niagara (first year)	4	334	211	63
Onondaga	5	1060	820	77
Orange	12	1062	501	47
Queensborough	5	828	379	46
Rockland	6	503	238	47
Staten Island	6	741	268	36
Suffolk	9	1193	640	54
Sullivan (first year)	3	73	35	48
Ulster (first year)	5	193	97	50
Westchester	12	981	197	20
Total - Community Colleges	25	22849	7282	32%

Source: Compiled from data made available by State University of New York

ENROLLMENTS IN PREPARATORY VOCATIONAL-TECHNICAL PROGRAMS (TITLE III), IN SELECTED STATES, 1962-1963.

State	Enrollment			Non-agricultural employment - 1963 (thousands)	Total enrollment per 1000 in non-agricultural employment
	Secondary	Post-secondary	Total		
California	1,180	22,919	24,099	5,390	4.47
Connecticut	915	1,469	2,384	963	2.48
Florida	977	2,416	3,393	1,404	2.42
Georgia	-	1,070	1,070	1,131	.95
Illinois	122	1,092	1,214	3,605	.34
Massachusetts	355	279	634	1,952	.33
Michigan	398	4,703	5,101	2,375	2,15
New Jersey	829	489	1,318	2,096	.63
New York	5,257	-	5,257	6,298	.84
North Carolina	126	1,525	1,651	1,288	1.28
Ohio	470	697	1,167	3,126	.37
Oklahoma	575	1,604	2,179	606	3.60
Oregon	-	965	965	545	1.77
Pennsylvania	2,384	188	2,572	3,689	.70
Rhode Island	31	-	31	293	.11
South Carolina	131	292	423	617	.69
Texas	485	1,669	2,154	2,691	.80
Virginia	52	711	763	1,107	.69
Washington	-	1,780	1,780	850	2.10
Wisconsin	-	3,750	3,750	1,231	3.05
Total United States	19,662	56,226	75,888	56,283	1.35

Total males enrolled - - 72,879
" females " - - 3,009 or 4% of total

Source: Enrollment data - Vocational and Technical Education. U.S. Office of Education, Bulletin OE-80008-63 1964.
Employment data - Manpower Report of the President/ U.S. Department of Labor.

V. RATIONALE AND NEED

A PROCEDURE FOR MAKING A ROUGH ESTIMATE OF NUMBERS OF TECHNICIANS REQUIRED, ON A STATE-WIDE BASIS, WHEN ACCURATE SURVEY DATA ARE NOT AVAILABLE, TOGETHER WITH ESTIMATED NUMBERS OF STUDENTS REQUIRED TO FILL THE NEEDS.

It is often desired to arrive at a rough estimate of technician needs in a state or other area when data from specific surveys are not available. The following procedure might be utilized, if data on engineers are available from the 1960 Census. Several assumptions are required, and the validity of the end results will depend upon the accuracy of the assumptions. CAUTION IS SUGGESTED IN THE USE OF THE FINDINGS.

The recent Bureau of Labor Statistics study on "Technician Manpower; Requirements, Resources and Training Needs" (available to the writer in manuscript form) provides extensive data on technician needs and resources in the United States. Ratios found in that study are utilized here, in suggesting how estimates can be made for a single State. Certain assumptions made are as follows:

1. That the number of engineers reported in the 1960 Census for the State embraces the same types of engineers as recorded in the B.L.S. study.
2. That the ratio of engineering technicians to engineers as shown in the national study also hold for the State.
3. That the projected growth in the number of engineers follows the general pattern projected for professional growth.
4. That the sources of supply of technicians for the State follow the same pattern as the national study.
5. That attrition rates for the State for technicians are the same as nationally.

The procedure suggested is as follows:	As applied to New Jersey
a) Number of engineers in the State according to 1960 Census - -	46,381
b) Number of engineering technicians in the State in 1960, based upon .91 technicians per engineer - - - - - - - - - -	42,184
c) Number of engineers - 1970 - based upon projected growth of 62% for 10-year period by N.J. Bureau of Employment Security -	75,160
d) Number of technicians in 1970 (.91 x engineers) - - - - - - - -	68,270
e) Technician growth in number of jobs - - - - - - - - - - - - - -	26,086
f) Numbers of new technicians needed because of attrition (1.2% per year for death & retirement; 3.0% for movement into other occupational fields — 4.2% total) - - - - - -	17,718
g) Total technicians needed for 10-year period - - - - - - - - - -	43,804
h) Average number needed per year as new entrants - - - - - - - -	4,380

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The B.L.S. study indicates that 35.2 percent of the entrants into technician occupations from all sources come from 2-year post-secondary formal technician training programs.

35.2 percent of the 4,380 technicians needed annually equals 1,540 technicians to be supplied by the post-secondary schools.

(The B.L.S. study indicates that the numbers of technicians entering employment directly from high school technical programs is negligible, in the nation as a whole.)

One-third of the total number of students enrolled in full-time 2-year programs can be expected to graduate each year.

65 percent of the graduates enter technician jobs directly from school.

Combining these ratios gives approximately one-fifth of the total number of students enrolled as entering technician jobs annually.

To provide 1540 technicians annually from post-secondary 2-year programs thus requires a total enrollment of 7700 students on the average for the 1960-1970 period.

Data from the B.L.S. study show a national average of some 36,200 technicians per year entering the labor market, and the projected number for 1974 is 53,500 technicians.

The total enrollment needed in two-year post-secondary schools for 1974 — assuming the same proportion of the total supplied by these schools as for the 1960-70 period — would amount to

$$\frac{53,500}{36,200} \text{ or } 11,400 \text{ full time students}$$

The B.L.S. study predicts increasing proportions of the total supply of technicians in the years ahead to come from organized training programs, hence the enrollment needed to meet the demands may be estimated somewhat higher than the above.

Lynn A. Emerson
April, 1966

VI. PROGRAMS AND CURRICULUM

CURRICULUM DESIGN

IN

TECHNICAL EDUCATION

By

Maurice W. Roney
Director, School of Industrial Education

CURRICULUM DESIGN IN TECHNICAL EDUCATION

The educational requirements of semi-professional technical occupations present a new challenge in curriculum design for the junior college. The pioneering effort of technical institutes and the growing support of professional engineering societies have focused attention upon the need to provide more and better educational programs designed to prepare supporting personnel for engineers and scientists. The technical skills needed for these rapidly emerging occupations are peculiarly suited to the type of educational service that the two-year college can provide. Nevertheless, there are few indications that any consistent pattern of curriculum design has evolved from the work of the comparatively few two-year schools offering technical curricula. The junior college, as Henninger so aptly puts it, "is at the threshold of a really significant participation in technical education."[1] With Federal support already available through the National Defense Education Act (176 junior colleges participated in 1960-61) and with additional support legislation being considered, this area of educational services deserves careful study. Programs are in operation. How have they been developed? What can be considered a satisfactory standard for such programs? Where have the institutions now conducting technical programs turned for information in the planning and development of this form of educational service.

Technical education, like many other fields of education, suffers from a lack of definitive research. It is paradoxial, in an age of technology where new scientific achievements are becoming almost commonplace, that we have no real curriculum theories in education. For a true theory must be based on established facts and we do not have enough facts in education on which to base a theory. Einstein's theory of mass-energy equivalence is a classic example of a pure theory. It consisted of known facts, meticulously assembled, carefully arranged in a new combination, and with a resultant prediction. His theory was capable of being tested and the results could be compared with the prediction. The contrast in education is sharp. We do not have comparable theories in education because we start with opinions--not facts. Any combination of opinions results in a new opinion--not a theory. We have scientific data that enables us to put a man in exact orbit around the earth and to return him with still more accumulated data, but we do not have educational data that can be used to formulate a basic curriculum for the preparation of competent technicians--or for that matter good citizens.

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1. G. Ross, Henninger, The Technical Institute in America, (1959, New York: McGraw-Hill Book Company, Inc.) p. 5

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PROBLEMS IN CURRICULUM DESIGN

Curriculum design in higher education has too often been largely curriculum construction--an assembly job. The procedure has been to start the process by selecting a core of course offerings available in an institution and putting them together in the traditional sequences. Usually this core will consist of traditional general education courses. With this as a base the remainder of the curriculum is devoted to the field of specialization, making certain, of course, not to deviate appreciably from all similar curricula. Furthermore, a multitude of other factors will influence the form and content of any new curriculum. Economic considerations, staff competencies (and prejudices), real and fancied student abilities and interests, instructional facility limitations, scheduling conveniences, and, all too often, just plain reactionary attitudes, all militate against realistic curriculum design.

In the junior college, real curriculum design is further restricted by an overriding concern for academic respectability. One of the arguments advanced for using existing courses rather than designing new ones is based on this concern. The idea is to avoid, wherever possible, the taint of specialization. Courses must be pure. Mathematics must be algebra, trigonometry, or calculus; physics must be traditional physics, not applied mechanics; and chemistry must be general chemistry rather than industrial chemistry. Except in terminal courses. Here it is customary to go to the other extreme, carefully segregating these courses (and ultimately, of course, the students) by the use of adjectives such as "practical", "applied", or "elementary". The idea is to be certain, at all costs, to differentiate between the academic and the practical.

Disturbing as it is for those who like things neat, orderly, and traditional, technical programs cannot operate under this outdated educational philosophy. For the inevitable consequence of educational snobbery is a segregation of students on the basis of academic ability. When this occurs the technical program cannot operate, simply because it must inevitably deterioriate until it has no appeal to able students with well-identified interests. It will then attract only those students who are either not willing or not able to do the work required in college level education. A curriculum designed with this as a guiding philosophy may serve an educational purpose, but it cannot be technical.

One of the most significant features of technical education is its appeal to the individual who is intensely interested in a specialized field of study. This person comes to the technical program because of its positive values--not because he cannot study in some other field. He is, in a sense, a fugitive from general education; tired of taking "subjects"; and anxious to get his teeth into something interesting. He comes to learn electronics, or metallurgy, or industrial chemistry, not more of the same things he studied in high school. Furthermore, the typical student in a technical program is likely to be more mature. He may very well have worked for a year or two since leaving high school. It is not unusual either to find individuals with one or more years of college credit enrolling in these special purpose curricula.

A First Principle in Technical Curriculum Design.

If the technical curriculum is to attract and hold the type of students that have been described--and these will be some of the very best--it must include in the first term a substantial introduction to the specialized field of study. If the first term consists only of general education subjects--mathematics, English, and social studies--it will hold very little interest for many of the most capable students. In many technical curricula, courses in the field of specialization make up from one-third to one-half of the first term. Mathematics and communications, being tool subjects are also introduced in the first term which means that social sciences, humanities, and physical sciences are deferred to the following terms.

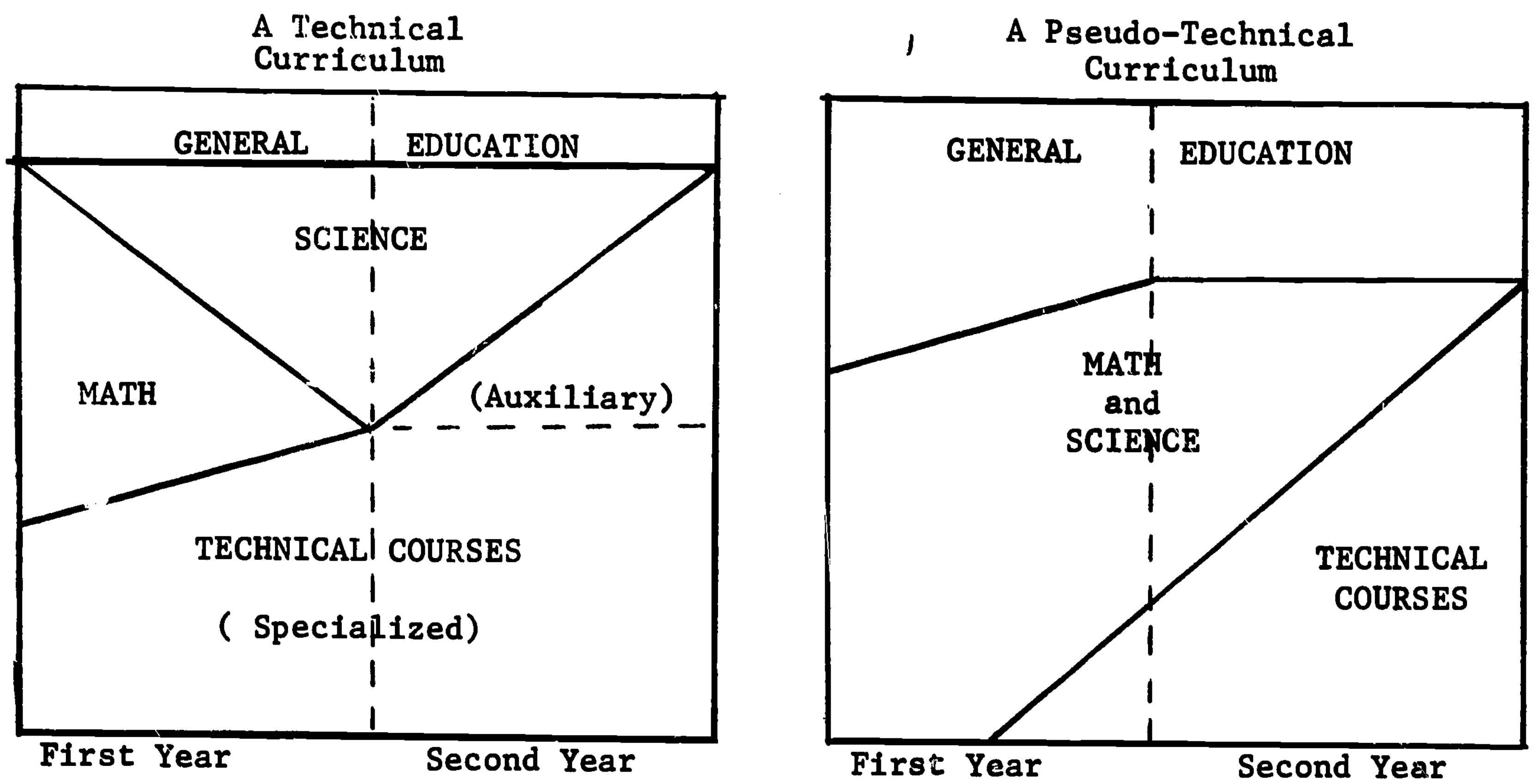
Another important advantage is obtained by introducing technical courses in the first term. It is possible, by this design, to obtain depth in the specialized field of study in the final stages of the program. In the four-semester program, for example, if the introduction to the specialized field is deferred, even for one term, it is not possible to cover both the range of basic principles and the more advanced concepts needed for success as a technician. In this connection the so-called "core curriculum" in which students in several technologies take a common first term can be dangerously deceptive. Economically, the core curriculum is an attractive compromise. But like many such compromises in education, it sacrifices quality for expediency. The same dangers exist in trying to meet both transfer credit and occupational objectives in a single curriculum, a procedure that is often recommended for junior colleges by those who like to have their cake and eat it too. This curriculum compromise usually results in a fuzzy-objective program. It cannot be overemphasized that capable students will not be attracted to any program that gives secondary consideration to their occupational objectives. In contrast, it is a matter of record that a strong, well-planned curriculum, in which the technology is the central focus from the first day to the last, can attract and hold capable students. Such a curriculum can be extremely rigorous, as in fact it must be if it is to accomplish its purpose.

A second major consideration in the design of technical curricula is the correlation of course work in mathematics, science, and technology. A number of studies have been made to determine the relative emphasis on mathematics in technical institute curricula. This emphasis is usually measured by the credit hour requirements in mathematics. But the amount of mathematics shown in formal courses is not a true measure of the mathematical ability needed for the curriculum. True, the content of courses in mathematics should identify the concepts, formulas, and constructs that are needed. But the technical courses must provide the applications. This means that the content of technical courses must be tailored to parallel the student's progress in mathematics. With this arrangement the student has the advantage of formal mathematics instruction plus the reinforcement of learning that comes from interesting applications of mathematics in technical courses.

Science principles can be treated in somewhat the same manner, although it is not always possible to coordinate science courses with technical courses. The important consideration here is mathematics again. In general, science courses should be scheduled during the second and third terms of a four-term curriculum. With this plan the student has one full term of mathematics preceding the study in science and takes at least one course concurrently. The choice of which science topics to schedule first in the curriculum can be made on the basis of the need for principles of electricity, mechanics, chemistry, et al, in the technical study.

To illustrate the two factors of curriculum design that have been introduced--early introduction of technical study and coordination of mathematics, science, and technical study--a graphic illustration may be helpful.

THE DISTRIBUTION OF SUBJECT MATTER IN TWO TYPES OF TWO-YEAR POST-HIGH SCHOOL CURRICULA



The two diagrams illustrate a basic difference that exist between two types of curricula: technical curricula, and what I have chosen to call pseudo-technical curricula. In these diagrams the areas shown represent subject matter emphasis starting at the left with the first term and moving to the right through the two-year program. The first curriculum, represented by Figure 1, is a fair representation of the course organization in a technical institute type curriculum. It contains the two basic elements of strength that have been discussed. Specialized technical course work is introduced in the first term and constitutes almost 50% of the curriculum with mathematics and science courses carefully coordinated. The slanting lines indicate the change in emphasis on subjects in scheduled classes. Mathematics, for example, begins in the first term as a discrete subject but it is also an integral part of both technical and science courses. It is possible with this design to obtain effective integration of subject matter.

Figure 2 represents a compromise between the objectives of a technical curriculum and the forces that impinge on the institution to design all curricula as nearly alike as possible. Approximately two-thirds of the course work is in mathematics, science, and general education. Technical courses are concentrated in the second year. This type of curriculum has neither the appeal to students nor the effectiveness of an integrated curriculum. Its primary appeal is to administrators, since roughly two-thirds of the course work can be "taken from stock" in most institutions. A curriculum of the type represented by Figure 2 lacks the positive approach that is necessary to attract the really able student interested in a specialized field of study. It may, and very probably will, suffer from a lack of unity, cohesion, and direction. By contrast, the integrated curriculum shown in Figure 1 has a strong sense of direction. Students are normally under the guidance of technical specialists from the very first day and the interrelationship of all subjects and courses can be made apparent.

A well-designed technical curriculum will also provide numerous opportunities for individual student performance. Part of this objective is achieved by the proper use of tests and written technical reports. Good teaching will provide many opportunities for individual growth and development as in any educational program. Design courses can and should incorporate individual problem-solving assignments. Instructional material for laboratory work in advanced courses should identify only the parameters of problems, shifting to the student more of the responsibility for planning, evaluating, and summarizing the work. Further than this, however, the curriculum should include specific requirements for problems which require investigating, planning, designing, and reporting functions. In the final term of the curriculum, one course can be devoted entirely to individual design problems. In a course of this type the student should be responsible for the selection of a problem, a review of relevant published materials, and a well-organized report of the work done and the results achieved in the solution of the problem. In a very real way, the performance of students in this course can serve to evaluate both the student and the instructional program.

Student Work Load

One of the critical controlling factors in technical curriculum design is the student work-load. With the heavy emphasis on technical knowledge, rather than manual skills, much of the learning is accomplished outside of the scheduled class and laboratory periods. Class preparation, drill, report writing, and review are real elements of the curriculum and should be provided for as consistently and carefully as all other elements. A very common mistake in technical curriculum planning is to schedule the student heavily in class and laboratory courses without giving due consideration to his need for outside study time. If there is such a thing as an optimum class and laboratory load it would appear to be approximately twenty-eight hours per week. The nature of technical study is such that a great deal of reading and problem work must be done outside of class and laboratory. While the amount of outside time will vary with the type of course, a rule of thumb that can be used in curriculum design, is to allow for two hours of outside study for each hour of scheduled class time. Obviously, this rule will not always hold. For example, some laboratory courses require outside work, such as library research and report writing. The important thing in all of this is the total workload. If the student has a schedule of 12 class and 16 laboratory hours per week, he will have a total workload of 12 class-24 outside study--and 16 laboratory for a total of 52 hours per week. Not many students will spend more than this amount of time on school work and those who must work at outside jobs to stay in school will be pressed with this amount.

The number of courses in each term must also be limited. If the student must prepare work in more than five subjects during any one term, he is unnecessarily handicapped. Three 4-credit courses carry the same total credit as six 2-credit courses but the differences between these two schedules can be extreme, as anyone who has taken 2-credit courses in college can testify.

In summary, the curriculum design principles that I am suggesting can be stated in six general rules:

1. The curriculum should have at least 30 credit hours of specialized course work in the field of specialization and from 15 to 20 credit hours of mathematics and science.
2. The technical specialty should be introduced in the first term by one or two major courses.
3. Mathematics and science courses should be coordinated with technical courses whenever possible, to introduce concepts as they are needed.
4. Auxiliary technical courses should be included to broaden the student's understanding of the technology.
5. Provision should be made for either individual or small group problem work during the final term to promote independent thinking and to test each individual's comprehension of the total curriculum content.
6. The total class and laboratory load for students should not exceed 30 hours per week and should not include more than 5 courses requiring extensive outside preparation.

The curriculum design principles outlined here are admittedly opinions. As I have indicated, research in this area of education is virtually nonexistent. Nevertheless, there is sufficient evidence to indicate that technical institutes with curricula that follow quite closely this design and this guiding philosophy have consistently attracted good students and produced outstanding graduates. They have been able to do this without the status appeal of a baccalaureate degree--an extremely significant and, in my opinion, a conclusive point.

MATHEMATICS AND SCIENCE
in
TECHNICAL EDUCATION

One of the distinguishing characteristics of technical education is its base of mathematics and science. It is this base that enables a student of technology to expand his knowledge, to transfer ideas from one technical application to another, and to continue study in his chosen field after graduation.

Technical study at any level requires a foundation of mathematics and science. Mathematics is a basic tool of learning from the most elementary stages of a high school physics course to post-doctoral study in some esoteric scientific field. The physical sciences are no less important. Without a knowledge of scientific principles, it is impossible to study with any depth in a specialized field of technology. Our total scientific knowledge is said to be doubling every ten years and technology has become the framework of our economic and social structure. In the few short years since Sputnik I, even the lay public has come to recognize the significance of science and technology in protecting and improving our way of life.

Modern technology, based as it is on change, has little in common with traditional ways of doing things. It would be unrealistic to expect that traditional ways of teaching mathematics and science would be adequate for the great variety of educational programs that relate in one way or another to technology. Instruction in mathematics and the sciences is undergoing changes at all levels of education. The School Mathematics Study Group has developed some revolutionary methods of instruction, particularly in the field of secondary school mathematics. Many of the cherished traditions of mathematics teachers are threatened by the research being done in this field. A revolution is also budding in the field of science education. New materials and new techniques for teaching the physical sciences show promise of displacing some of the built-in mystery that has characterized this instruction for many years. One example of this is the Richmond Plan, developed in the high schools of the San Francisco Bay Area. Science, shop, and mathematics have been tied together in an integrated program. This project, aimed at salvaging able students who through a lack of interest are potential dropouts, has shown real promise.

The problem of providing effective and efficient mathematics and science instruction is especially acute in the two-year post-high school technology curriculum. The post-high school program is a unique educational package. It borrows heavily from higher education for its content and from vocational education for its objectives. But its curriculum and its instructional processes are strictly its own. Neither the college nor the vocational school provide a pattern for the course work in a technical curriculum.

Prepared for the National Clinic on Technical Education, Charlotte, North Carolina, October 39 by Maurice W. Roney, Director, School of Industrial Education, Oklahoma State University, Stillwater, Oklahoma.

The traditional courses of a multipurpose university, college, or junior college do not provide the kind of mathematics and science instruction required in a technical curriculum. Colleges usually operate on the "goods-by-the-yard" system. Standardized mathematics and science courses are pulled from the shelf, supermarket style. While this kind of curriculum design may be satisfactory for the four-year college curriculum, it is highly unsatisfactory for technical programs. For one thing, the structure of a college curriculum is entirely different from that of a technical curriculum. In engineering, for example, mathematics and science courses make up the first half of the study program. The student is given an extensive program of mathematics, physics, and chemistry before he enters upon any study of a specialized nature. A two-year technology curriculum cannot afford the luxury of this kind of a plan. It is necessary, for a number of well-established reasons, to introduce the technical study in the first term of a technical program. Concurrent courses in mathematics and science must be coordinated with the technical study. For this reason, if for no other, mathematics and science courses designed for an engineering curriculum are inefficient in a technical curriculum.

Neither do the traditional methods of trade training provide the answer. Trade training normally requires a person-to-person relationship, with a single instructor responsible for most, if not all, of the training program. Skills and knowledge are integrated by the trade instructor who relates mathematics and science directly to the needs of the trade. Technical training requires an entirely different approach. First of all, the instruction is a team job. The subject matter, in any technology, is far too broad to be taught by any one person. Mathematics, physical sciences, and technical courses are frequently taught by separate instructors, each of whom is a specialist in his field. Secondly, the mathematics and sciences of the technical curriculum are not job skills, per se; they are learning skills. The content of mathematics and science courses is determined by the specific needs of technical courses. The mathematics needed, for example, in a materials testing course may be well beyond the mathematics used by the graduate technician in his job functions. These three factors; the separation of mathematics and science into discrete courses, the coordination of course work required in the tight vertical structure of the two-year curriculum, and the emphasis on principles rather than job skills, put special requirements on the math and science program in technical curriculums.

As a means of presenting the significant points of conclusion, I will describe the mathematics and science program in a typical school. This hypothetical school offers several two-year post-high school technology curriculums. It has an enrollment large enough to provide flexibility of schedules. The school has its own instructional staff. Entering students are average in ability based on national norms for college freshmen . Entrance requirements include two years of high school mathematics.

The mathematics and science program in this school has the following characteristics:

The mathematics program consists of algebra, trigonometry, and selected topics of analytic geometry and calculus. Two courses are required, a first term course in algebra and trigonometry and a second term course which includes algebra, trigonometry, and selected topics in analytic geometry and calculus.

Algebra and trigonometry are functional in nature. Instruction is aimed at developing practical problem-solving skills. Emphasis is on the use of formula - not the mechanics of formula derivation.

Analytic geometry and calculus are introduced by special applications. The purpose is to introduce the fundamental concepts of higher mathematics. Problem-solving using these concepts is limited.

Because the needs of individual curriculums differ, separate sections in mathematics are set up for students in each curriculum. The topics covered in algebra and trigonometry courses are much the same as those included in any college-level courses in these subjects. Important differences appear in the sequence or order in which topics are studied and in the selection of topics for special emphasis. Both the order in which topics are taught and the emphasis given to each topic are determined by the needs of each curriculum.

Coordination of mathematics instruction with technical courses is accomplished in two ways: (1) Mathematics courses give special emphasis to the topics being used in technical courses. Technical courses provide the applications of mathematics being taught in mathematics courses. (2) Instructors in technical courses review or reteach the mathematics needed in these courses. Up to twenty percent of the class time is used for this purpose.

The physical science part of the technical program consists of selected topics in physics and one general chemistry course. Physics-mechanics and physics-electricity are required in all technical curriculums. Physics courses have a base of mathematics which include algebra and plane trigonometry. Higher mathematics is not used.

The order of priority for physics courses varies by curriculums. For example, physics-mechanics is the prerequisite for technical courses in mechanical technology and civil or construction technology. Physics-electricity is an auxiliary science in these curriculums and is scheduled without particular reference to technical courses.

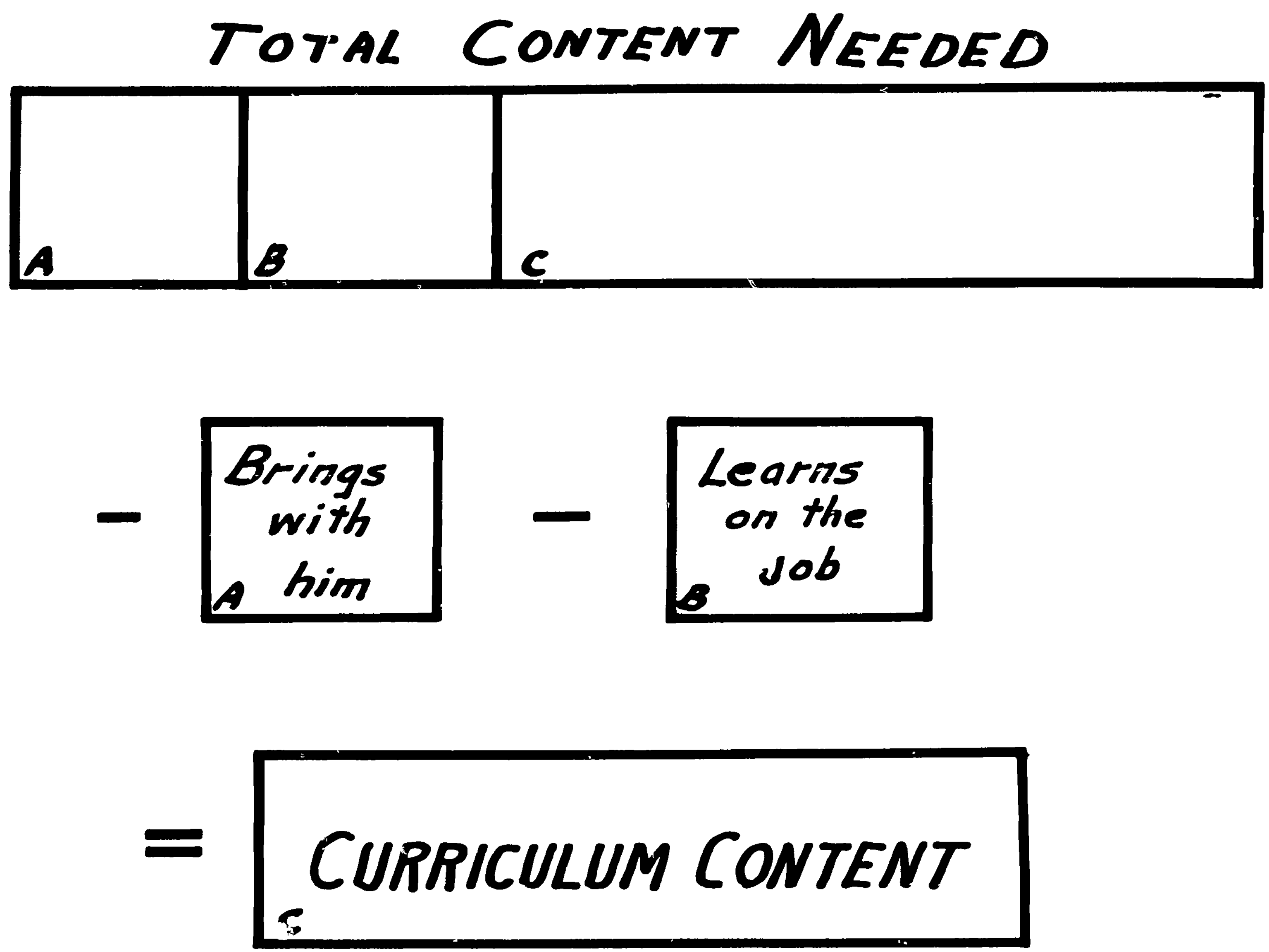
Mechanics and electricity are given special emphasis by a liberal use of applications. Auxiliary topics such as heat, sound and light are introduced but are given less emphasis.

All instructors of mathematics and science have technical education and experience.

The foregoing description is necessarily oversimplified. Many philosophical and practical problems arise in the process of developing a program in such broad and comprehensive fields as mathematics and science. There are areas of disagreement, for example, between advocates of pure mathematics and proponents of applied mathematics. In some schools, no discrete mathematics courses are included in technology curriculums; the mathematics is taught "as needed". By way of contrast, some schools will require a "common core" of mathematics for several curriculums. A similar variation is found with respect to the physical sciences in technology curriculums. Nevertheless, the program I have described is representative of on-going programs in successful schools.

This is not to say that what is being done now will be entirely adequate for the future. What can be said, however, is that the experiences of technical educators have shown that some of the traditional methods of teaching mathematics and science are not satisfactory for technical education. Technical education has a form and character of its own. Its genesis may lead some to call it a hybrid form of education - a strange mixture of college and vocational education. If this kind of a mixture is necessary, so be it. It will be infinitely better than a failure to provide good educational services by refusing to change from our traditional ways of doing things.

ERIC


TOTAL CONTENT NEEDED
A
B
C
–
Brings with him
A
–
Learns on the job
B
=
CURRICULUM CONTENT
C

PRINCIPLES UNDERLYING CURRICULUMS

TITLE EASILY UNDERSTOOD

CONTENT RANGE SUITABLE FOR 2-YR PROGRAM

CONTENT LENDS ITSELF TO SCHOOL INSTRUCTION

SUBSTANTIAL PORTION OF CONTENT IS TECHNICAL

APPROPRIATE DIFFICULTY LEVEL

FEASIBLE TO SECURE NEEDED EQUIPMENT

BUILT AROUND ESTABLISHED ENTRANCE REQ'TS

PROBLEMS ENCOUNTERED IN CURRICULUM PLANNING

"DUAL PURPOSE" CURRICULUMS

GENERAL ENGINEERING CURRICULUM

USING EXISTING COURSES THAT DON'T FIT

PATTERNING IT AFTER THE SKILLED CRAFT CURRICULUM.

QUALITY STANDARDS TOO LOW

ERIC

PROCEDURES IN CURRICULUM DEVELOPMENT

Setting up Objectives

Picking Job Clusters

Job Cluster Analysis

Setting Entrance Requirements

Curriculum Controls

Grouping Content into Areas

Tentative Course Titles

Allocating Content among Courses

Type of Instruction for Courses

Determine Course Lengths

Instructional Order of Courses

Course Allocation by Terms

Making Tentative Time Schedule

Revise courses, sequences, etc as needed.

ERIC

CURRICULUM CONTROLS

TOTAL PERMISSIBLE LENGTH OF PROGRAM
TERMS OR SEMESTERS
COURSES REQUIRED OF ALL STUDENTS
GENERAL EDUCATION MANDATES -- Total Hours
PRACTICE CONCERNING ELECTIVES
ENTRANCE REQUIREMENTS OF INSTITUTION AS A WHOLE
TYPE OF SCHEDULE - Term length, periods per day, etc.
DIPLOMA OR ASSOCIATE DEGREE REQUIREMENTS
POTENTIAL FOR SECURING NEEDED EQUIPMENT

ERIC

NUMBERS OF INSTITUTIONS OFFERING TECHNICIAN TRAINING PROGRAMS, BY STATE, BY TYPE

Listed in Technician Education Yearbook, 1965-66

	College or university	Community college	Technical institute	Area Voc'l school	High school	Total
Alabama	1	-	3	9	4	17
Alaska	-	-	-	-	-	-
Arizona	2	3	-	-	2	7
Arkansas	1	1	-	2	4	8
California	-	68	4	13	10	95
Colorado	3	6	-	2	1	12
Connecticut	-	1	5	11	-	17
Delaware	-	-	-	2	1	3
Florida	1	23	5	7	7	43
Georgia	3	2	1	22	-	28
Hawaii	1	-	2	-	-	3
Idaho	1	3	-	-	1	5
Illinois	3	18	9	-	7	37
Indiana	7	-	3	4	3	17
Iowa	1	8	-	6	2	17
Kansas	4	4	-	2	3	13
Kentucky	2	-	1	10	-	13
Louisiana	-	-	1	16	-	17
Maine	1	-	1	-	-	2
Maryland	-	7	1	2	3	13
Massachusetts	1	4	4	15	-	24
Michigan	6	15	4	1	8	34
Minnesota	-	2	-	16	-	18
Mississippi	-	11	-	-	3	14
Missouri	3	3	2	7	9	24
Montana	1	-	-	1	2	4
Nebraska	-	-	-	1	2	3
Nevada	1	-	-	2	3	6
New Hampshire	-	1	2	1	1	5
New Jersey	1	1	8	14	-	24
New Mexico	4	-	-	-	3	7
New York	-	22	5	3	21	51
North Carolina	1	5	11	5	-	22
North Dakota	1	-	-	-	-	1
Ohio	6	2	14	-	6	28

(continued)

Institutions offering technician training programs - continued.

	College or university	Community college	Technical Institute	Area Voc'l school	High school	Total
Oklahoma	5	8	-	-	1	14
Oregon	-	10	3	-	-	13
Pennsylvania	17	6	9	6	14	52
Rhode Island	-	1	2	1	-	4
South Carolina	-	-	-	6	2	8
South Dakota	1	1	-	-	1	3
Tennessee	-	-	2	1	10	13
Texas	6	28	-	-	5	39
Utah	6	-	-	2	-	8
Vermont	-	-	1	1	3	5
Virginia	1	1	2	2	3	9
Washington	-	14	-	6	-	20
West Virginia	3	-	-	1	6	10
Wisconsin	1	-	4	20	-	25
Wyoming	-	1	-	-	-	1
Dist. of Columbia	-	-	1	-	1	2
Puerto Rico	1	—	1	-	-	2
TOTAL	97	280	111	220	152	860

Rank order: States with 20 or more programs

California	95
Pennsylvania	52
New York	51
Florida	43
Texas	39
Illinois	37
Michigan	34
Georgia	28
Ohio	28
Wisconsin	25
Massachusetts	24
Missouri	24
New Jersey	24
North Carolina	22
Washington	20

ERIC

CURRICULUM OFFERINGS AND ENROLLMENTS FOR ASSOCIATE DEGREES IN COMMUNITY COLLEGES AND TECHNICAL INSTITUTES IN NEW YORK STATE, FALL 1963

(The 6 agricultural and technical institutes enrolled 6,339 students, the 25 community colleges enrolled 22,638. Of the total of 28,977 students enrolled, 21,695 were in occupational curriculums, 7,282 were in "transfer" curriculums.)

Curriculum	Number of schools offering curriculums	Enrollment
AGRICULTURE		
Agricultural business	4	109
Agricultural engineering	4	131
Agriculture, general	4	207
Agronomy	4	90
Agricultural science	1	13
Animal husbandry	5	340
Biological technology	1	72
Dairy industry	3	39
Dairy technology	2	31
Floriculture production	3	75
Flower shop management	1	7
Food processing technology	2	146
Greenhouse management	1	7
Landscape development	1	20
Nursery management	1	6
Ornamental horticulture	2	117
Poultry science	1	5
FOOD, MEDICAL AND HEALTH		
Culinary arts - hotel	1	47
Dental hygiene	6	702
Dental laboratory technology	3	197
Food service administration	2	272
Institutional foods	2	112
Medical laboratory technology	8	529
Medical office assistant	5	445
Nursing (R.N.)	13	967
Ophthalmic dispensing	2	104
Restaurant management	3	110
BUSINESS		
Accounting	22	1478
Banking, insurance, real estate	3	181
Business administration	20	2293
Fashion buying and merchandising	1	421
Fashion communications	1	36
Hotel administration	3	287
International trade marketing	1	40
Retail business management	11	877
Sales	1	29
Secretarial science	24	1924
Technical sales & marketing	1	52
Commercial art	2	178
Graphic arts	1	128
Fashion illustration	1	96
Advertising design	1	133
Marketing, industrial	4	178

New York State Curriculums and enrollments -- continued

	Schools	Enrollment
INDUSTRIAL & TECHNICAL		
Air conditioning technology	4	139
Aircraft operations technology	1	80
Automotive technology	3	259
Apparel and textile design	1	673
Building construction technology	8	1030
Chemical technology	9	547
Civil technology	5	296
Construction (business)	2	33
Diesel - gas turbine technology	1	20
Electrical - electronic technology	19	2114
Engineering science	22	1078
Industrial technology	3	257
Industrial instrumentation technology	2	31
Industrial laboratory technology	2	15
Mechanical equipment for buildings	1	6
Mechanical technology	14	1015
Mechanical power technology	2	125
Mechanical product & machine design	3	273
Metallurgical technology	2	178
Photographic equipment technology	1	35
MISCELLANEOUS		
Correction administration	2	11
Data processing	1	22
Nursery education	2	227
OCCUPATIONAL CURRICULA	31	21,695
LIBERAL ARTS	31	7,282
TOTAL		28,977

OCCUPATIONAL-CENTERED CURRICULUMS OFFERED IN 10 OR MORE JUNIOR COLLEGES IN CALIFORNIA -- FALL 1963

Curriculum	Number of junior colleges offering the curriculum
Secretarial, general	64
Electronics technology	54
Accounting and bookkeeping	52
Clerical office training	51
Drafting technology	49
Business management	44
Marketing and merchandising	40
Engineering technology	39
Automotive technology	38
Nursing - vocational	37
police science	37
Home economics	34
Advertising and commercial art	31
Secretarial - professional and technical	27
Nursing - registered	26
Machine shop technology	26
Architectural drafting	24
Dental assisting	23
Business data processing	22
Real estate	22
Journalism	19
Electrical technology	16
Welding	16
Cosmetology	16
Publication and printing	14
Auto body and fender	14
Agri-business	13
Music	13
Construction technology	13
Metal trades technology	13
Plant science - crop production	12
Photography - commercial	12
TV and radio production	12
Aircraft powerplant maintenance	12
Building trades	12
Cabinet and millwork	12
Animal science	11
Women's clothing - millinery design	11
Medical assisting	11
Theater arts	10
Aircraft airframe maintenance	10

Source: A Guide for California Public Junior Colleges - 1963-64

OCCUPATION-CENTERED CURRICULUMS OFFERED BY CALIFORNIA PUBLIC JUNIOR COLLEGES — Fall, 1963

Curriculum	Number of colleges
AGRICULTURE, HORTICULTURE, FORESTRY	
Agri-business	13
Agricultural engineering & mechanics	6
Agricultural management	5
Animal science	11
Dairy husbandry (industry)	4
Forestry	6
Horticulture, ornamental	7
Landscape design & contracting	5
Plant science - crop production	12
Retail nursery management	3
APPLIED AND GRAPHIC ARTS	
Advertising & commercial art	31
Interior design	3
Journalism	19
Music	13
Photography, commercial	12
Public relations	2
Publication & printing	14
Technical illustration	8
Technical writing	2
TV and radio production	12
Theater arts	10
Womens clothing design & millinery	11
BUSINESS AND OFFICE OCCUPATIONS	
Accounting and bookkeeping	52
Advertising	4
Banking and finance	3
Business data processing	22
Business management	44
Clerical office training	51
Food store management	3
Hotel and restaurant management	2
Insurance	7
Marketing and merchandising	40
Materials management	1
Medical-dental receptionist	7

Curriculum	Number of colleges
Business - continued	
Personnel management	3
Purchasing	1
Real estate	22
Secretarial - general	64
Secretarial - professional & technical	27
Stewardess training (airline)	8
Transportation & traffic management	7
HEALTH SERVICES	
Dental assisting	23
Dental hygiene	1
Dental technology	1
Dietician training	2
Medical assisting	11
Medical laboratory technology	2
Nursing - psychiatric	5
Nursing - registered	26
Nursing - vocational	37
X-ray technology	9
HOME ECONOMICS	
Home economics	34
TRADE AND TECHNICAL OCCUPATIONS	
Aeronautics	6
Aircraft (airframe) maintenance	10
Aircraft (powerplant) maintenance	12
Architectural drafting	24
Auto body and fender	14
Automated electronic control technology	2
Automotive technology	38
Building & grounds management	1
Building trades	12
Cabinet & millwork	12
Ceramics technology - industrial	4
Chemical technology	7

(continued)

California Junior College curriculums — continued

Trade & Technical Occupations - continued	
Construction technology	13
Culinary occupations	6
Drafting technology	49
Dry cleaning	2
Electrical technology	16
Electro-mechanical technology	2
Electronics - communications	6
Electronics technology	54
Electronics tube technology	2
Engineering technology	39
Garment manufacturing	1
Gunsmithing	1
Household appliance repair & service	2
Industrial management & supervision	7
Inspection technology, manufacturing	1
Instrumentation	3
Laboratory technology	8
Machine shop technology	26
Manufacturing technology	1
Mechanical technology	4
Mechanics - heavy equipment	9
Metal trades technology	13
Metallurgical technology	4
Mining	1
Music	1
Office machine repair & servicing	1
Ophthalmic optics	1
Painting & decorating	3
Petroleum technology	1
Physical science technology	1
Plastics technology	2
Power sewing	3
Radio and TV repair	6
Radiological technology	1
Refrigeration & air conditioning	5
Science data processing	2
Ship construction & repairing	2
Shoe rebuilding	1
Tailoring	2
Tool design & toolmaking technology	8
Upholstering	1
Vending machine repair	1
Welding	16

PUBLIC AND PERSONAL SERVICE OCCUPATIONS	
Cosmetology	16
Fire science	8
Library assisting	4
Linguistic receptionist training	1
Nursery school education	4
Police science	37
Professional travel guides	1
Recreation leadership	9
Social welfare aide	2
Translator & interpreter	1

Summary: Day Curriculums in California Junior Colleges

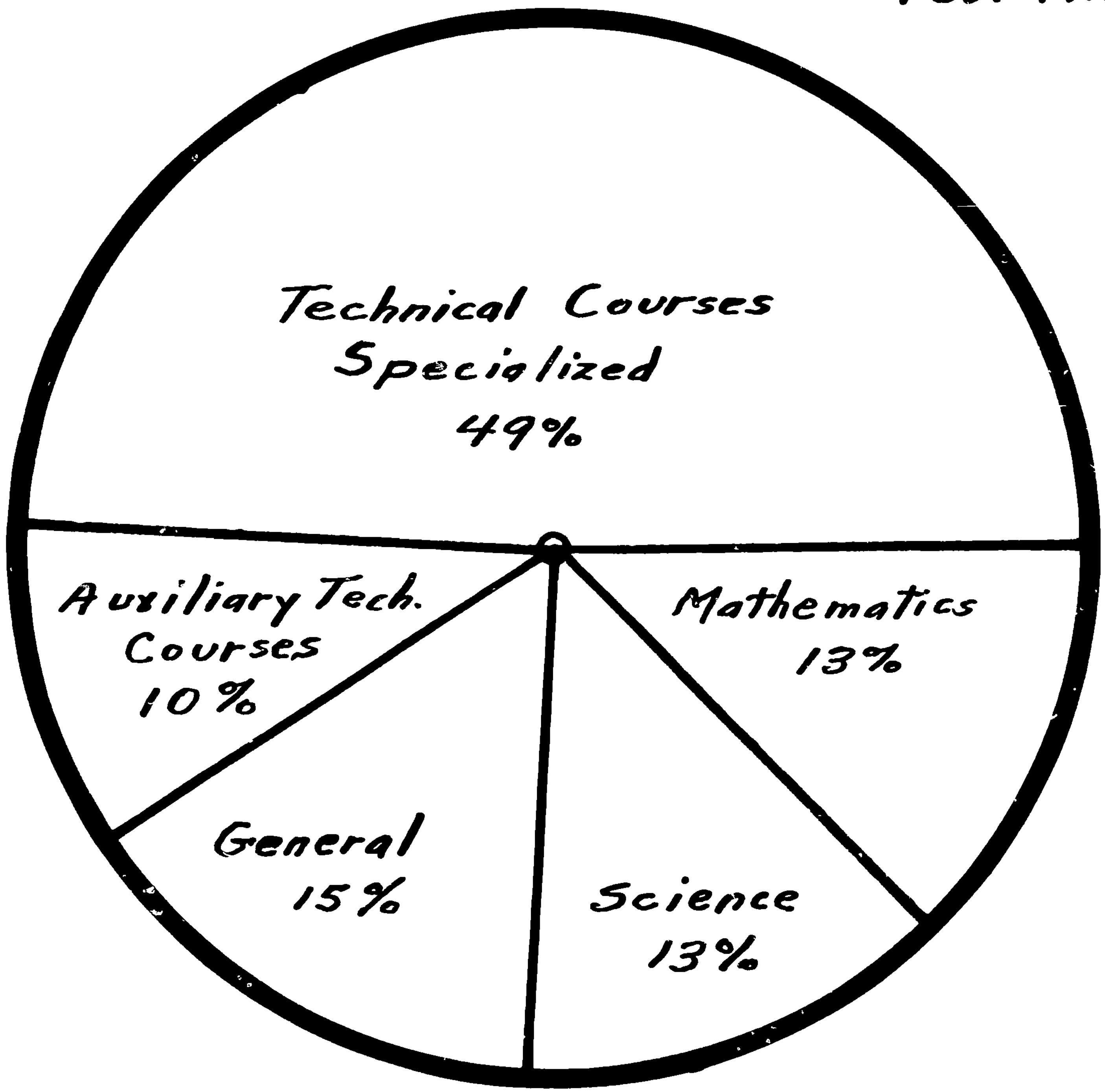
Total number of different curriculums offered, by major fields:

Agriculture, Horticulture, Forestry	10
Applied and Graphic arts	12
Business & Office Occupations	19
Health services	10
Home economics	1
Trade & Technical Occupations	55
Public and Personal Service Occupations	10
Total	117

Total number of junior colleges - - - - - 71

CURRICULUM CONTENT DISTRIBUTION

POST HIGH SCHOOL INSTITUTIONS



TECHNICAL SPECIALTY COURSES:
Basic and advanced courses in the specific technology (e.g. machine design)

AUXILIARY AND SUPPORTING TECHNICAL COURSES:
Mechanical drawing (general), shop, technical report writing

MATHEMATICS COURSES:
Algebra, trigonometry, analytic geometry, calculus

SCIENCE COURSES:
Physics, chemistry, mechanics, hydraulics, thermodynamics, etc.

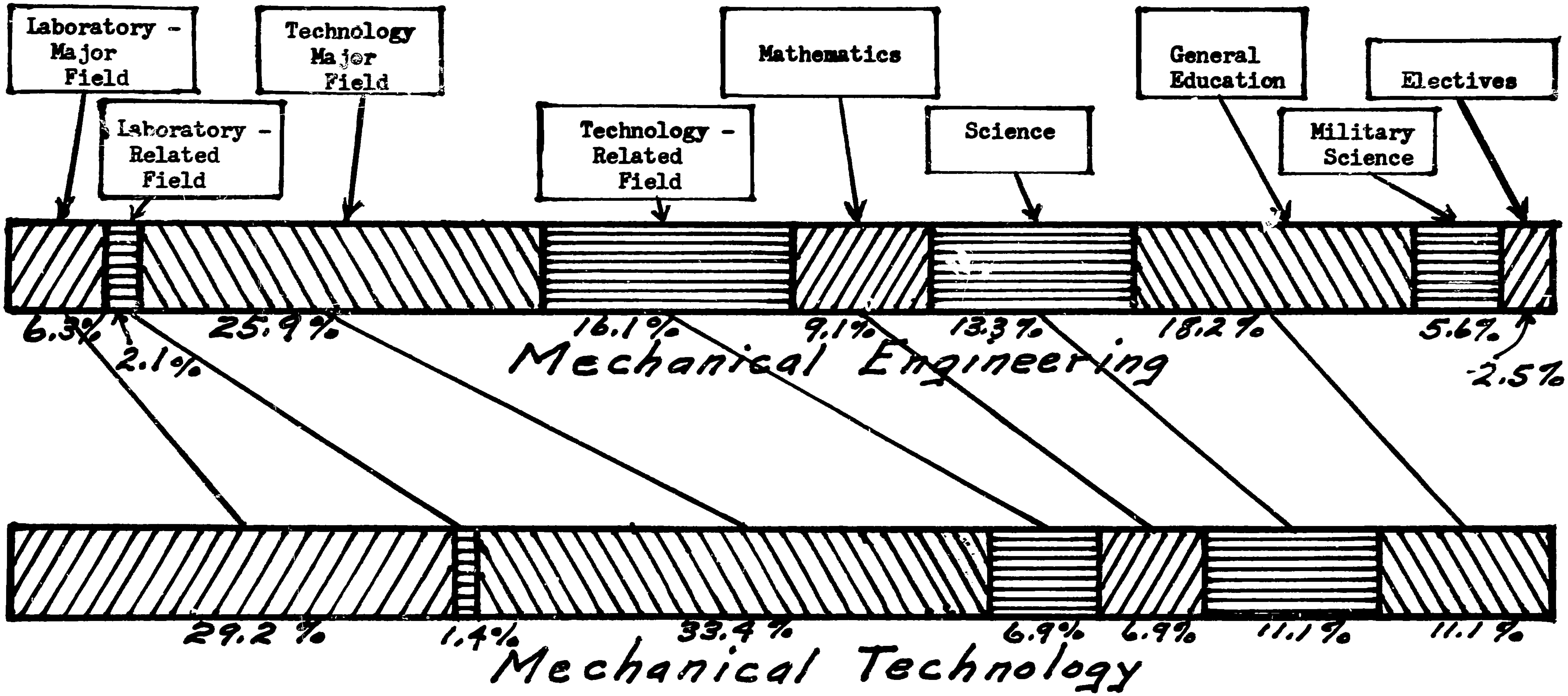
GENERAL EDUCATION COURSES:
Communications, humanities, social studies, health

SOURCE: RONEY - OCCUPATIONAL CURRICULUMS (OE-80015)

COMPARATIVE CURRICULUM CONTENT

Mechanical Engineering - Mechanical Technology

Percentage - Semester-Hours (Oklahoma State University - 1965)



CRITERIA FOR SELECTION OF TEXTBOOKS

CONTENT COVERAGE
ABILITY LEVEL NEEDED FOR MASTERY
BACKGROUND REQUIRED
USE OF ILLUSTRATIONS
READABILITY OF TEXT MATERIAL
UP-TO-DATENESS OF CONTENT
ORGANIZATION OF CONTENT
COST
REFERENCE MATERIAL AVAILABLE
STYLE OF FORMAT
QUALITY OF PRINTING

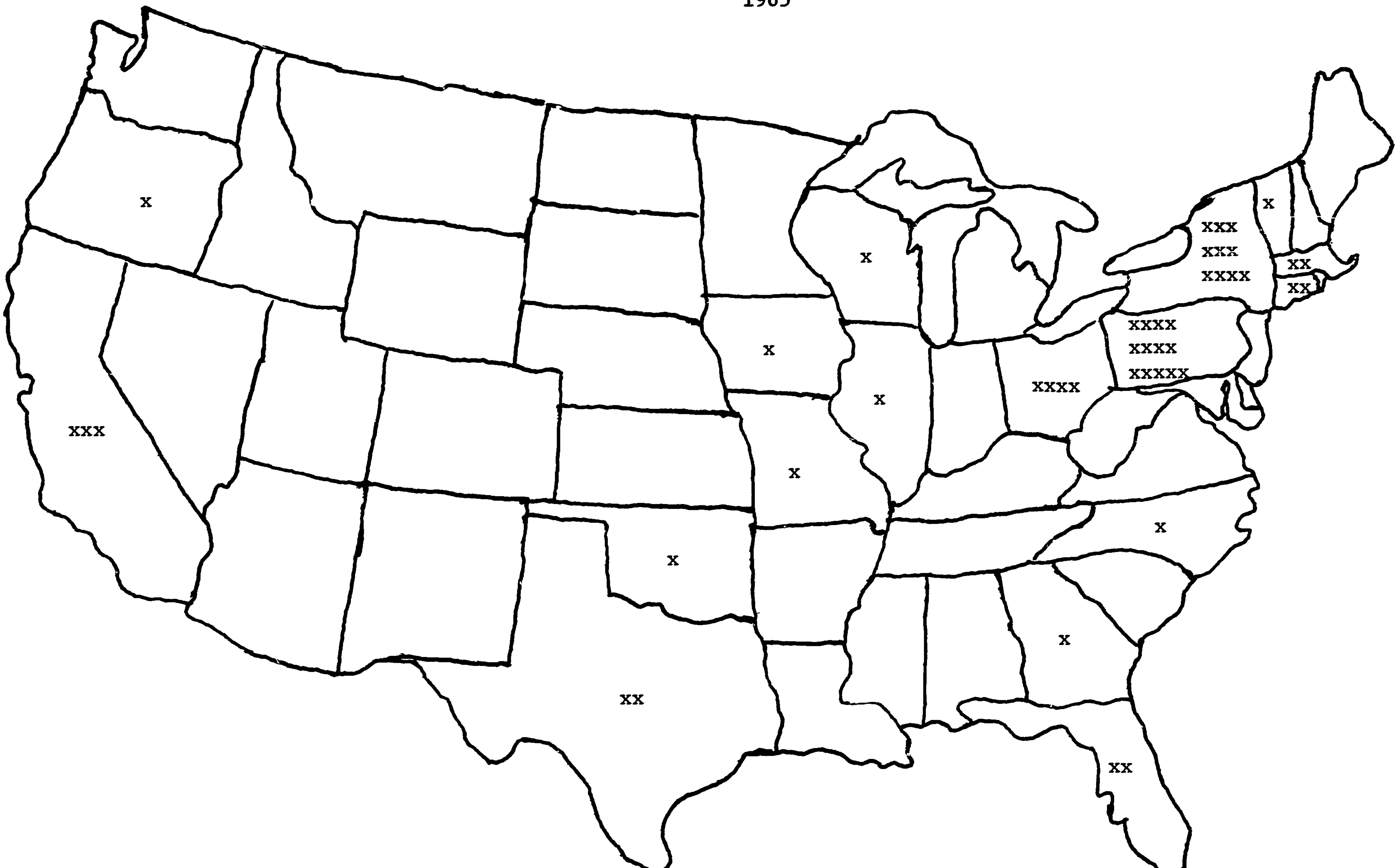
E.C.P.D - Engineering Technician Curriculums

Recommended Minimums

	Sem-Hrs
Mathematics	9 - 12
Physical Science	6
Oral & Written Communication	6
Humanistic - Social	6 - 9
Engineering Graphics	3
Mfg - Construction Techniques	3
Technical Specialties	24 (30-50 %)
Total	60

NUMBERS OF INSTITUTIONS WITH E.C.P.D. ACCREDITED CURRICULUMS FOR TECHNICIAN TRAINING

1965



E. C. P. D. ACCREDITATION OF TECHNICIAN TRAINING CURRICULUMS, BY STATES — 1965

STATE	NUMBER OF SCHOOLS WITH ACCREDITED CURRICULUMS	NUMBER OF ACCREDITED CURRICULUMS
California	3	14
Connecticut	2	8
Florida	2	2
Georgia	1	8
Illinois	1	1
Iowa	1	3
Massachusetts	2	16
Missouri	1	2
New York	10	35
North Carolina	1	4
Ohio	4	10
Oklahoma	1	5
Oregon	1	6
Pennsylvania	13	26
Texas	2	10
Vermont	1	1
Wisconsin	1	6
District of Columbia	1	1
18 States	48	158

Source: 33rd Annual Report - E.C.P.D.

E. C. P. D. ACCREDITATION OF TECHNICIAN TRAINING CURRICULUMS

1965

CURRICULUM	NUMBER OF SCHOOLS OFFERING THE CURRICULUM
Electronics technology	23
Mechanical technology	21
Design and drafting technology	20
Electrical technology	17
Electrical-electronics technology	12
Civil technology	9
Construction technology	8
Heating and air conditioning technology	6
Chemical technology	5
Aeronautical technology	4
Highway engineering technology	3
Industrial engineering technology	3
Mechanical power technology	2
Tool technology	2
Architectural technology	2
Structural technology	2
Surveying technology	2
Computer engineering technology	2
Electro-mechanical technology	1
Mechanical design engineering technology	1
Machine processes technology	1
Materials engineering technology	1
Metallurgical technology	1
Aircraft maintenance technology	1
Automotive technology	1
Diesel - gas turbine technology	1
Gas engineering technology	1
Industrial engineering technology - mamagement option	1
Production engineering technology	1
Nuclear engineering technology	1
Fire protection technology	1
General engineering technology	1
Commercial broadcast technology	1

Total number of curriculums accredited - - - - 158

Source: 33rd Annual Report - Engineers' Council for Professional Development

VII. FACILITIES AND EQUIPMENT

RATING FORM
for
THE SELECTION OF SCHOOL SITES

Location of Site ______________________________

Site Size ____________ acres

Assessed Value ____________

Appraised Value ____________

Present Owner ____________

Availability ____________

____

____

(insert photo of site)

RATING OF SITE

Basic Conditions	Ideal Score	Actual Score	Percentage Rating 0	10	20	30	40	50	60	70	80	90
1. Size	400											
2. Topography	250											
3. Location	200											
4. Cost	150											
Total	1000											

GENERAL RATING OF SITE

____

____

____

ADAPTED FROM: INSTITUTE OF FIELD STUDIES....TEACHERS COLLEGE.......
COLUMBIA UNIVERSITY

SCHOOL SITE RATING FORM

INSTRUCTIONS: Score items as follows: 5 - Very Superior, 4 - Superior, 3 - Average, 2 - Below Average, 1 - Poor, 0 - Very Poor. Multiply score times weight and enter result in "total" column.

BASIC CONSIDERATIONS	SCORE	WEIGHT	TOTAL	GRAND TOTAL	NOTES
I. SIZE					
1. Size		60			
2. Expansibility		20			
II. TOPOGRAPHY					
1. Elevation		10			
2. Drainage		10			
3. Soil		10			
4. Contour		10			
5. Shape		5			
6. Natural Features		3			
7. Attractiveness		2			
III. LOCATION					
1. Central Location		5			
2. Type of Neighborhood		5			
3. Zoning		5			
4. Accessibility		5			
5. Traffic Arteries		3			
6. Water Lines		3			
7. Sewers		2			
8. Electricity		2			
9. Gas Lines		1			
10. Fire Protection		2			
11. Public Transportation		2			
12. Parks and Playgrounds		2			
13. Natural Hazards		1			
14. Noise		1			
15. Odors and Dust		1			
IV. COST					
1. First Cost		10			
2. Site development		5			
3. Building Removal		5			
4. Installation of Utilities		5			
5. Street Development		5			
GRAND TOTAL					

Standardization of Educational Specifications

WALTER L. NELMS

Dr. Nelms is an assistant professor, School of Education, Memphis State University, Memphis, Tenn.

The title of this article may cause some to be skeptical of its merit. For this reason it is vital to read the article from the correct perspective. The information presented is not an attempt to stereotype the construction of school plants. The purposes are to present arguments for standardizing the procedures by which school buildings are planned and to present the elements of an instrument designed for this purpose.

Most educators involved in school-plant planning will agree that the use of educational specifications is not widespread. Some of the possible reasons for the exclusion of this document may be (1) educational specifications are not accepted by some plant planners as necessary in school-plant planning; (2) diversification among planners as to what data should be included in educational specifications; (3) the lack of established acceptable methods by which this data may be presented to the architect; (4) the time element involved in preparing useful educational specifications; (5) the pressing need for school facilities which does not allow time for preparing a multipage document of the plant requirements of the educational program; (6) the misconceived opinion that the educator has little or no responsibility for assisting in the planning of new school facilities; and (7) the unawareness of the real value of adequate educational specifications to the usefulness of the completed school plant as well as to the architect.

Reasons for Standardization

The following four premises compose a minimum list of reasons defending the importance of some type of standardization of the procedures for writing educational specifications.

1. Most writers of educational literature dealing with school-plant planning agree that the formulation of adequate educational specifications is among the most important steps leading from the recognition of a need for new school-plant facilities to the ultimate acceptance of a plant to fulfill those needs. The unfortunate fact that the step of writing educational specifications is often eliminated, for one or more of the reasons mentioned earlier, has little or no relation to the importance of educational specifications. The possibility of an adequate school plant being constructed without the benefit of written educational specifications is a tribute to school architects and not to educators or school boards. The architect's basic responsibility is to design a building so that it will be structurally sound; this is accomplished through good design and architectural specifications. The educator's basic responsibility is to insure that the plant is adequate for the educational program to be conducted; this must be accomplished through educational specifications.

2. The rate of the construction of school plants is not diminishing to an important degree. It seems that the more classrooms that are constructed the larger the school-age population to fill them. If these new school plants are going to be adequate for changing educational programs, they must be soundly planned from an educational as well as architectural point of view.

3. True economy in school-plant construction is obtained when the school plant provides precisely what the educational program demands — certainly no less. It is conceivable that school plants constructed in 1965 may still be in use in 2065. A prerequisite to this statement must be that only those schools which are soundly planned architecturally and educationally will be utilized for long periods of time. Any part of a school plant which is not functional is a waste of construction dollars; any part of a school plant needed but omitted is a waste of educational talent and opportunity. The only method available to insure that neither of these situations is allowed to exist is through adequate educational specifications.

4. Most school districts involved in planning school plants need assistance in this planning effort. This assistance may be obtained from several sources; there is one source which as yet remains untapped, and it should be considered for it has potential as one of the most valuable of all sources. This is the use of a standard form for writing educational specifications. Immediately some will say that procedures used for writing educational specifications cannot be standardized. This is not the case. We cannot say that something cannot be done simply because it has not been tried. It is readily admitted that each school plant is, and must be, specifically designed for particular educational needs. However, we should consider that basically the same questions must be asked and answered when preparing educational specifications for any school plant. Only the answers are different; the questions and problems are basically the same whether the plant is to be constructed in Maine or California,

Mississippi or New York. Therefore, the content of educational specifications can be standardized. Only the answers to content questions must vary with the individual school being planned. It is on this basis that the study described below was conducted.

This study was concerned with the possibility of the development of a standard form to be used as an implement for preparation of written educational specifications for elementary and secondary school buildings. The form was created after an intensified search of literature dealing with all phases of school-plant planning. This literature was sifted to determine what data was essential to the adequate planning of each area of a school as well as the school plant as a whole. In order to validate items which writers of literature deemed essential to adequate educational specifications, a detailed outline of the form was submitted to 19 outstanding men involved in school-plant planning. This panel was composed of four school architects, four state directors of school-plant planning and management for their respective states, four local administrators of school-plant planning or management for selected urban school districts, three college professors who taught school plant, two members of the School Housing Section of the United States Office of Education, and two members of the school planning section of Educational Facilities Laboratories. This questionnaire contained 209 items to which each member of the panel was to respond either necessary or unnecessary in adequate educational specifications. Of these 209 questions, eight were considered by the panel to be unnecessary in written educational specifications. An analysis of the questionnaire returns revealed that there was no significant difference of disagreement among the various groups of the panel.

Conclusions of the Study

The results of this study led to the following conclusions:

1. There is general agreement among the various groups of school-plant field personnel as to the necessary elements of written educational specifications.

2. There is general agreement between school-plant field personnel and writers of school-plant literature as to the necessary elements of written educational specifications.

3. The information which architects usually need from educational specifications can be identified as a result of the general agreement shown in Conclusions 1 and 2.

4. As a result of the general agreement shown in Conclusions 1 and 2 and based on Conclusion 3, a standard form to be used as an implement for writing educational specifications could be devised for general use in school-plant planning.

Following is an outline of a form devised for this purpose. The form itself is much too long to include, and the outline presented is quite general and does not list the questions of the form, but only a skeleton of the areas covered by the form, and in some cases the type of information called for by the questions of the form.

OUTLINE OF STANDARD FORM

I. General Data Section

A. Identification data
   1. Time placement of plant planning and construction
   2. Locale placement of the school-plant construction
   3. Personnel identification
   4. Type of construction

B. Educational philosophy of the school and community
   1. Educational goals
   2. Anticipated methods and techniques of teaching
   3. Ways school plant may aid in reaching educational goals

C. School organization
   1. Type of school
   2. General school and class size data
   3. Curriculum content
   4. Activity curriculum content
   5. Special services to be offered by the school

II. Site Selection and Development

A. Site selection
   1. Site selection committee
   2. Checklist for site selection
   3. Geographical data of selected site
   4. Site size and shape

B. Site development
   Site development checklist

III. School Environmental Factors*

A. General characteristics of environmental factors
B. Spatial factor
C. Thermal factor
D. Lighting factor
E. Sonic factor
F. Aesthetic factor
G. Safety factor
H. Balance of environmental factors

IV. Administrative Suite

A. General characteristics of the suite
   1. Purposes
   2. Location
   3. General spaces to be provided

B. School executives' quarters
   1. Superintendent's office space
   2. Principal's office space
   3. Assistant principals', deans', or supervisors' offices
   4. General office space
   5. Guidance suite
   6. Health suite
   7. Administrative conference room(s)
   8. Teachers' lounge

V. Auditorium

A. General characteristics
B. Location
C. Seating space
D. Stage requirements
E. Dressing rooms
F. Auxiliary rooms

VI. Food Services Section

A. General characteristics
   1. Purposes of the food services center
   2. Location of the food services center
   3. General spaces to be provided

B. Food preparation center
   1. Food circulation flow chart
   2. Receiving dock
   3. Kitchen area
   4. Storage rooms
   5. Manager's office space
   6. Housekeeping equipment and supplies storage

C. Dining area(s)
   1. Organization of the dining area(s)
   2. Equipment for the dining area(s)

D. Environmental aspects of the food preparation center
   1. Structural design
   2. Plumbing requirements
   3. Lighting and electrical requirements
   4. Aesthetic requirements

VII. Physical Education Suite

A. General characteristics
   1. Purposes and location of suite
   2. General spaces to be provided

B. Gymnasium floor space
   1. Construction data for gymnasium floors
   2. Playing-floor markings
   3. Gymnasium seating

C. Smaller activity rooms
   General characteristics and location of auxiliary rooms

D. Physical-education classrooms
E. Swimming-pool requirements
F. Dressing rooms
G. Shower-room requirements
H. Toilet-room requirements
I. Team-room requirements
J. Equipment drying rooms
K. Laundry-room requirements
L. Equipment-storage requirements
M. Physical-education offices
N. Outdoor physical-education facilities

VIII. Group Rest-Room Facilities

A. General characteristics
B. Group rest-room equipment

IX. Library

A. General characteristics
   1. Purposes and location
   2. General use of spaces to be provided

B. Specifications for specific library areas
   1. Student reading rooms
   2. Storage space for books and periodicals
   3. Librarian's office and workroom
   4. Studio and control room for ETV
   5. Individual study carrels
   6. Library conference rooms

X. School Circulation

A. Corridors
B. Stairways
C. Exits
D. Bus-loading platforms and traffic lanes
E. Other vehicle traffic lanes

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* Planning of boiler rooms, electrical services, sanitary services, etc., is a special problem of the engineer rather than of the educator who is doing the educational planning of a school.

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F. School commons

XI. Teachers' Offices

A. General characteristics
B. Organization of the teachers' offices
C. Size of teachers' offices
D. Equipment and furniture of the teachers' offices

XII. Custodial Services

A. General spaces required for custodial services
B. Location of the central custodial services in the plant
C. Description of custodial storage room(s)
D. Description of custodial internal storage spaces
E. Description of custodial external storage spaces
F. Head custodian's office
G. Custodial equipment to be stored

XIII. Science Suite

A. General characteristics
B. Requirements of the general science room(s)
C. Requirements of the biology room(s)
D. Requirements of the chemistry room(s)
E. Requirements of the physics room(s)
F. Darkroom requirements
G. Requirements for special science areas
H. Science storage facilities

XIV. General Classroom Section

A. General characteristics of the general classrooms
  1. Purposes and location of the general classrooms
  2. General classroom size requirements
B. Activities of the general classrooms
  1. Teaching techniques to be used
  2. Nonteaching activities
C. Equipment and furniture for the general classrooms

XV. Special Classrooms Section

A. General characteristics of the special classrooms
  Subjects which require special classrooms and their general location within the building
B. Home-economics suite
C. Business-education suite
D. Music facilities
E. Art room(s)
F. Industrial-arts suite
G. Language laboratory

XVI. Kindergarten Section

A. Kindergarten room size requirements
B. Location of the kindergarten room(s)
C. Kindergarten program
D. Auxiliary space for kindergarten classrooms

XVII. Primary Classroom Section

A. Primary organization
  1. Definition of primary classroom
  2. Primary classroom size requirements
  3. Location of primary classrooms
B. Primary program of activities
C. Auxiliary space for primary classrooms

XVIII. Intermediate Classroom Section

A. Intermediate classroom organization
B. Intermediate program of activities

XVIX. Multipurpose Room Section

A. General characteristics of multipurpose rooms
B. Activities of multipurpose rooms
C. Size requirements of multipurpose rooms
D. Location of multipurpose rooms

XX. Classrooms for Exceptional Children

A. General characteristics of the classrooms for exceptional children
B. Facilities for trainable children
C. Classrooms for educable children
D. Facilities for children with motor handicaps
E. Facilities for children with speech and hearing handicaps
F. Facilities for children with visual handicaps

PLANNING FACILITIES - COSTS

The following overall costs of facilities built for four separate technical institutes were provided by the Connecticut State Department of Education.

1.	Location of Technical Institute	Hartford	Norwalk	Norwick	Waterbury
2.	Starting date of building	1959	1959	1962	1962
3.	Maximum Student Capacity	360	600	360	450
4.	Number of classrooms	6	15	7	10
5.	Number of Laboratories	9	14	10	11
6.	Drafting Rooms	5	4	3	3
7.	Library	1	1	1	1
8.	Audio-Visual Room	1	1	1	1
9.	Student Dining Room	Shared	1	-	1
10.	Faculty Dining and Conference Room	-	1	-	1
11.	Administrative Offices	5	5	5	5
12.	Combination Gymnasium-Auditorium	Shared	1	-	Assembly
13.	Bookstore	1	1	1	1
14.	Faculty Offices	3	3	1	2
15.	Student Study area	2	2	1	2

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16.	Service Building	-	1	1	1
17.	Total Square Foo Area of School	47,380	102,003	55,100	71,200
18.	Cost Per Square Foot, including cost of built-in equipment, also site development	$18.95	$18.38	$21.66	$21.41
19.	*General Construction Cost Per Square Foot	.90	1.08	1.25	1.28
21.	*Heating & Ventilating Cost Per Square Foot	2.06	1.80	1.99	2.20
22.	* Electrical Cost Per Square Foot	2.31	1.59	3.19	3.20
23.	Estimated Total Cost of Additional Equipment Not in General Building Contract	--	722,068	464,134	494,262

24. Cost per student - $\frac{\text{Lines } (17 \times 18) + 23}{\text{Line} \quad 3} =$

*Note - Line 19, 20, 21, 22 are included in, but are only a part of the total cost shown in Line 18.

The following cost data for specific facilities for teaching various technical programs were also provided by the Connecticut State Department of education, based on bids obtained in 1962: 1/

Name of Rooms	Room Size	Area Sq. Ft.	Cost including Built-in Equipment	Additional Equipment	Total Maximum	Total Maximum
MECHANICAL, CIVIL, AND/OR METALLURGICAL TECHNOLOGY						
Drafting Room (24 large tables)	28' x 44'	1232	$ 23,600	$ 6,400	$ 20,000	$ 33,000
Drafting Room (28 small tables)	28' x 44'	1232	23,600	3,300	26,900	27,000
Metal Working Lab. including storage	28' x 60'	1680	31,000	89,000	120,000	125,000
Metallurgical Lab. including storage & dark room	28' x 60'	1680	31,000	21,000	52,000	58,000
Physics Lab. including storage	28' x 56'	1568	28,800	22,200	51,000	56,000
Material Testing Laboratory	28' x 40'	1120	20,600	30,000	50,600	55,000
ELECTRICAL, AND/OR ELECTRONIC, AND/OR INSTRUMENTATION TECHNOLOGY						
Electrical Power Lab. including storage and reference library	28' x 60'	1680	30,900	98,000	128,900	134,000
Electric Circuit Lab. including storage and reference library	28' x 64'	1792	33,000	44,000	77,000	33,000
Servo Control Laboratory	28' x 16'	448	8,200	16,000	24,200	26,000
Electronics Lab. including storage and Instrumentation Laboratory	28' x 56'	1568	28,800	55,700	81,500	89,000

1/ Note that the laboratories listed for each group of technologies does not necessarily include all facilities need for the technologies. For example, a physics laboratory is needed for teaching the electrical group of technologies and for chemistry. Similarly, a chemistry laboratory is needed for teaching metallurgy.

Name of Rooms	Room Size	Area Sq. Ft.	Cost including Built-in Equipment	Additional Equipment	Total Maximum	Total Maximum
CHEMISTRY TECHNOLOGY						
General Chemistry Lab. including storage	28' x 52'	1456	$26,800	$15,600	$44,000	$47,000
Organic Chemistry Lab. including storage	28' x 48'	1344	24,700	57,000	81,700	86,000
Quantitative " " " "	28' x 48'	1344	24,700	6,700	31,400	36,000
Instrument Lab. including Dark and Balance Rooms	28' x 44'	1232	22,600	38,400	61,100	65,000
Unit Operations Lab. including 2 story Erection Area	28' x 56'	1568	28,800	57,000	85,000	91,000
RELATED FACILITIES						
Classroom 35 capacity	28' x 28'	784	14,400	1,000	15,400	18,000
Lecture Room (40 capacity tiered seating	28' x 24'	672	12,300	300	12,600	15,000
Audio-Visual Room	28' x 12'	336	6,200	5,500	11,700	12,800
Conference Room	28' x 15'	420	7,700	1,100	8,800	10,200
Lecture Room (700 capacity tiered seating)	28' x 32'	896	16,500	2,900	19,400	22,300
Library including Librarian workroom (not including books)	28' x 60'	1680	30,900	24,000	54,900	60,400
Bookstore	28' x 12'	336	6,200	2,000	8,200	9,300
Student Lounging Room	28' x 44'	1232	23,600	4,000	27,600	30,700
Student Dining Room	44'6" x 116'3"	5173	95,100	5,900	101,000	118,000
Kitchen and Serving Area	36' x 44'6"	1602	29,500	5,000	34,500	39,700
Faculty Dining Room	28' x 15'	420	7,700	1,000	8,700	10,100
Administrative Offices	28' x 64'	1792	33,000	13,600	46,600	52,400

VIII. STAFFING

FACULTY QUALIFICATIONS FOR TECHNICIAN EDUCATION PROGRAMS

Some highlights of the recommendations made in the A.S.E.E. study "Characteristics of Excellence in Engineering Technology Education".

Desirable attributes:
- Intelligence
- A genuine interest in developing students
- Personal and professional integrity
- Capacity for communicating ideas in oral and written form
- Thorough knowledge of subjects taught and of relevant supporting subjects
- Skill in the fundamentals of the teaching-learning process

All members of the engineering technology faculty (technical and non-technical) should be familiar with and sympathetic toward the goals of this type of education.

A high proportion of the faculty should have acquired at least a bachelor's degree. Half the faculty members teaching the technical specialties should be graduate engineers or the equivalent.

Engineering technology graduates who have continued their education toward a higher degree in their field often make excellent teachers in these programs.

A significant portion of the faculty must have had relevant industrial experience of current nature, and must maintain technical competence.

CHARACTERISTICS OF SUCCESSFUL TEACHERS OF TECHNICAL EDUCATION

A summary of the findings of a study conducted by the School of Education of Oregon State University, as reported by George Storm, principal investigator.

The study dealt with a total of 406 instructors, in 195 schools, in 38 states. These instructors were evaluated by their supervisors, and data gathered from selected groups.

"The average high success instructor, as represented by the study participants, was male, 41 years of age, married, and had two children. He received his technical preparation from three sources: post-high school technical programs, industry, and four-year colleges and universities. In college, he completed 24 semester units of academic work in his subject field and 17 units in Education Courses. The successful instructor was a graduate of a State University with a B.A. or B.S. degree in Education or Engineering.

The high success instructor began his teaching career at age 30, after nine years of technical work experience in industry. He is teaching in a vocational-technical school or community college, between 21 and 24 hours per week, and has an average of 23.1 students in his classes. Currently he is earning $10,434 per year. He is probably teaching in some phase of Electronics, Drafting, or Mechanical or Machine Technology. He holds membership in a technical society and a national educational organization.

The successful technical teacher has no doubt about the need for industrial experience for instructors -- he is definitely in favor of it. In addition to this, he believes that all candidates for technical teaching positions should be required to pass a qualifying examination in their respective subject fields. For the "ideal" technical teacher education program he recommends 29 semester hours in the "basics" (English, Speech, Psychology, Mathematics, and Physical Science), 17 units in technical subjects, 32 units in specific Education subjects, 4 units of supervised teaching, and 5 units of electives. His total recommendation came to 87 units. "

Source: Duplicated memorandum from Professor Storm.
(See also article in Technical Education News, February 1966)

THE TECHNICAL TEACHER
HIS JOB

William R. Hawthorne
U.S. Office of Education

All teachers are characters, as anyone who has seen a motion picture or looked at TV knows. And no two teachers are absolutely alike, as anyone also knows. So in talking about technical teachers as if they were a special breed we have to make general statements that will fit quite a number, and outrageous statements to point up the characteristics of a few. Certainly they are not all cast from the same mold -- and thank goodness for that.

It would not seem too difficult a task to write about technical teachers by one who has been such a teacher. But, as I undertook the task I found myself thinking of real teachers and actual situations with a tendency to arrive too quickly at the general from the specific.

There was the great temptation to tell about the odd, the lady who rode the tiger sort of thing, the teacher who always wore white ties, the chemistry teacher who prepared his food and drink from reagents in the laboratory, the science teacher who taught with his dog under the desk, the drawing teacher who started three fires by putting his lit pipe in his coat pocket and hanging it in the closet and the electricity teacher who never looked at the class but taught the blackboard with a 36 inch slide rule.

It is a fact, of course, that technical teachers work in a number of types of schools including comprehensive high schools, vocational high schools, technical high schools, community colleges, junior colleges, technical institutes and universities. This means a range of situations from where he may be the only technical teacher in a large academic faculty, such as one might find in a comprehensive high school, to being one of many technical teachers comprising a large part of the total faculty, such as in a technical institute. The generalities that follow, therefore, will not apply to all technical teachers, but have been derived from observations of many technical teachers in many situations.

What generalities can one make? If odd characters are in sufficient quantity and generally accepted this is a generality in itself. One principal who has known many says they are prima donnas. Groups of technical teachers have accepted, "You can always tell a technical teacher, but you can't tell him much," with pride rather than umbrage.

The technical teacher is what he is because of his previous experience and training and what the job demands of him. He has had a scientific or engineering type of training which always gaits one's thinking in a certain way. On top of this he has had practical experience -- work experience. This immediately separates him from some of his colleagues who have never been beyond the educational cloister and, it is feared gives him a superior air. Add to this that in most cases he has a competency which no one else on the faculty has and you have the ingredients of a distinct character.

It might be well to dwell a bit more on the factor of work experience. The technical teacher, along with all vocational teachers, feels that his experience enhances him as a teacher. He even feels, since this requirement of his preparation for teacher seems to be given scant consideration in salary schedules, that perhaps all teachers should be required to have it in order to bring about a greater appreciation of its value. How can the teacher prepare students for occupational productivity if he has not had the experience himself? How can he point out the applications of the principles he teaches if he is not thoroughly familiar with them?

The strictly academic teacher, on the other hand, feels that teaching is a life's work, a profession, and that the dedication should come early so that all training will be toward that work. He or she makes a great point of scholarship and abstract information, generally meaning the recognition of great thoughts, the aesthetic things, culture. He believes that by proper study one can acquire knowledge of subject matter sufficient to teach. He is suspicious of anyone who comes into teaching as a second choice of vocation, a vascillation, and confirmation of the nasty saying that if one cannot succeed he teaches.

So the academic teacher feels that the technical teacher is not scholarly and is too mundane; and the technical teacher feels that the academic teacher is too narrow and not practical. This may be unfortunate and something to which we should all devote ourselves toward better understanding, but it does exist and must be recognized in any discussion of the technical teacher.

Much of what has been expressed above may be unfair to academic teachers. It should be remembered, however, that it is written by a technical teacher and in a fair measure expresses the philosophy of the greater part of technical teachers. The question is not whether these opinions are logical or beneficial to the profession but whether they are generally true.

The technical teacher is illogical and a bundle of anomalies. He approaches life by the scientific method and abhors the inefficiency, but he may be a poor housekeeper. He wants system; but, being creative and inventive, he may be a dreamer. He can be interested in an organization plan or a utopia but not be a humanitarian, he is apt to be impatient with human foibles. He is interested in exactitude and efficiency and may be poor at keeping his own books. He is alert to improving production and the economy of cutting costs by improving design, but unconscious of his own market value. He thinks the salvation of the human race is education and education courses are a waste of time.

The technical teacher is a subject specialist and he is not a subject specialist. The boundaries of his subject matter reach out and overlap others. Thus, it is more likely that a strength of materials teacher can teach mathematics or physics than the other way around. The strength of materials teacher might also teach machine design or drafting. In fact, a guess might be ventured that the average technical teacher teaches more different subjects than any member of the faculty.

There are two reasons for this. First, (and we are talking about <u>good</u> technical teachers) because his training has been so thorough that he is competent, subject wise, to teach more than his specialty. Second, he generally is the odd man of the faculty. He is hired to teach strength of materials or machine design or electronics, or whatever the specialty is, and then, since this would only be ten periods a week, it is natural to ask him to teach something else.

Even in teaching his own subject he reaches more across subject lines than other subject teachers. You might say he is a special subject generalist. (Generalist being an expression much in vogue by educators who are specialists in nothing.) When an English teacher teaches English it is mostly English. A mathematics teacher teaches mathematics. They stick pretty much to their lasts.

The technical teacher is different. He teaches his subject, but he teaches <u>across</u> subject lines. An electronics teacher will have to pause to give a physics lesson on Doppler's Principle; a power teacher will have to stop to re-teach the Laws of Pascal, Charles and Boyle. In teaching metallurgy there will be some re-teaching of chemistry. The teacher of electricity will have to devote time to solving the root mean square value when he introduces the sine wave.

Some will immediately say that the mathematics teacher can do this. All good mathematics should be taught with applications. In fact there are books that tell the mathematics teacher how to do it such as, <u>Basic Mathematics for Television and Radio.</u> If a mathematics teacher would teach this way, he is a technical teacher and would be highly competent in electronics and could teach that subject. Incidentally the man who wrote the book is an electrical engineer.

Besides this overlapping of subjects adjacent to his specialty, the technical teacher teaches other subjects. The good technical teacher teaches English. He has a special vocabulary that is a language of its own. Besides this he is continually involved in report writing. It is said that English is taught by all good teachers. The fact is that report writing has to be taught by the technical teacher, if it is to be taught at all, for there are few academic English teachers capable of doing it.

As for foreign language, we have already mentioned the enormous vocabulary that goes with a technology. We can add that blueprints are a foreign language to most people and that fortran, algol, cobol are the foreign languages of the computer. But most important of all is the necessity to stress the exactitude of technical language. The technical student must be taught to eliminate the "weasel words" and use language with the nicety of the lawyer. This becomes most evident in the writing of specifications.

The technical teacher unfortunately often reduces the aesthetic to a scientific basis. Music to him is hi-fi and stereophonic, and apt to become a powerhouse of warpers and woofers, even though his ear is dull to a full appreciation of what he is producing. Art becomes a theory of color based on Munsels circle, or an analysis by mechanical principles of perspective, and photography a geometric criticism or discussion of gadgetry and processes. However, to give the devil his due, where he forgets art and designs for use he approaches the acme and achieves the philosophy of Frank Lloyd Wright that a <u>thing of utility</u> is a <u>thing of beauty</u>.

The technical teacher is a creature of this age. He represents and is an exponent of the culture of advanced living. He is teaching culture, not a dead culture, but the culture of today. There is music in the riveting gun and the roar of the jet. There is art in the picture of a blast furnace being tapped. There is inspiration in the suspension of the Golden Gate Bridge and the modeling of an airfoil.

To emphasize the aesthetic work in which the technical teacher is involved see what happens when the "artist" tries to improve the technician's work. See the rows of brownstone buildings in New York City with sheet iron cornices and cast iron banisters made to look like sandstone. See what happens to the beautiful steel piers of the Washington Bridge when a silly architect covers them up to look like stone piers. Look at our modern automobile. See what is in the name of design. Compare it to the modern jet airplane streamlined for efficiency.

The technical teacher has to expand continually in depth of subject the same as a teacher of literature. But he expands knowledge that was not available yesterday. He has to run to stand still, and if we could imagine a technical teacher cut off from the stream of technological advancements for a few years, such as being abandoned on a desert island, he would be a poor teacher when he returned even though he knew as much as when he left. The technical teacher is teaching a living subject.

Stop and think a moment of the revisions in subject matter that a technical teacher must make. The transistor is only about three years old and it has been surpassed in some characteristics by at least three other devices. Hardly a technical course is written that does not have to be revised before it has been taught once.

Where can the technical teacher get the help he needs? He cannot get assistance from a large group of other teachers in the school teaching the same subject matter. He is a loner. This tends to give him the feeling of importance, of being a key teacher, and, unfortunately, may make him arrogant. He may assume that he is indispensable and become lazy, despotic and self-sufficient. He may grow to resent supervision since nobody on the staff knows what he is talking about. He may become intolerant of ignorance.

Since he is apt to neglect aesthetics and place little value on the mysteries of life, he may find himself at odds with other members of the faculty. He may resent change because he is not a blind follower or welcome change if it is based on science or logic.

The students who face the technical teacher differ from the type who generally face the trade and industrial teacher. They do, if they have been properly screened. All of the difference is not in the intelligence quotient, though this is a big factor at the high school level.

Some phases from a recent article on "The Creative Child" which appear in a recent issue of Look Magazine are apt in describing the technical student: An ability to sense and also question the implicit; a willingness to take a calculated risk larger than others would take in a given situation; considerable sensitivity and exuberance; and a greater acceptance of himself than is the norm.

If the technical teacher does not get the student out to this pattern at least he tries to form these traits in the student. He tries to instill the capacity to be puzzled, to question the implicit. His work differs from the shop teacher in that he works from the theory to the application and not only the way that it is done, but the way that it might be done. He also works from the unknown to the known and vice versa through analysis and synthesis. He tries to train his students to be curious, skeptical and never satisfied.

The technical teacher has to take the young person who is probably starry-eyed with science-fiction and introduce him to the hard disciplines of mathematics. He has to imbue a philosophy for seeking the cause, for determining the solution, for realizing that everything in nature is relationship; that these relationships can be reduced to mathematics; that each event is one of a series of events. His students must learn that just as in life, so in engineering everything is a compromise, and they must learn to appreciate the economies of production and time.

His students must grasp the fund of basic knowledge that they must accumulate or know where to find it, in order to come up with the best economical answer. They must learn to delineate a problem, to isolate those parts that lend themselves to classical or empirical solutions and those which require research and theoretical approach. They must learn the meaning of measurement and accuracy and the comprises that may be made with absolute accuracy and the allowable factors for cost, production, durability and safety. In short, they must not only know how to do the job, but to use judgment, to weigh alternate solutions in order to get around difficulties of materials, patents, production, safety and utility. They must learn that it is not "the best is good enough" but that "good enough is best."

Such a student will graduate with a fund of basic knowledge in science and mathematics and some skill in applying these fundamentals. He will be aware of what he does not know and where he can get help. He will have learned to stake out a problem, to get all the facts, or identify those that are missing, and to assemble them in order of their importance. He will be skeptical of the obvious reasons and courageous enough to depart from trammeled ways. He will know the way it has been done and be able to conjecture about how it might be done.

In engineering education we have assumed that we could give all the basic science and mathematics in the first two years and make the applications to engineering problems later. In technical education, because we are dealing with a different type of student and because we have such little time, we do both things simultaneously. You might say we do a little of each at a time. This is accomplished through spiral teaching. We teach some mathematics. Then we make an application where the mathematics is required in the solution and we teach the mathematics again. We can't teach the application without the mathematics and nobody has yet devised a mathematics course where all the applications fall in sequence to the technology as learned in studying mathematics. The practical solution, if the technical teacher is to keep his subject matter in logical order at all, is to be prepared to teach or re-teach the mathematics and science as it comes up in the subject.

This means that the technical teacher must be competent in teaching the mathematics and science as it relates to his subject and not take the high and mighty attitude that the students should know it. He must recognize this when he organizes his course of study and writes his lesson plan.

In approaching a new unit of instruction the technical teacher must be able to lead the students all around the problem, discussing all the significant facts and gradually closing in on a possible general solution. Then he must introduce a specific problem and let the students see if the general solution applies. It is all right for engineers to talk in generalities and even estimate in astronomical numbers. Sooner or later somebody has to determine the size of the bolts, make the blueprints, write the specifications, crowd the circuits in a given space, trouble shoot it and make it work. That fellow is the technician. It is the technical teacher's job to train him.

While he is keeping abreast of his technology and altering the course of study to provide for changes he is carrying out the usual duties of a member of the faculty, writing examinations, marking papers, and grading students. In addition he has the special marking of technical reports, the inventory of equipment and the organization of a laboratory. He must be aware that when the student leaves he will move into industry, hired and retained on what he can produce. The technical teacher must keep up his industrial contacts to be aware of change and to uncover employment opportunities for his students. Often he is the placement officer for his curriculum and is involved in follow-up studies of graduates.

This, then, is a rather general picture of the technical teacher and his job. Little has been indicated as to whether he should be improved or how to prepare him to perform his service. He is unique in many ways from other types of teachers and the full blown variety is a remarkable fellow rendering a great service.

IX. FINANCING

FEDERAL MONEY FOR EDUCATION: PROGRAMS ADMINIST

OGRAM	AUTHORIZATION	PURPOSE	HOW DISB
onal Defense Education Act (continued) tle VII. Media Research	5,000,000	Support research on educational uses of television, radio, motion pictures, and other media	Contracts
tle X. State statistical services	2,800,000	Improve statistical services of State education agencies	Grants
tle XI. Institutes for advanced study	32,750,000	Improve qualifications of the elementary and secondary school teachers	Contracts, Stipen
cation of the handicapped P.L. 88-164, Title III) eacher training	19,500,000	Prepare teachers and others who work with handicapped	Grants
esearch and demonstration	6,000,000	Promote research and demonstration on the education of the handicapped	Grants
tioned Films for the Deaf	1,500,000	Provide cultural and educational services to the deaf through films	Contracts
perative Research Program Arts and humanities	(2)	Support research on education in the arts and humanities at all levels	Contracts, Grants
Curriculum	(2)	Support research on the improvement of curriculum	Contracts, Grants
Research and development centers	(2)	Support research on the major problems of education	Contracts, Grants
search on comparative education (special foreign currency program, P.L. 480) Research	(2)	Use counterpart funds for educational research of value to the United States and other nations	Contracts
Travel	(2)	Finance travel necessary to complete comparative education studies conducted abroad	Contracts
EA-related Fulbright-Hays fellowships	(2)	Improve competence of prospective teachers of modern foreign languages and area studies	Grants
Foreign language training-area studies Faculty members	(2)	Improve competence of faculty members of NDEA language and area studies centers	Grants
Elementary and secondary school teachers	(2)	Improve competence of elementary and secondary school teachers of foreign languages and area studies	Grants
Seminars	(2)	Improve competence of elementary and secondary school teachers of foreign languages and area studies	Grants
Curriculum specialists	(2)	Provide foreign curriculum specialists to U.S. schools to help strengthen language-area studies programs	Grants
onomic Opportunity Act of 1964 College work-study program	(2)	Provide part-time employment for needy college students	Grants
Adult basic education	(2)	Provide literacy programs for adults to help them obtain employment	Grants
ivil Rights Act of 1964 Institutes	(2)	Provide training on problems incident to desegregation	Contracts
Grants to school boards	(2)	Aid school boards in hiring advisors and training employees on problems incident to school desegregation	Grants
ducational television (P.L. 87-447)	(2)	Aid in the acquisition and installation of transmitting and other type equipment necessary for broadcasting	Grants
cience clubs (P.L. 85-875)	(2)	Encourage students interested in science to pursue their interest outside of class in science clubs	Contracts
uban refugee program Aid to Dade County, Fla.	(2)	Assist schools in providing education for great numbers of refugee children	Grants
Student loans	(2)	Aid refugee college students to continue their education	Loans
Professional training	(2)	Provide refresher training for physicians and teachers	Contracts
ivil defense adult education	(2)	Provide information on civil defense procedures to the public	Contracts
nternational exchange service	(2)	Train foreign participants on programs sponsored by the Agency for International Development	Grants
Elementary and Secondary Education Act of 1965 Title I. Programs for the disadvantaged	(2)	Support educational programs in areas having high concentrations of low-income families	Grants
Title II. Library resources	100,000,000	Support provision of school library resources, textbooks, and other instructional materials	Grants
Title III. Supplementary centers	100,000,000	Support supplementary educational centers and services	Grants
Title IV. Research	[illegible]	Construct national and regional research facilities	Grants, Co
Title V. Strengthening State education agencies	[illegible]	Improve leadership resources of State education agencies	Grants

1 Proportion of the costs the Federal Government will pay.

2 Not specified.

3 Includes fiscal year 1964 unappropriated authorization of $50,600,000, which is available for reappropriation in

4 Includes fiscal year 1964 unappropriated authorization of $179,400,000, which is [illegible]

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D BY THE U.S. OFFICE OF EDUCATION, FISCAL YEAR 1966

FEDERAL SHARE[1]	WHO MAY APPLY	ADMINISTRATIVE OFFICE
Some matching required	Grants: Public or nonprofit institutions, individual persons Contracts: Public agencies; individual persons	Division of Research Training and Dissemination Bureau of Research
50 percent	State education agencies	Division of Data Sources and Standards National Center for Educational Statistics
100 percent	Colleges and universities	Division of Educational Personnel Training Bureau of Elementary and Secondary Education
100 percent	State education agencies, colleges and universities	Division of Educational Personnel Training Bureau of Elementary and Secondary Education
100 percent	State education agencies, local school districts nonprofit private organizations, public groups	Division of Elementary-Secondary Research Bureau of Research
100 percent	Usually by invitation	Division of Research Training and Dissemination Bureau of Research
No specific minimum matching required	Colleges, universities, State education agencies Private or public groups, or individuals	Division of Laboratories and Research Development Bureau of Research
No specific minimum matching required	Colleges, universities, State education agencies Private or public groups, or individuals	Division of Elementary-Secondary Research Bureau of Research
No specific minimum matching required	Colleges, universities, other public and private agencies, institutions, and organizations	Division of Laboratories and Research Development Bureau of Research
No specific minimum matching required, but there must be some	Ministries of education and colleges and universities abroad	Division of Higher Education Research Bureau of Research
100 percent	American or foreign researchers; institutions abroad	Division of Higher Education Research Bureau of Research
100 percent	Graduate students through the National Defense foreign language fellowships committee at home institutions	Division of Foreign Studies Bureau of Higher Education
100 percent	NDEA center faculty members through center directors	Division of Foreign Studies Bureau of Higher Education
100 percent	Teachers and supervisors of modern foreign languages and area studies with five years' experience	Division of Foreign Studies Bureau of Higher Education
100 percent	Teachers of foreign languages and area studies in secondary schools or colleges with two years' experience	Division of Foreign Studies Bureau of Higher Education
100 percent	Local school agencies and State education agencies	Division of Foreign Studies Bureau of Higher Education
90 percent	Colleges and universities	Division of Student Financial Aid Bureau of Higher Education
100 percent	State education agencies	Division of Adult Education Programs Bureau of Adult and Vocational Education
100 percent	Colleges and universities	Office of Equal Educational Opportunities
100 percent	School boards and other public agencies responsible for operating public schools	Office of Equal Educational Opportunities
50-75 percent	Nonprofit organizations, public colleges, State educational television agencies, and education agencies	Office of Educational Television U.S. Department of Health, Education, and Welfare
100 percent	State education agencies; colleges and universities	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
About 50 percent	Dade County, Fla.	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
100 percent	Cubans who became refugees after January 1, 1959	Division of Student Financial Aid Bureau of Higher Education
90 percent	Refugee physicians and teachers	Division of Educational Personnel Training Bureau of Elementary and Secondary Education
100 percent	State agencies (by invitation)	Division of Adult Education Programs Bureau of Adult and Vocational Education
100 percent	Teachers and school administrators from other countries	Division of Educational Personnel Training Bureau of Elementary and Secondary Education
100 percent	State education agencies	Division of Program Operations Bureau of Elementary and Secondary Education
100 percent	Local education agencies	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
100 percent	Local education agencies	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
Some matching required	Public and private research agencies	Division of Laboratories and Research Development Bureau of Research
100 percent	State education agencies	Division of State Agency Cooperation Bureau of Elementary and Secondary Education

5 Includes fiscal year 1964 unappropriated authorization of $70,750,000, which is available for reappropriation in fiscal year 1966.

6 $25 million authorized from fiscal year 1959 through duration of the act.

966. 7 $32 million authorized for fiscal years 1963 through 1967 plus unobligated balance of administrative funds.

966. 8 Construction aggregate of 100,000,000 for 1966 through 1970.

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FEDERAL MONEY FOR EDUCATION: PROGRAMS ADMINISTE

GRAM	AUTHORIZATION	PURPOSE	HOW DISBUR
Hughes Act	$7,161,455	Provide for vocational education and teacher training in agriculture, trade and industry, and home economics	Grants
-Barden Act e I	29,991,000	Extend Smith-Hughes Act to include distributive occupations, fishery trades, and vocational guidance	Grants
e II	5,000,000	Develop training programs for health occupations	Grants
e III	15,000,000	Train highly skilled technicians	Grants
onal Education Act of 1963	159,750,000	Maintain, extend, and improve vocational education programs; develop new programs	Grants
earch and training	17,750,000	Develop research and training programs, and experimental and pilot programs for special needs .	Grants
k-study program	50,000,000	Provide part-time employment for young people to help them begin or continue vocational training	Grants
idential schools		Prepare young people for employment	Grants
chian regional development program	[illegible],060,000	Construct vocational education facilities in the Appalachian region	Grants
wer Development and Training Act	(2)	Train skilled workers in all sections of the Nation	Grants
Education Facilities Act of 1963 e I: Community colleges, tech. institutes	101,200,000[3]	Construct or improve academic facilities at public community colleges and technical institutes	Grants
ther undergraduate facilities	358,800,000[4]	Construct or improve undergraduate academic facilities	Grants
e II. Graduate facilities	60,000,000	Construct or improve graduate academic facilities	Grants
III. Construction loans	190,750,000[5]	Construct or improve undergraduate and graduate academic facilities	Loans
e administration	[illegible]	Help States administer program under Title I	Grants
ment of colleges of agriculture mechanic arts	14,500,000	Support instruction in agriculture and mechanic arts in land-grant colleges	Grants
y Services and Construction Act e I. Extension of services	(2)	Extend and improve public library services	Grants
e II. Construction	(2)	Aid construction of public libraries	Grants
federally impacted areas 874. Maintenance and operation chool districts	(2)	Aid school districts on which Federal activities have placed a financial burden	Grants
ederal agencies	(2)	Aid Federal agencies such as Department of Defense in providing schools for children who live on Federal property	Grants
815. Construction: School district	(2)	Aid school districts in providing minimum school facilities in federally impacted areas	Grants
ederal Agencies	(2)	Aid other Federal agencies in building schools for children living on Federal property	Grants
echnical services	(2)	Provide funds for technical services in the construction of schools in federally impacted areas	Payments to HHFA
al Defense Education Act of 1958 e II. Student loans ontribution to loan fund	179,300,000	Provide for low-interest loans to college students	Loans
ans to institutions	(2)	Provide for loans to colleges and universities that cannot meet matching obligation	Loans
ancellation of loans	(2)	Reimburse institutions for their portion of principal and interest canceled for teachers	Grants
e III. Strengthening of instruction ublic schools	90,000,000	Strengthen instruction in critical subjects in elementary and secondary schools	Grants
ans to private schools		Improve instruction in critical subjects in private schools	Loans
pervision and instruction	10,000,000	Strengthen supervision and administration in State education agencies	Grants
IV. Graduate fellowships	(2)	Prepare more teachers	Grants
V-A. Guidance, counseling, and testing: ate programs	24,500,000	Provide for guidance, counseling, and testing in public elementary and secondary schools; testing in private schools	Grants
V-B. Counseling institutes	7,250,000	Improve qualifications of guidance workers and counselors in schools and colleges	Contracts
VI: Language and area centers	14,000,000	Increase amount of study of uncommon languages and area subjects and improve quality of instruction	Contracts
reign language fellowships		Train college teachers of modern foreign languages and area studies	Grants
search and studies		Support research on improved instruction in modern foreign languages and teaching methods	Contracts

...ERED BY THE U.S. OFFICE OF EDUCATION, FISCAL YEAR 1966

...RSED	FEDERAL SHARE[1]	WHO MAY APPLY	ADMINISTRATIVE OFFICE
	50 percent	Public schools through State boards of vocational education	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	50 percent	Public schools through State boards of vocational education	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	50 percent	Public schools through State boards of vocational education	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	50 percent	Public schools through State boards of vocational education	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	50 percent	Public schools through State boards of vocational education; contracts with private, commercial institutions	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	No specific minimum Matching required	State education agencies, colleges and universities, local education agencies	Division of Adult and Vocational Research Bureau of Research
	100 percent first 2 years 75 percent next 2 years	State education agencies	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	100 percent	Public schools through State boards of vocational education	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	50 percent	State education agencies	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	100 percent	Persons referred by State employment services	Division of Vocational and Technical Education Bureau of Adult and Vocational Education
	Up to 40 percent	Public community colleges and technical institutes	Division of College Programs Bureau of Higher Education
	Up to 33 1/3 percent	Public and private, nonprofit colleges and universities, except community colleges and technical institutes	Division of College Programs Bureau of Higher Education
	Up to 33 1/3 percent	Public, private nonprofit, and cooperative graduate centers of high learning	Division of Graduate Programs Bureau of Higher Education
	Up to 75 percent	Public and private, nonprofit colleges and universities, cooperative graduate centers, boards of higher education	Division of College Programs Bureau of Higher Education
	100 percent	State commissions set up to administer the program	Division of College Programs Bureau of Higher Education
	100 percent	The 68 land-grant colleges	Division of College Programs Bureau of Higher Education
	Matching grants based on State per capita income	State library administrative agencies	Division of Library Services and Educational Facilities Bureau of Adult and Vocational Education
	Matching grants based on State per capita income	State library administrative agencies	Division of Library Services and Educational Facilities Bureau of Adult and Vocational Education
	100 percent	Local school districts	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
	100 percent	Federal agencies operating schools	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
	100 percent	Local school districts	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
	100 percent	Other Federal agencies	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
HFA	100 percent	Not applicable.	Division of School Assistance in Federally Affected Areas Bureau of Elementary and Secondary Education
	90 percent	Accredited nonprofit institutions including any accredited business school or technical institute	Division of Student Financial Aid Bureau of Higher Education
	100 percent	Colleges and universities and other institutions taking part in student loan program	Division of Student Financial Aid Bureau of Higher Education
	100 percent	Participating institutions	Division of Student Financial Aid Bureau of Higher Education
	50 percent	States get allotments; school districts apply to State	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
	100 percent	Nonprofit private elementary and secondary schools	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
	50 percent	States get allotments	Division of Plans and Supplementary Centers Bureau of Elementary and Secondary Education
	100 percent	Prospective college teachers working for Ph.D. degrees	Division of Graduate Programs Bureau of Higher Education
	50 percent	States get allotments	Division of Planning and Supplementary Centers Bureau of Elementary and Secondary Education
	100 percent	Accredited public and private nonprofit colleges and universities	Division of Educational Personnel Training Bureau of Elementary and Secondary Education
	50 percent	Accredited public and private nonprofit colleges and universities	Division of Foreign Studies Bureau of Higher Education
	100 percent	Persons trained in modern foreign languages with the exception of French, German, Italian, and European Spanish	Division of Foreign Studies Bureau of Higher Education
	100 percent	Colleges, universities, professional associations, public school systems, and individual persons	Division of Higher Education Research Bureau of Research

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X. GUIDANCE

Some Paths in the High School of Tomorrow (Explanation of the chart)

The accompanying chart attempts to portray a general idea of what the high school of tomorrow might look like, with respect to curriculum offerings. It may well be a comprehensive institution, attempting to meet the needs of the student body which has a wide range of interests and abilities. Much of the program will be of occupational preparation character, either through direct training for occupational life or basic preparation leading to later specialized training.

In planning this chart it is assumed that:

(a) Much of the specialized vocational education now found in the high school, especially in the vocational high school, will move into the post-high school years, and will be found largely in community colleges or technical institutes.

(b) The high school of tomorrow will provide a wide range of curriculum offerings, varying from a liberal arts college preparatory sequence to such specialized occupational offerings as fit better into the high school than the post-high school institution.

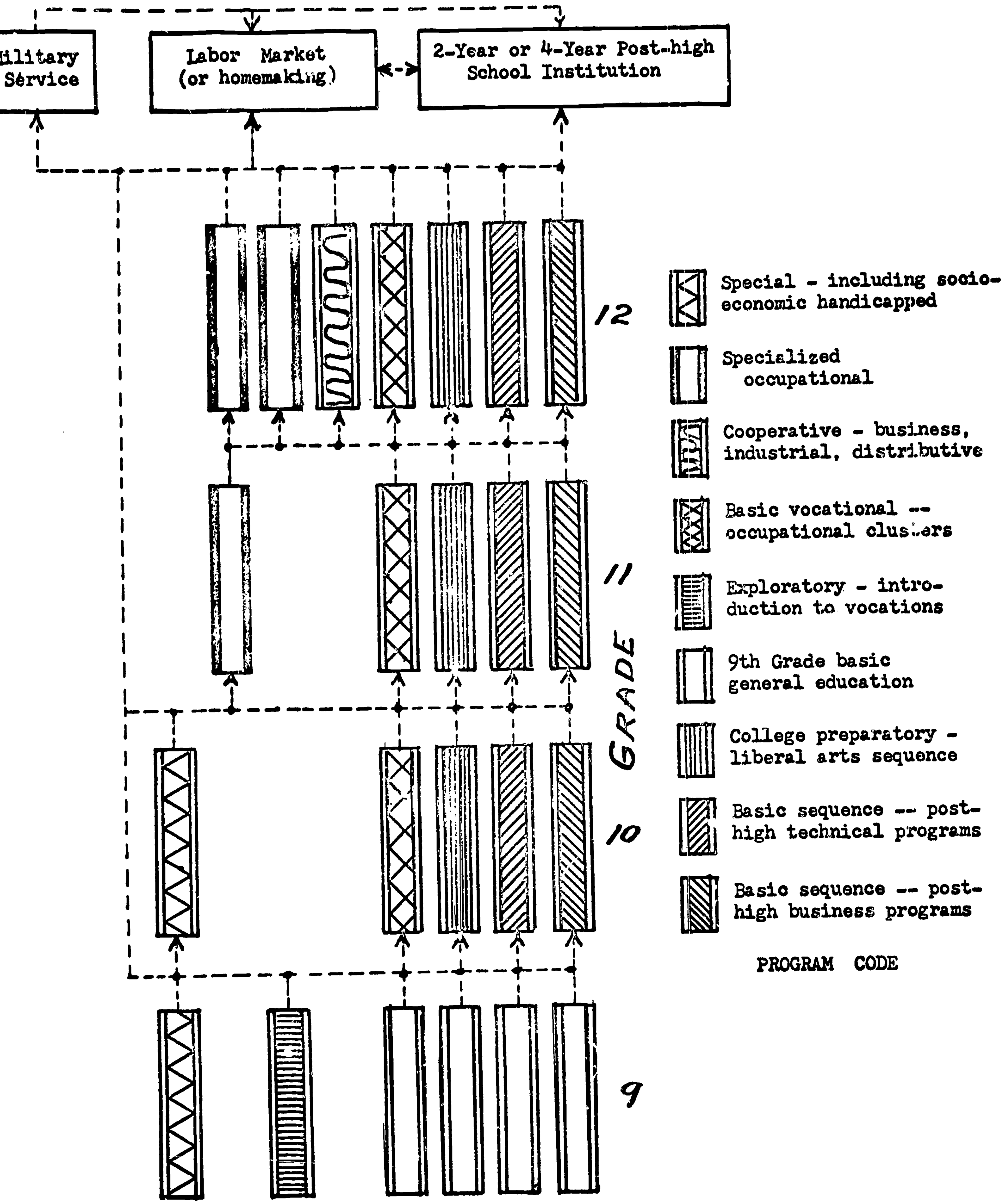
(c) Appropriate guidance and other student personnel service will be available to meet the individual needs of students, helping them in making original choices of curriculums and in making changes in such choices as needs arise.

(d) The school will provide great flexibility with respect to student adjustment. The chart shows provision for moving from one curriculum or unit to another at the end of each school year. (Some provision may also be needed for such "switching" of "tracks" or curriculums within the school year if necessary.)

The overall program outlined on the chart makes provision as follows:

1. Special, including socio-economic handicapped.
These units - placed in the 9th and 10th grades - include those types of educational service needed by students who deviate from the broad groupings served by the other curriculums in sufficient degree to warrant special attention. This student group includes the slow learners, those emotionally disturbed, those with inadequate educational background such as in reading ability, those culturally deprived, and the like. The program might continue one year, two years, or longer, with transfer to one of the other curriculums as soon as the student reaches the point where such transfer is feasible, or with placement in the labor market for over-age students if this seems desirable.

2. Specialized vocational education curriculums.
This type of program will include direct preparation for the labor market, with intensive specialization to the extent feasible and desirable in a comprehensive high school. This might be limited to the 12th grade, or start in the 11th grade and continue through the 12th. The occupational fields included might well be certain of the skilled and semiskilled occupations in industry, business, agriculture, para-medical field, and the like. (As the attendance in full-time school grows to include the post-high school years for many more students, this type of program will tend to be offered in post-high school institutions rather than in the high school.)



SOME PATHS IN THE HIGH SCHOOL OF TOMORROW

Emerson 3/66

3. Cooperative education programs

In these programs - which may well operate in business, distributive, industrial, para-medical, and other fields - the student spends half of the school day in school and the other half day on a paid work job. Variations in this type of program include the work period on pay with a private employer (the type most commonly found), work on projects financed by Federal work-study funds, or possibly a half-day attendance at a training skills center without pay. Some cooperative programs are operated both in the 12th grade and in the 11th grade, but labor law often restricts much of the work to the older students of the 12th grade.

4. Basic vocational programs -- occupational clusters.

Occupational changes in the labor market are revealing the need for breadth as well as depth in occupational education, and indicate the need for educational programs that prepare the person for anticipation of occupational change, as well as for the initial entry job into the labor market. These basic programs dealing with occupational clusters aim to provide knowledge, understandings and skills that are common to a number of specialized occupations that are sufficiently alike to be classified as a "cluster". The building trades, or mechanical work in the metal field, are examples of clusters. In these programs the student learns basic tools and their uses, materials used in the cluster, basic typical operations in several of the specialized occupations in the cluster, drawing common to these occupations , and the like.

This type of program prepares the student for effective entrance into the specialized occupational training in the post-high school institution, or in the high school. The basic program may take the form of a single year of study, located at the appropriate grade level in keeping with later specialized study, or of a sequence covering more than one year.

5. Exploratory program - introduction to vocations.

This 9th grade unit might well be taken by all students to provide a basis for understanding the work of the world, and for assistance in helping the student make a wise selection of occupational choice. A broad study of occupational life in this unit, followed by basic vocational education in a selected occupational cluster, and later by highly specialized occupational education in a specific field provides a logical sequence for effective occupational choice and preparation.

6. 9th Grade basic general education.

This educational "core" might well be common to most students, followed by one of the several three-year sequences, or by a program involving parts of two or three different ones.

7. College preparatory - liberal arts sequence.
Basic sequence for post-high technical programs
Basic sequence for post-high business programs

These sequences have much in common, meeting the requirements for admission to post-high school institutions. The technical sequence would include appropriate mathematics, science, drawing, and basic cluster units, aimed to provide background for effective study in a post-high school technician training program. The business sequence would include similar basic content preparatory to post-high business education. These programs have content similar to that of preprofessional sequences leading to engineering training or business management training in a four-year university progra m

The suggested program provides a variety of "tracks", but it also provides for adequate numbers of "switches" that lead from one track to another when desirable.

TECHNICIAN TRAINING:

DIFFERENCES BETWEEN TWO LEVELS

by

Frank J. Coyle

Area Vocational Education Branch
Division of Vocational Education
U.S. Office of Education

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TECHNICIAN TRAINING: DIFFERENCES BETWEEN TWO LEVELS

MANY educators believe that the high school cannot train technicians as effectively as the post-high-school institution can. To be sure, high school programs of technical education differ from post-high-school programs, but these differences do not argue for the high school's staying out of technician training. In fact, there are many high schools today which have highly successful programs for training technicians. These are the schools which have recognized the differences between the two levels--and made their plans accordingly.

Three types of high schools offer technician training: The comprehensive, the vocational-technical, and the technical. Post-high-school programs are usually found in area vocational schools, community and junior colleges, technical institutes, and, in some instances, 4-year colleges or universities.

Much of the difference between technical training in high schools and in post-high-school institutions can be traced to the differences in the emotional maturity of the students the programs usually serve.

The post-high-school student is usually a few years older than the high school student. He has probably reached full physical growth, and he has very likely solved many of the psychological problems of adolescence. He is nearer the reality of working for a living--in fact, his first job or two may have shown him the need for additional or specialized training. His motivations are strong, his vocational goals more or less firmly set.

The high school student, who is still an adolescent, is more self-centered than the post-high-school student. His objectives are not so well established; he has less perspective about the future. His interest span is shorter, and he often looks on assignments as burdens, not as meaningful parts of a whole. Often he may have no other drive than a thirst for knowledge. More than likely he is taking technical courses because technology interests him or because he sees technical training in high school as a step toward college engineering.

Another difference between training at the two levels is that the high school makes more rigorous demands on the student. At the post-high-school level the student is usually a high school graduate and it is generally assumed that he has had a general education and should now have a program which concentrates more on occupational preparation and devotes proportionately less time to the humanities. The high school student, however, must take his technical work along with the regular high school course, for most States require him to have general education units for graduation. This difference between the two levels has at least three results: Technical work takes 3 years in high school but usually 2 years in the post-high-school program; the high school day must have 7 or 8 periods--more than some high schools now have; and the increased work load in the high school demands that the student be selected for high intelligence--higher than that required in the post-high-school student.

Lesser but important differences grow out of these. For instance, technician training in high school should be general--organized around a cluster of jobs. The post-high-school program can offer training for specific employment. It can be more flexible in the order of presentatic since the prerequisites can be set up for mathematics and science ahead of time whereas the high school must give them concurrently.

The organizational pattern of the high school is usually more complicated than that of the post-high-school institution. When the technical program is a part of or a department of a high school, it may conflict with the philosophy and scheduling of the school, particularly since it demands only able students and special subjects. The post-high-school level, with its single purpose, may have a better overall atmosphere and its faculty probably has better morale. It is easier to teach at the post-high-school institution--the students are older and require less motivation. Because the post-high-school institution can usually offer a better salary schedule, it is able to get teachers with higher qualification than the high school. It often requires its teachers to have master's degrees, a requirement not always set by the high school. Both programs cost more than programs of general education.

In the important matter of selecting students from among those who desire to enroll, there is a wider range of ability found in the high school. In the high school it is a matter of students being selected on the basis of interest, aptitude and high intelligence, so that only those capable of performing well go into the program. At the post-high-school level the highly intelligent applicants are usually counseled to consider a college engineering program because it would be manifestly poor guidance not to do so. The high school program admits high ability students because the nature of a good secondary school technical education program is such that the graduate will be well prepared for college engineering.

THESE are the principal differences between the two programs. Lack of understanding of these differences often causes confusion about the objectives and outcomes of both programs and may account for the skepticism of some educators. Yet in high schools where there are good technical programs, we may safely assume--and examination will bear it out--that the differences between the two levels of instruction--in student ability, curriculum, and teaching--have been recognized.

ERIC

JOB CLUSTERS

Closely-knit jobs with common elements

Basic jobs - supplementary jobs

Each job of technician character

Requires post high school maturity & 2 years training

Easy to shift from one job to another

Important elements are common to all jobs:
Math. - Science - industrial technology, etc.

Number of jobs in cluster to provide reasonable spread. of placement opportunities

XI. PUBLIC RELATIONS

LOOKING AHEAD AT OCCUPATIONAL EDUCATION IN THE COMMUNITY COLLEGE

An address presented at the National Clinic
on Technical Education, Norwalk, Connecticut
November 4, 1964
by
Lynn A. Emerson

Technological Change

Within the past decade or so technological change has progressed at an unprecedented rate. The installation of computers in the United States started in 1951 and has now risen to well beyond 12,000 of general purpose type, with thousands more on order. Instrumentation and automatic controls are constantly taking over manufacturing and other processes. Power is coming from atomic energy. Recent demonstrations show power being transmitted without wires. Communication satellites are in orbit.

What is past is prologue to what is to come. The curve of technological development is rising rapidly. The "lead time" between discovery of a principle and its commercial use is shortening. Technological change is exerting great pressure on technical education for the adaptation of training programs to meet the changing conditions. It demands that educators lift their sights toward meeting the needs of the future as well as those of the present.

Conditions to be Faced in the Years Ahead

Many present jobs will have been eliminated or changed in character; many new ones will have emerged.

The numbers of workers in production will continue to decrease; those in professional and technical jobs will increase considerably; some increase will be noted in the service occupations.

Job entrance qualifications will require higher educational attainment.

Entry age into most occupations will be higher; young persons seeking jobs will be at a greater disadvantage than at present.

Mobility of workers will rise, with labor markets much broader than the local community.

More paid on-the-job time and off-the-job time will be given to education at all levels, to keep workers abreast of changing conditions.

Increasing amounts and kinds of services will be made available to meet the needs of the aging -- medical care, housing, recreation, and the like.

An increasing share of the GNP will be devoted to furnishing recreational services -- travel, boating, camping, sports events, etc. Some new jobs will emerge in these fields.

Most workers -- with the possible exception of professionals -- will have more leisure time. How will this be spent -- "moonlighting", avocations - ?

Changes in job requirements will become more prevalent, and workers will be desired who have flexibility, the ability to adapt to change, "No one will stay educated for very long."

Higher proportions of youth in the corresponding age bracket will attend high school; a higher proportion will graduate; more will go on to higher education.

Occupational education curriculums will have a dual responsibility: preparing students for entry jobs, and preparation for meeting changing conditions.

Programs of occupational education will become articulated at the various grade levels, with basic programs at the lower levels culminating in specialized programs at the higher levels. Many of the high schools will have developed technical education "tracks" as well as tracks leading to other post high school programs.

Curriculum objectives will have broadened, aimed at clusters of occupations. This will apply to all occupational areas, with basic training for the skilled crafts; for example, aimed at clusters of related occupations, followed by later specific education.

Research will have shown how to educate for change, and research findings will have been incorporated into occupational curriculums.

Occupational education will have become an integral part of total education, a part of the trunk of the educational tree rather than a separate branch. Appropriate portions and types of occupational orientation and occupational education will be included at all grade levels, beginning in the elementary school.

Most occupational education programs will be in institutions that also provide substantial offerings of general education, with occupational curriculums flexible enough to permit general education electives in accord with student interests and abilities.

Occupational education will have become fully accepted; on a par with college preparatory programs.

The range of occupational curriculum offerings available to every youth will have expanded considerably, made possible partly by increase in the size of the educational institutions.

The total program of the educational institution will be concerned as much with course offerings for employed workers as for preemployment students. The "extended day" program will enroll considerably more students than the full-time day program.

ERIC

Many schools established as area vocational schools will have become comprehensive community colleges.

Increased public concern for, and support of, community colleges will have spread throughout the nation.

In the program of occupational education in the years ahead the community college will play an increasingly important role. We will still need some specific occupational programs at the upper high school level. Specialized area vocational schools will be established in the immediate future -- on the high school level as well as post high school. In time, however, it is predicted that these institutions will tend to grow upward in level of curriculum offerings, and to broaden into the comprehensive community college pattern, retaining within this pattern, however, the distinct characteristics of quality programs of occupational type.

Cybernation and its Impacts on Occupational Education

The impact of cybernation upon our economy, and upon occupational education may be far greater than many of us have realized. In his report on "Cybernation: The Silent Conquest" (1) Donald Michael defines cybernation as including both automation and computers, with automation described as the automatic production of material products, and computers as sophisticated analyzers and interpreters of complex data. Michael indicates what cybernated systems can do as follows:

> "Perform with a precision and rapidity unmatched in humans.
> Detect and correct errors in their own performance.
> Make judgments on the basis of instructions programed into them.
> Remember and search their memories for appropriate data.
> Receive information in more codes and sensory modes than man can.
> Are beginning to perceive and recognize.
> Some of the machines show originality and unpredictability.
>
> "There is every reason to believe that within the next two decades machines will be available outside the laboratory that will do a creditable job of original thinking, certainly as good thinking as that expected of most middle-level people who are supposed to 'use their minds'."
>
> "But as cybernation advances, new and profound problems will arise for our society and its values. Cybernation presages changes in the social system so vast and so different from those with which we have traditionally wrestled that it will challenge to their roots our current perceptions about the viability of our way of life. If our democratic system is to survive at all, we shall need far more understanding of the consequences of cybernation.

(1) Michael, Donald N. "Cybernation: The Silent Conquest." Santa Barbara: Center for the Study of Democratic Institutions, 1962.

"The problem of retraining blue-collar workers is formidable enough. But, in view of the coming role of cybernation in the service industries, the retraining problem for the service personnel seems insuperable. No one has seriously proposed what service tasks this working group could be retrained for -- to say nothing of training them for jobs that would pay high enough wages to make them good consumers of the cornucopia of products manufactured by automation."

Gerard Piel has this to say in "Jobs, Machines, and People" (2):

"The general hypothesis of our system is that people displaced in employment in one sector will find it in others, and we are assured that retraining and other such programs will fit them to get jobs in that part of the labor force which is engaged in distribution, the service trades, and so on. But these sectors, which have been growing rapidly in the past fifty years and have been soaking up the disemployed from productive and extractive functions, are beginning to fail to soak them up. New jobs are not being created in these fields.

"The new development in our technology is the replacement of the human nervous system by automatic controls and by the computer. - - - This has staggering ramifications going way beyond the automation of production functions; the white-collar functions are even more susceptible to automation; all a computer needs to be effective as a management tool is a typewriter on each side of it. It then becomes a white-collar worker."

The development of cybernatics is rapidly bringing our social structure into an economy of abundance, as contrasted with an economy of scarcity to which our institutions and our thinking habits are largely attuned. There is now need for a revision of our total thinking on how we shall distribute the products and the services of the future, and how we shall prepare persons to work and live in the society we shall face tomorrow.

Occupational Education and Post High School Institutions

In 1961 Dr. Arthur S. Adams, President of the American Council on Education, said:

"We are approaching the time when two years of college, either to develop a vocational skill or to prepare for further college education, will be as necessary and commonplace as is graduation from high school."

Secretary of Labor Wirtz advocates two years of education beyond high school to keep youth off the labor market until they have attained the

(2) Helstein, Piel, and Theobald, "Jobs, Machines, and People," Santa Barbara: Center for the Study of Democratic Institutions, 1964.

maturity, knowledge and skills needed for today's occupations. Occupational education programs of post high school type are growing rapidly, in area vocational schools devoted solely to occupational curriculums, and in community colleges of comprehensive type including both occupational and transfer curriculums.

With the need for occupational education programs on both the high school and post high school levels, some criteria may be useful in making the decision as to whether the curriculum should be offered at the post high school level. The program may well be offered at the post high school level:

1. If the occupation is generally classified as of semiprofessional type.

2. If the geographical area required to recruit sufficient qualified students for a program of optimum size is substantially greater than that ordinarily encompassed by the high school district.

3. If the maturity demanded by employers for entrance into the occupation is beyond that of the average high school graduate.

4. If the prestige of a post high school institution is needed to attract the type of student required for the program.

5. If the on-the-job learning time required for the development of full occupational competency is substantially lower for the graduate of the post high school program as compared with a high school graduate in the same field.

6. If the curriculum content is of such type and level as to require high school graduation, including the completion of specified courses, as a minimum foundation for undertaking the occupational study.

7. If the cost of initial installation of equipment, and its upkeep and maintenance, is beyond the fiscal ability of the high school district.

8. If the State proposes to meet the needs of students from widely scattered communities with small high schools which have little or no provision for occupational education.

9. If the State desires to meet the needs of persons who went to work on graduation from high school with no specific occupational training, and who later desire to enter full-time training to prepare themselves for better jobs.

10. If there is need for a wide range of evening courses in the community which require advanced technical equipment beyond that normally possible in high school occupational training programs.

11. If a suitable post secondary educational institution is available -- such as a junior college -- to which may be added appropriate occupational education curriculums.

The growth of the junior college movement in the United States and the expansion of junior colleges into community colleges have opened up new opportunities for occupational education. The maturity of the students in such institutions, the potential for serving needs over reasonably wide geographical areas, the wider tax base for the support of the institution, and other factors combine to provide opportunity for the community college to make substantial contributions to this field.

Certain types of occupational education programs logically are located on the high school level; others on the post high school level. The post high school institutions include technical institutes, some area vocational schools, and the junior/community colleges. Some programs are offered by four-year collegiate institutions. Curriculums pertinent to the community college include the following:

Transfer programs -- liberal arts and preprofessional,
Engineering technician curriculums,
Semiprofessional nonengineering type curriculums, as in paramedical field,
Curriculums in highly technical craft or industrial technician occupations,
High level curriculums in office and distributive occupations, of middle management level,
Agricultural and agricultural-related curriculums, in rural settings,
General adult education programs.

The community college has partial responsibility, shared with comprehensive high schools and area vocational schools, for training programs in the skilled crafts, in office occupations, in semiskilled training for out-of-school youth and adults. In broad terms it has two responsibilities:

(a) Providing curriculum offerings of types and levels beyond, or not suited to the high school setting.

(b) Meeting the educational needs of adults and out-of-school youth, whether or not they are high school graduates.

In the fall of 1963 the 71 community colleges in California offered some 117 different occupationally oriented curriculums.

Perhaps the best single type of institution for training technicians for specific occupational fields is the technical institute, with its singleness of purpose. But their numbers are limited, and prospects not bright for any considerable growth. In the years ahead in which adaptation to changed conditions is essential, the technician will need breadth as well as specialization in his educational background.

The junior/community college appears to be the most promising agency for nationwide large-scale development of technician training. But this potential development is conditioned by some "ifs." The community college can make a significant contribution to the supply of technicians needed in industry and in other fields if it meets certain conditions. Here are some of them:

1. If the community college administrators throughout the nation have a thorough understanding of technician education, and a real desire to provide it.

2. If strong leadership for the technical program is provided within the community college. (The task must not be assigned to any staff member who happens to be available but who does not possess competence in dealing with technician training and who does not have interest in its success.)

3. If the community college recognizes that the technician is just as important to industry as the engineer, and if the status of the program is kept on a high level.

4. If the technical programs gear in effectively with an overall master plan for the State or other labor market area, with program offerings located properly and of appropriate size.

5. If the size of the community college is sufficiently large to provide optimum enrollments in each curriculum offered.

6. If the curriculums are built from activity analyses of closely-knit clusters of technician occupations, and are designed to prepare graduates for effective entrance into jobs in these clusters.

7. If the training of technicians is recognized as a task different from preengineering transfer programs.

8. If each course of each technical curriculum is designed to meet specific needs, and no attempt is made to utilize courses already available in other curriculums in the institution unless these courses meet specific needs in technician training.

9. If it is clearly recognized that fixed requirements of certain academic courses for all students working for the associate degree may not be quite appropriate for technical training curriculums. (General education courses are needed in technical curriculums but must be selected with care.)

10. If it is clearly recognized that there are different levels and types of technical occupations -- engineering technicians, industrial technicians, technical specialists -- and that curriculums need to be designed in accordance with the requirements of these occupations.

11. If effective curriculums, courses of study, and instructional materials are made available and are kept up to date.

12. If close working relationships are developed and maintained with competent industrial personnel in the specific fields for which training is provided.

13. If capable instructors are provided, with backgrounds of appropriate technical education, practical experience of technician type, and suitable professional education.

14. If adequate provision is made for space, specialized laboratory equipment, and classroom demonstration equipment necessary for effective instruction.

15. If students of high quality, with appropriate high school background, can be recruited in sufficient numbers for each curriculum offered.

16. If effective measures are utilized in the selection of students for the technical curriculums.

17. If appropriate recognition is given to evening and other part-time technical courses for workers employed in industry, and for others who are not able to attend courses for the full day. (The upgrading of employed workers is just as important as the preemployment day training program, and the enrollment in the part-time program may well be two or three times that of the day program.)

America needs technicians in large numbers, in industrial and in other fields, if it is to maintain its position of leadership in the community of nations. The community college, with its rapid expansion and growth, is in a unique position to make a substantial contribution in this field. The most important element in meeting this challenge is the will to do it.

XII. OTHER

PROFESSIONAL, TECHNICAL, CRAFT, AND INDUSTRIAL OCCUPATIONS

Education-Training	Titles	Divisions	Employment
University 4, 5, 6, or more years. BS,MS,Ph.D	Scientist	Physicist Chemist Mathematician Metallurgist	Research Invention Design Development Teaching
University 4, 5, or 6 Years. BS, MS, Ph.D	Engineer	Architectural Chemical, Civil Mechanical Electrical Electronics	Basic Research Applied Research Process Development Quality Control Cost Control Service-Sales Administration
State College-Junior College 2, 3, or 4 years. Emphasis on broad and basic theory. Science, Math, Engineering Subjects, Communication, Economics Not Pre-Engineering Associate Degree	Technologist Engineering Technician Engineering Assistant Science Technician	Specialization is Field Oriented: Chemical, Civil Mechanical, Electrical Electronics, Industrial Metallurgical	Planning-Drafting Computations-Estimate Tests-Evaluations Modifications Time Study-Safety Technical Writing Industrial Chemistry
Area-Vocational Technical Institute 2 Years or Extension Courses, Lab-Shopwork Specific Skills, Tech. & Applied Knowledge Tools-Instruments-Controls Drafting-Calculations Diploma-Certificate	Technician Industrial Technician Laboratory Technician	Specialization Areas: Manufacturing Construction Installation Instrumentation Customer Service	Drafting Estimating Surveying Testing Diagnosis
Area-Vocational Technical Institute 2 Years or Less Practical Pre-Employ Applied Science - Math Shopwork - Drawing Processes - Equipment Tools - Instruments Certificate - Diploma Apprenticeship, 3 to 6 Years	Production Technician Maintenance Technician Highly Skilled Craftsman Highly Skilled Industrial Worker	Manufacturing Construction Installation Maintenance Service Graphic Arts Building Trades	Tool & Die Model Maker Set up Men Lay out Men Millwrights Mechanics Repairmen Draftsmen Carpenters Electricians Plumbers Sheet Metal Welders Printers
Vocational Programs Pre-Employment Work-Study, Retraining	Machine Operator Semi-Skilled Worker	Manufacturing Transportation	Operators Fabricators Assemblers Inspectors Truck Drivers Helpers
On-The-Job	Unskilled Labor	Manufacturing Construction Transportation Custodial	Handling Moving Loading Digging Cleaning

John Butler
Dunwoody Institute

ROUGH ESTIMATE OF TECHNICAL WORKERS IN NEW JERSEY BASED UPON COMPARISON OF THE NUMBERS OF SUCH WORKERS FOUND IN THE NEW YORK STATE SURVEY IN RELATION TO THE TOTAL NONAGRICULTURAL EMPLOYMENT IN THE TWO STATES

Technical Occupation Group	Number Employed in New York 1962	Estimated Number in New Jersey
Draftsmen	20,972	7,000
Structural design technicians & related specialists	2,516	850
Electro and mechanical engineering technicians	42,031	14,000
Mathematics technicians	831	300
Physical science technicians	8,969	3,000
Biological, medical, dental & related science technicians	25,445	8,500
Industrial engineering technicians & related specialists	6,901	2,300
Civil and construction technicians & specialists	13,464	4,500
Sales and service technicians	1,932	650
Technical writing & illustration specialists	3,034	1,000
Safety and sanitary inspectors & related specialists	4,084	1,350
Product testing and inspection specialists	8,059	2,700
Data-processing systems analysis & programming	6,153	2,050
Airway tower specialists & flight dispatchers	1,373	450
Broadcasting, motion picture & recording specialists	2,920	1,000
	148,684	49,650

Estimates of numbers of technicians in New Jersey are based upon the assumption that numbers and distribution are the same relatively as the overall nonagricultural populations of New York as compared with New Jersey.

Nonagricultural population - 1962: (Statistical Abstract of U.S.)

New York - - - - - - 6,271,000
New Jersey - - - - - 2,081,000

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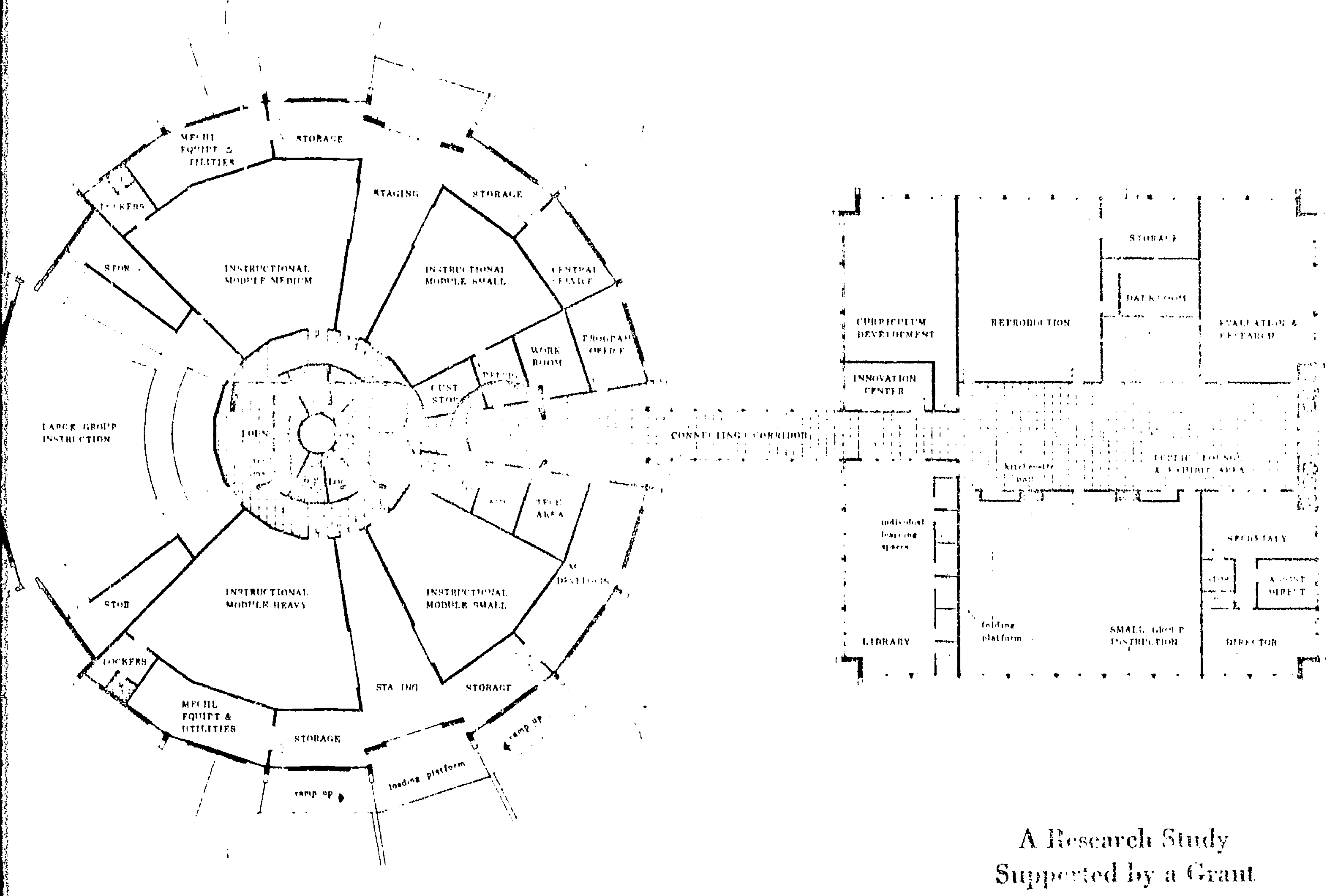
NEW JERSEY COUNTY COMMUNITY COLLEGE PROGRAM - Progress Report March 1966

COUNTY	Date of approval by State Board	Size of campus (acres)	Possible student enrollment	Planned initial building capacity	Estimated cost (thousands) Estimate made by: (C) College (S) State	Estimated cost per full-time student
Atlantic	12/63	501	1,700	800	2,964 (C)	3700
Bergen	10/65	-	7,800	2000	10,706 (S)	5350
Burlington	10/65	-	2,800	1000	4,190 (S)	4200
Camden	9/65	-	4,600	1000	4,655 (S)	4650
Cape May	2/64	-	628	500	1,978 (S)	3950
Cumberland	11/63	78	1,300	500	2,741 (C)	5500
Essex	2/65	-	10,000	700	4,073 (S)	5800
Gloucester	(Petition to State Board 12/65. Feasibility study 2/66)					
Hudson	(No official action)					
Hunterdon	(Feasibility study 11/65)					
Mercer	5/65	-	3,000	1500	6,983 (S)	4650
Middlesex	5/64	165	6,073	1000	3,126 (C)	3100
Monmouth	(Local study not completed)					
Morris	5/65	-	3,000	1000	5,320 (S)	5300
Ocean	5/63	276	1,500	900	2,832 (C)	3150
Passaic	(Local study not completed)					
Salem	(Local study not completed)					
Somerset	10/65	-	1,700	500	2,328 (S)	4650
Sussex	(No official action)					
Union	3/66	-	4,700	800	4,682 (S)	5850
Warren	(No official action)					

Source: N.J. State Education Department - SR-1685 -- March 8, 1966

Technology-Resource Center

for Vocational-Technical Education



A Research Study
Supported by a Grant
under the
Vocational Education Act
of 1963 Section (4)c

A Research Activity of

RUTGERS - THE STATE UNIVERSITY

New Brunswick, New Jersey

The information contained in this brochure is the result of the research findings of the project: A VOCATIONAL-TECHNICAL TEACHER TECHNOLOGY CENTER — THE DEVELOPMENT OF A MODEL. This project was supported by a grant under Section 4(c) of the Vocational Education Act of 1963.

The purpose of this grant was to plan a model facility for updating vocational-technical teachers. The planning includes the development of the educational specifications, preliminary architectural plans, and outline of engineering specifications.

It is hoped that this model may serve as a pattern for other institutions of higher education or State departments of education in the development of TECHNOLOGY-RESOURCE CENTERS FOR EDUCATION on an area basis throughout the United States.

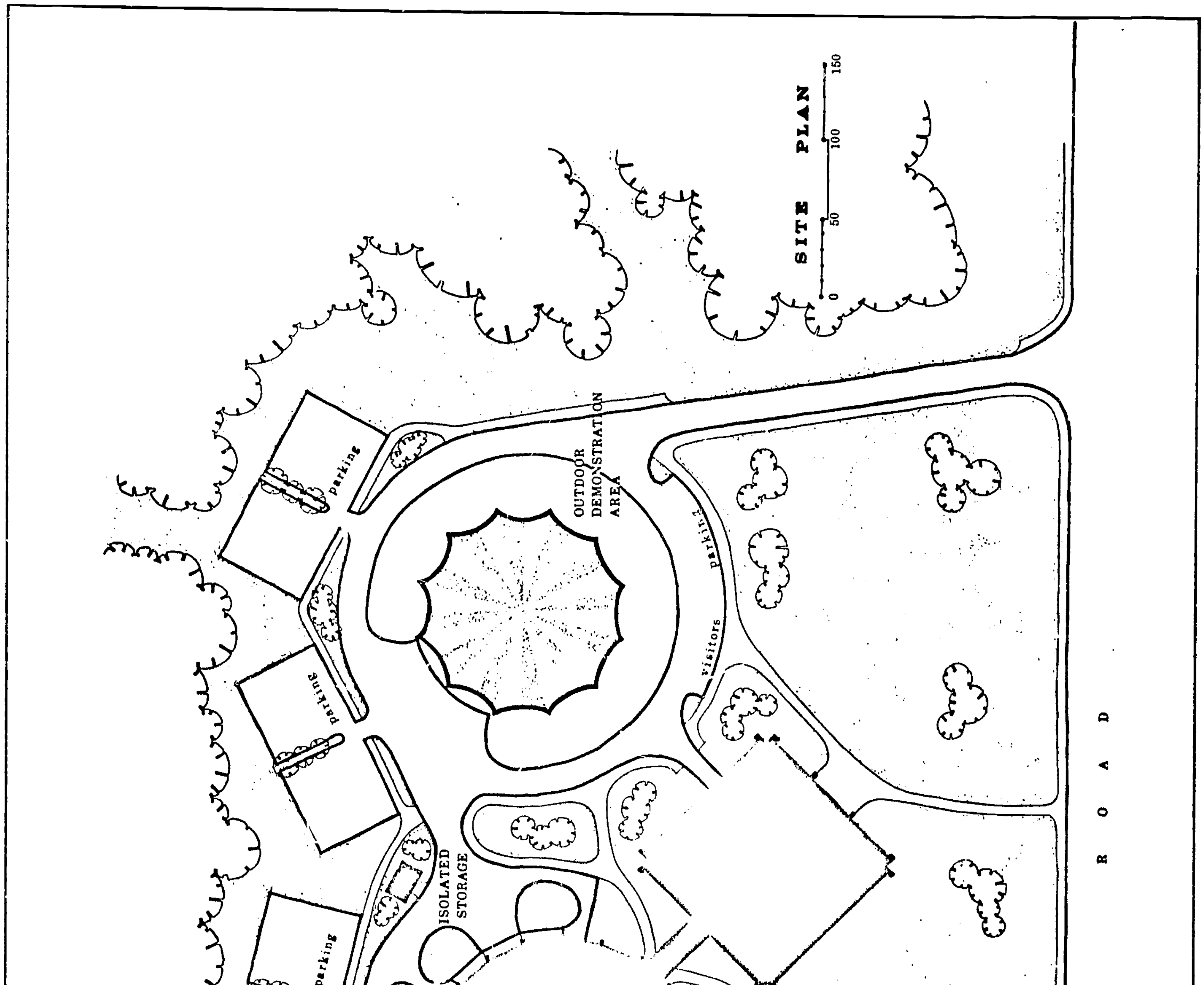
Aerial View of Technology Research Center for Vocational-Technical Education

ERIC

Technology-Resource Center

for Vocational-Technical Education

A new innovation in facilities planning to expedite updating of in-service personnel of vocational-technical schools; enriching both undergraduate and graduate teacher education programs; and, also providing research, development, and evaluation of new instructional media such as curricula, materials, models, and devices.


SITE PLAN
0
50
100
150
OUTDOOR DEMONSTRATION AREA
parking
parking
parking
parking
visitors parking
ISOLATED STORAGE
ROAD

Site Plan

A New Concept

Technology changes rapidly as a reflection of scientific research and industrial and business development.

Education for today and tomorrow, to be effective, needs to be based on current concepts and applications.

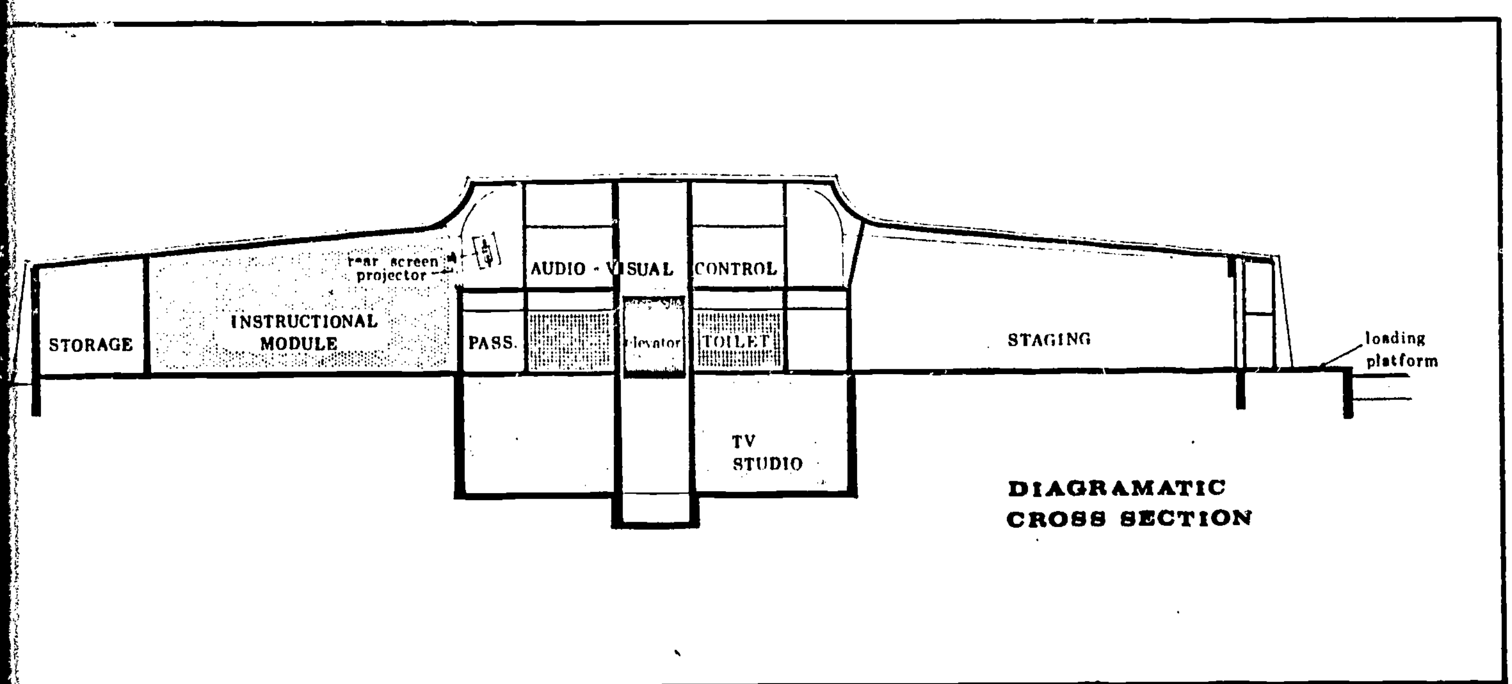
Updating of the principles of science to new applications of production and service for industry, business, and agriculture is also a major concern of education.

Vocational-technical educators, and especially teachers, require current information and familiarity with new "hardware" innovations to be effective.

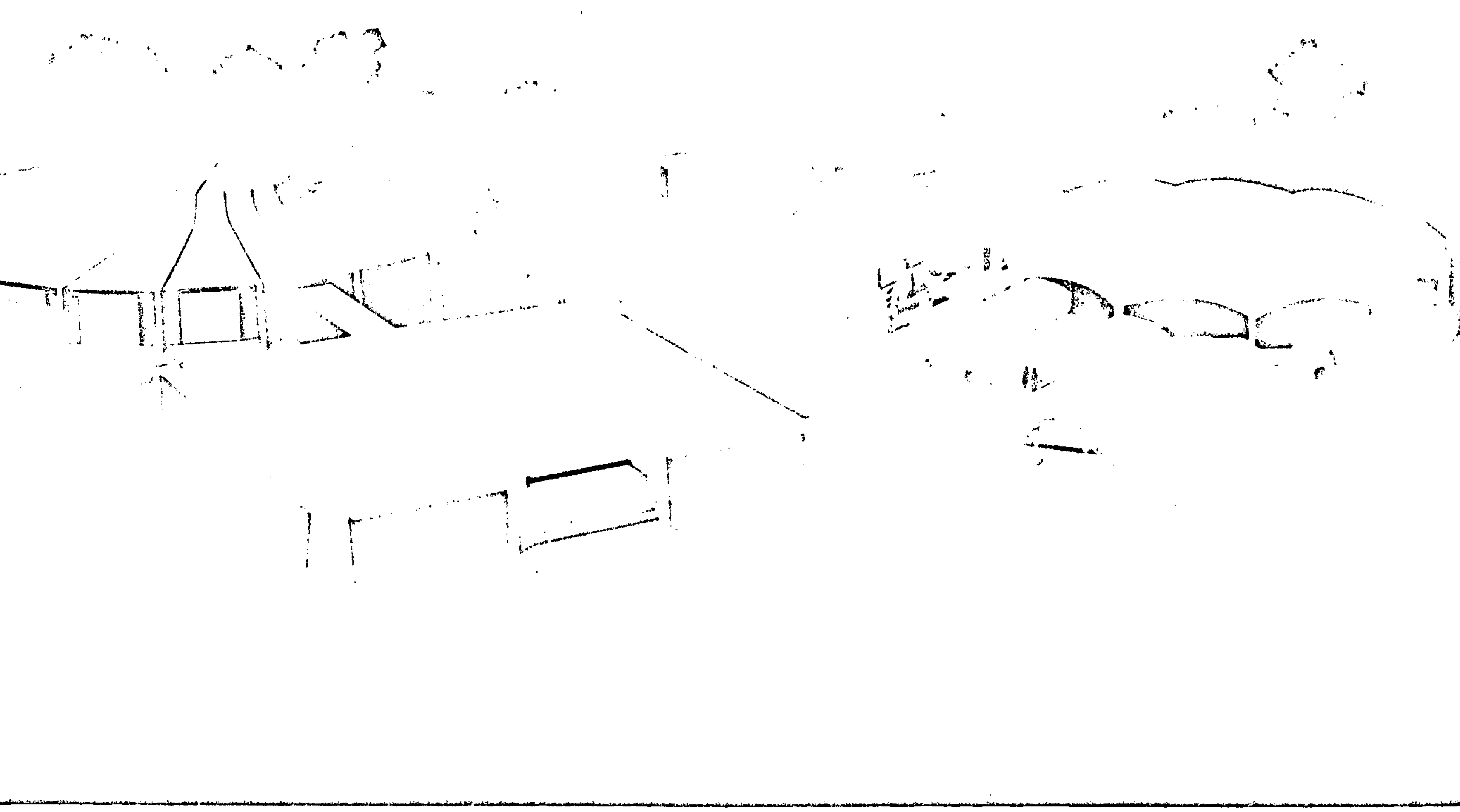
The need of overcoming obsolescence is one of the greatest challenges facing vocational-technical educators today.

A new concept in teacher education and in-service growth is recognized as a supplement to existing programs, activities, and facilities.

Satisfactory implementation of this new concept mandates a unique facility for these updating and enriching activities — A Technology-Resource Center for Vocational-Technical Education.



Diagramatic Cross Section



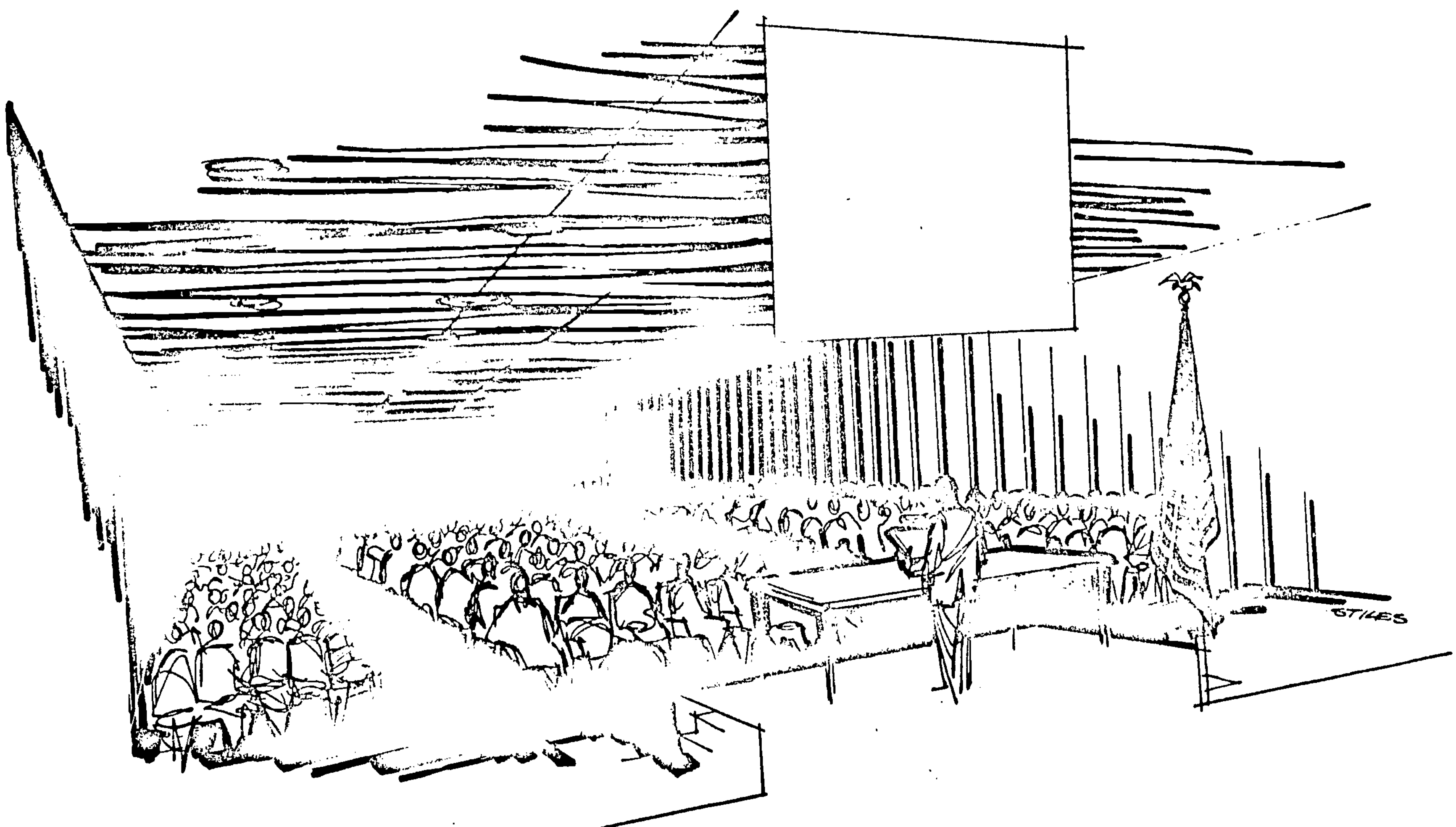
Technology Resource Center for Vocational-Technical Education

Purpose

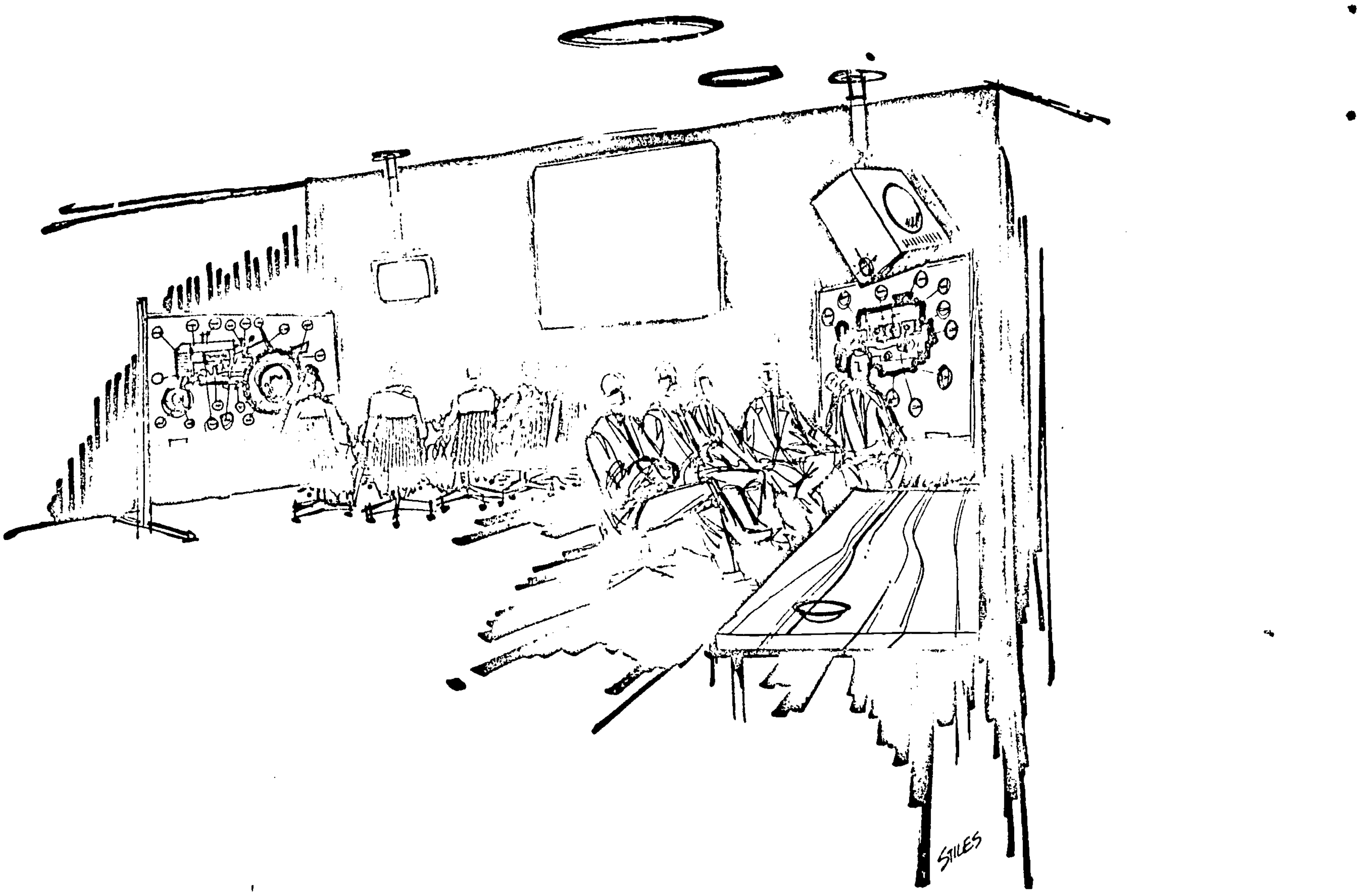
The purpose of the Technology-Resource Center is to provide a maximum of service to educators. It must represent the ultimate in educational innovations, so as to inspire and motivate, enrich the background and broaden the scope, enlarge the scientific and technical knowledge and understanding, and increase the ability to apply, in practical situations, the experiences gained.

The Technology-Resource Center is the innovation of a new and unique institution specifically designed for keeping present and future vocational-technical educators aware of new developments in technology, new "hardware", new pedagogical developments.

The Center consists of two main divisions, (1) the technology complex, and (2) the resources complex. The technology complex is devoted to updating and enriching of the vocational-technical instructional program. The resources complex is designed to supplement the teaching-learning process through curriculum research, development, evaluation and dissemination; model and innovations development; and other research oriented investigations into the improvement of teaching-learning techniques, methods, and materials.



Large Group Instructional Area



Small Group Instructional Area

Area Served

The unique characteristics of the Technology-Resource Center suggest an area or regional division of service which may be interstate as well as intrastate. Cooperation of two or more states in such an institution may not only be highly likely but extremely desirable.

Personnel Planned For

The Center is especially planned to meet the needs of in-service teachers, supervisors, guidance personnel, and administrators; it will provide enrichment for undergraduate and graduate students in teacher education; its facilities will be helpful to industrial practitioners and others in positions of leadership in business and industry.

Operational Considerations

Planning, developing and conducting programs and activities of the Center, in cooperation with other institutions of higher education will utilize and compliment other desirable and available public and private resources of equipment, technical knowledge, physical plants, and the like.

A base staff, serving on a full-time basis, needs to be provided for planning, coordinating, and providing continuous service. A supplemental call staff will need to be utilized to provide some of the aspects of technical and professional updating.

Curricula for updating educational personnel will need to reflect both horizontal articulation and vertical coordination. Horizontal articulation to express the concept of broad implications across the instructional fields; vertical coordination to indicate a level of program descriptive of "depth". Both of the above may be reflected in the same curricular activity.

Characteristics of the Physical Plant

It needs to be designed:

To meet the needs of short-time activities of such duration as 2-4 hours, 1, 2, or 3 days, 1, 2, or 3 weeks and a variety of combinations of short time spans.

To provide multi-purpose use.

For demonstration, and learning participation activities, in addition to lecture-discussions and conference-type updating activities.

To expedite moving in and out of units of the most recently developed "hardware". Convenient loading and unloading, handling, crating and uncrating, moving, and other millwright-related activities must be expedited.

To blend the functions of the Technology Center with the functions of the Resources Center to provide **maximum utilization and opportunities to serve the needs of educators.**

Characteristics of the Instructional Spaces

Institutes and workshops, demonstrations, and instructional methods seminars describe the broad classification of main activities of the Technology Center.

The word "module", as used in this research finding, is descriptive of a principal teaching-learning space for updating instructors and other educators relative to specific equipment, as well as applications, techniques, and processes utilizing this equipment. A module may be utilized for some or all of the functions of a laboratory, shop, or industrial demonstration, research, or production area.

The instructional suite of the Center consists of a minimum combination of modules together with the auxiliary spaces to provide required support activities. **Multiples of modules may be used as desired to meet the needs identified.**

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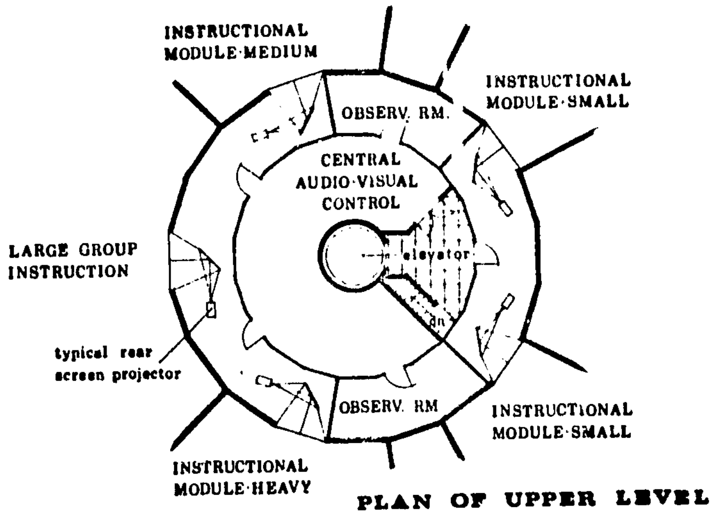
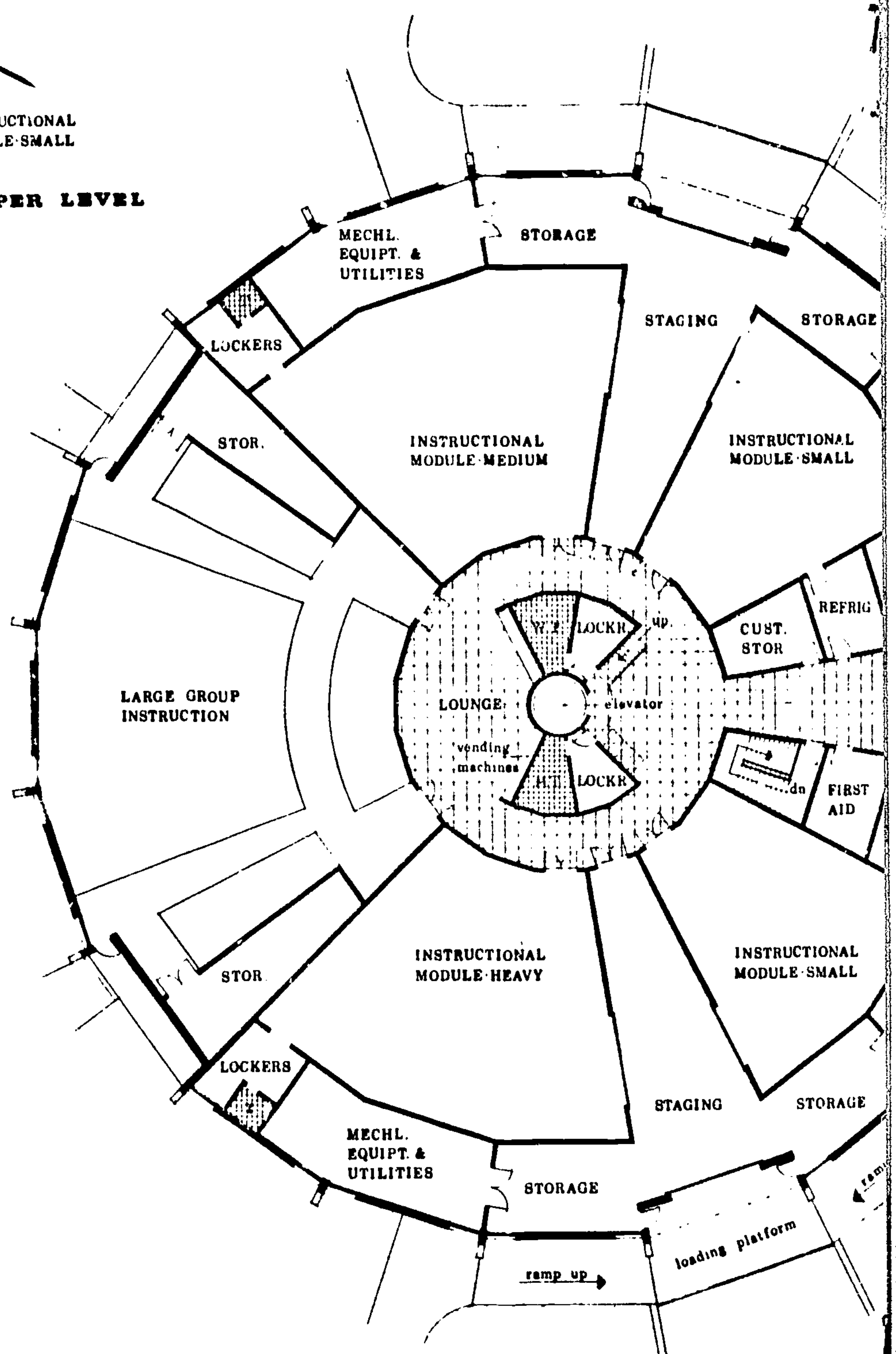
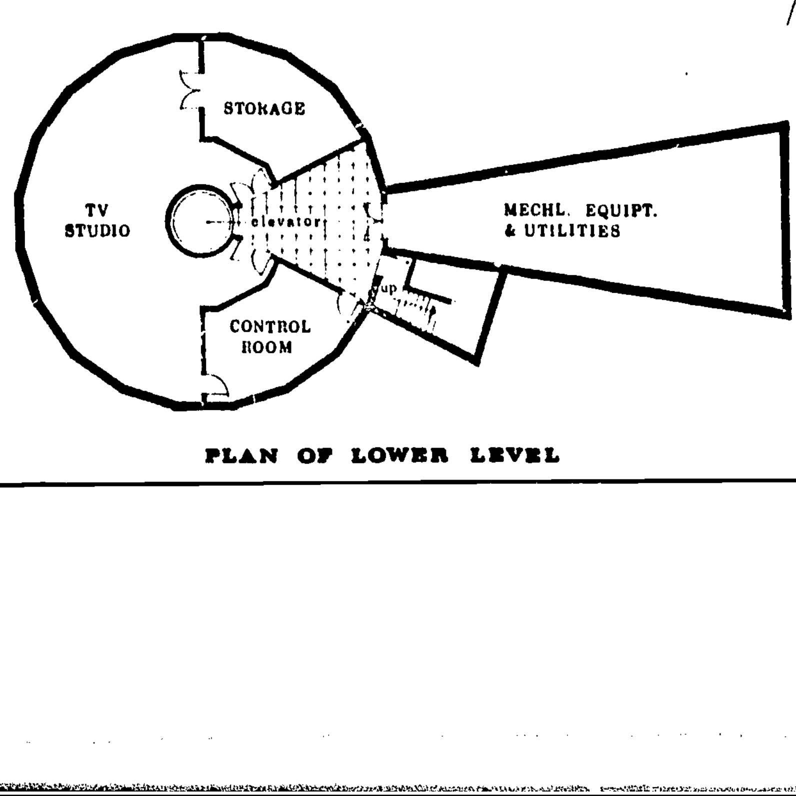
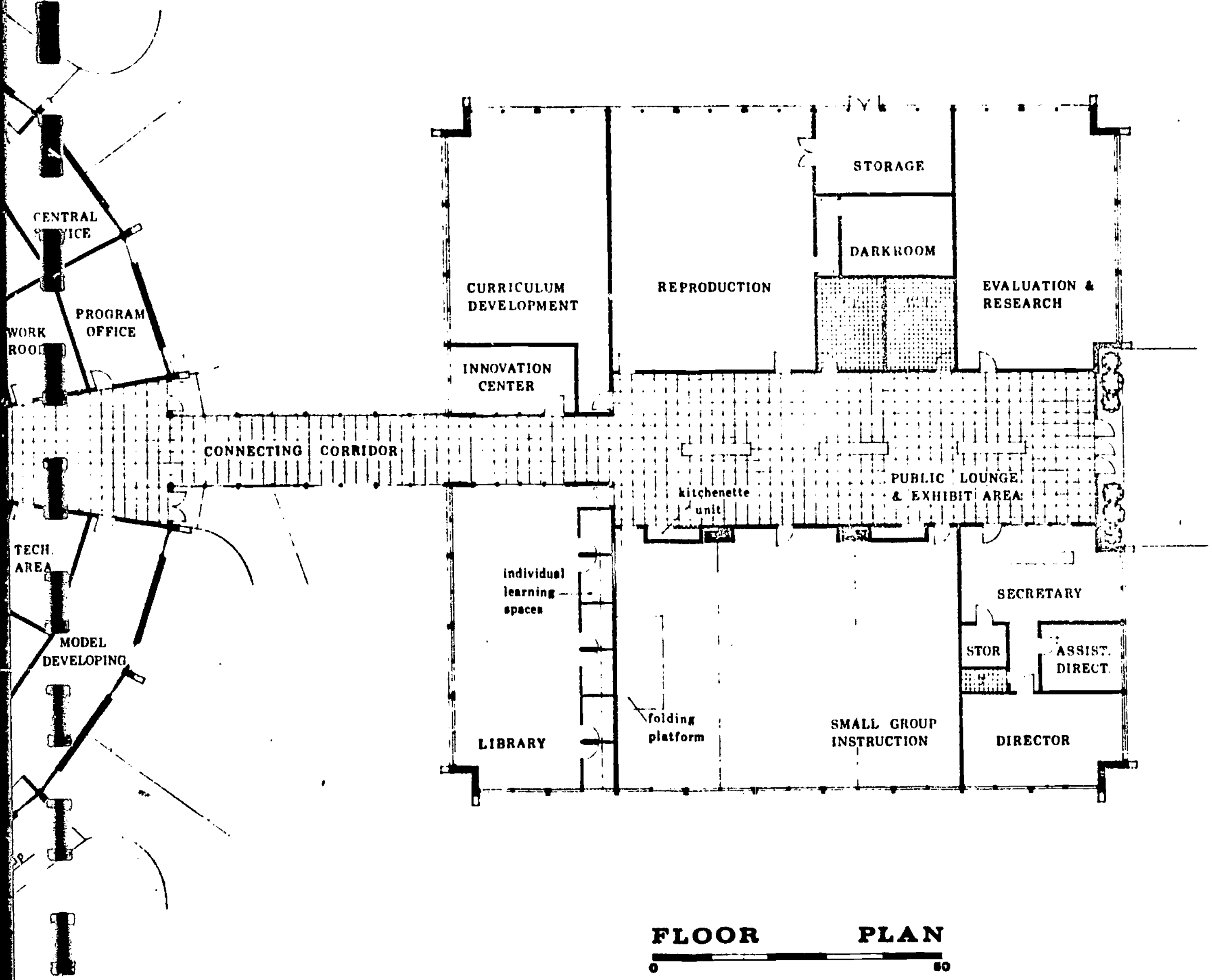


PLAN OF UPPER LEVEL





PLAN OF LOWER LEVEL


STORAGE
DARKROOM
CURRICULUM DEVELOPMENT
REPRODUCTION
EVALUATION & RESEARCH
INNOVATION CENTER
CENTRAL
PROGRAM OFFICE
TECH. AREA
MODEL DEVELOPING
CONNECTING CORRIDOR
kitchenette unit
PUBLIC LOUNGE & EXHIBIT AREA
individual learning spaces
SECRETARY
STOR
ASSIST. DIRECT.
folding platform
LIBRARY
SMALL GROUP INSTRUCTION
DIRECTOR

FLOOR PLAN

Technology Center Characteristics

Teaching-learning activities are focused in the four modules, the large group instructional area, and the multigroup instructional spaces. Significant planning considerations include needs such as:

Relationship of spaces (modules and ancillary)

Access to and egress from spaces

Ceiling heights, and door sizes

Sizes and arrangements of spaces

Environmental and light control

Facilities for the use of equipment such as:
- Rear screen projection
- Audio-visual equipment
- TV, etc.

Staging area for preparing equipment for use

Internal communication system

Ancillary spaces (inside)

Demonstration area
(outside) for extremely large equipment

Resources Center Characteristics

This complex is designed to supplement and strengthen the Technology Center and to provide additional educational services to vocational-technical education such as curriculum development (research, evaluation, and dissemination), model development, and the expediting of teacher education innovations.
Spaces are provided for:

Library — technical materials, microfilm, carrels, etc.

Curriculum development — evaluation, and reproduction

Evaluation and research — for curriculum and other related activities

Model development unit

Innovations center — experimentation

Production and recording center — slides, films, etc.

ERIC

Architectural Concept

The fundamental concept behind the circular plan is the creation of an enclosed space interrupted by as few columns or permanent facilities as possible. During the planning studies, and as the general concept evolved, certain principles and criteria were formulated to guide the physical planning of the center. Elsewhere in this study, concept, purposes and characteristics of the physical plan are noted.

The ability of servicing the four modules led to an intriguing possibility: It is possible to cluster all auxiliary spaces around a circular core module. The center is designed on three levels; the lower level, technology complex level, and audio-visual and observation level. The lower level accommodates a television studio, central room, storage and mechanical equipment-utilities room. The technology complex level provides for the four modules, large group instructional room, mechanical equipment and utility room, storage, staging, lounge, etc. The upper level provides for a central audio-visual control area, observation rooms, rear screen and television projection windows. All levels are serviced by a central core elevator.

The four modules provide for instructional groups of varying sizes and fields of study. The modules are readily serviced by rear platform delivery docks for varying sizes of equipment, staging areas for receiving and shipping and storage areas for instructional materials. Non-instructional areas are designed to accommodate and service the four modules which are the heart of the center.

The resource complex is joined by a glass connecting corridor to the technology complex. This complex provides facilities oriented for improvement of teaching-learning techniques and administration. The small group instructional area is subdivided by two removable acoustical doors. Instructional space can be divided into three rooms or one large lecture-demonstration room with complete demonstration facilities.

Other areas, such as, evaluation and research, darkroom, reproduction, curriculum development, innovation center, and library provide space and facilities to supplement the teaching-learning process. A public lounge and exhibit area allows for business, agriculture and industry to continuously display new materials and products.

To accommodate the display and instruction of large equipment, products, and vocational agricultural requirements, an outdoor demonstration area is planned.

[illegible]

Structural System

Precast concrete frame and structural purlins.

Floor Construction

Concrete floor slab on grade.

Exterior Walls

Precast concrete frames and panels.

Roof Construction

Insulating deck with plastic membrane roofing.

Interior Partitions

Lightweight concrete block.

INTERIOR FINISHES

Corridors

Floor—Terrazzo
Walls—Vitreous enamel on block
Ceilings—Acoustical

Instructional Modules

Floor—Concrete or Terrazzo
Walls—Exposed block with acoustical treatment
Ceiling—Acoustical

Large Group Instruction

Floor—Carpet
Walls—Exposed block with acoustical treatment
Ceiling—Acoustical

Storage and Staging Areas

Floor—Concrete
Walls—Exposed block
Ceiling—Exposed construction

Toilets

Floor—Ceramic tile
Walls—Ceramic tile
Ceiling—Acoustical

Lounge and Exhibit Area

Floor—Carpet
Walls—Plaster and wood paneling
Ceiling—Acoustical

Library and Small Group Instruction

Floor—Carpet
Walls—Plaster and wood paneling
Ceilings—Acoustical

Typical Office Space

Floor—Carpet
Walls—Plaster and wood paneling
Ceiling—Acoustical

Fenestration

Aluminum frame with glare reducing glazing.

Lighting

Instructional modules, group instruction areas, library and resource center offices will be lighted with fluorescent fixtures. The modules will be provided with a minimum of 100 foot-candles, all other instructional areas with a minimum of 60 foot-candles.

Corridors, storage areas, lounge and miscellaneous areas will be provided with incandescent and fluorescent fixtures.

Electrical System

Main electrical service and panels in mechanical equipment room. All raceways in conduit or armored cable throughout.

Audio-visual control cables installed in conduit.

All conduit to be oversized to accommodate future needs.

Heating and Ventilating — Air Conditioning

Central forced air system with electric heating cooling exchangers.

Ventilation will be provided on the basis of three (3) air changes per hour during heating and cooling cycles and six (6) air changes per hour during interim periods. Exhaust will be through wall registers; central duct system; exhaust fan and fall louver.

Temperature control (and humidity where required) will be an electronic system on an individual room basis. Electronic air cleaners will be provided to remove dust, smoke, etc.

Plumbing

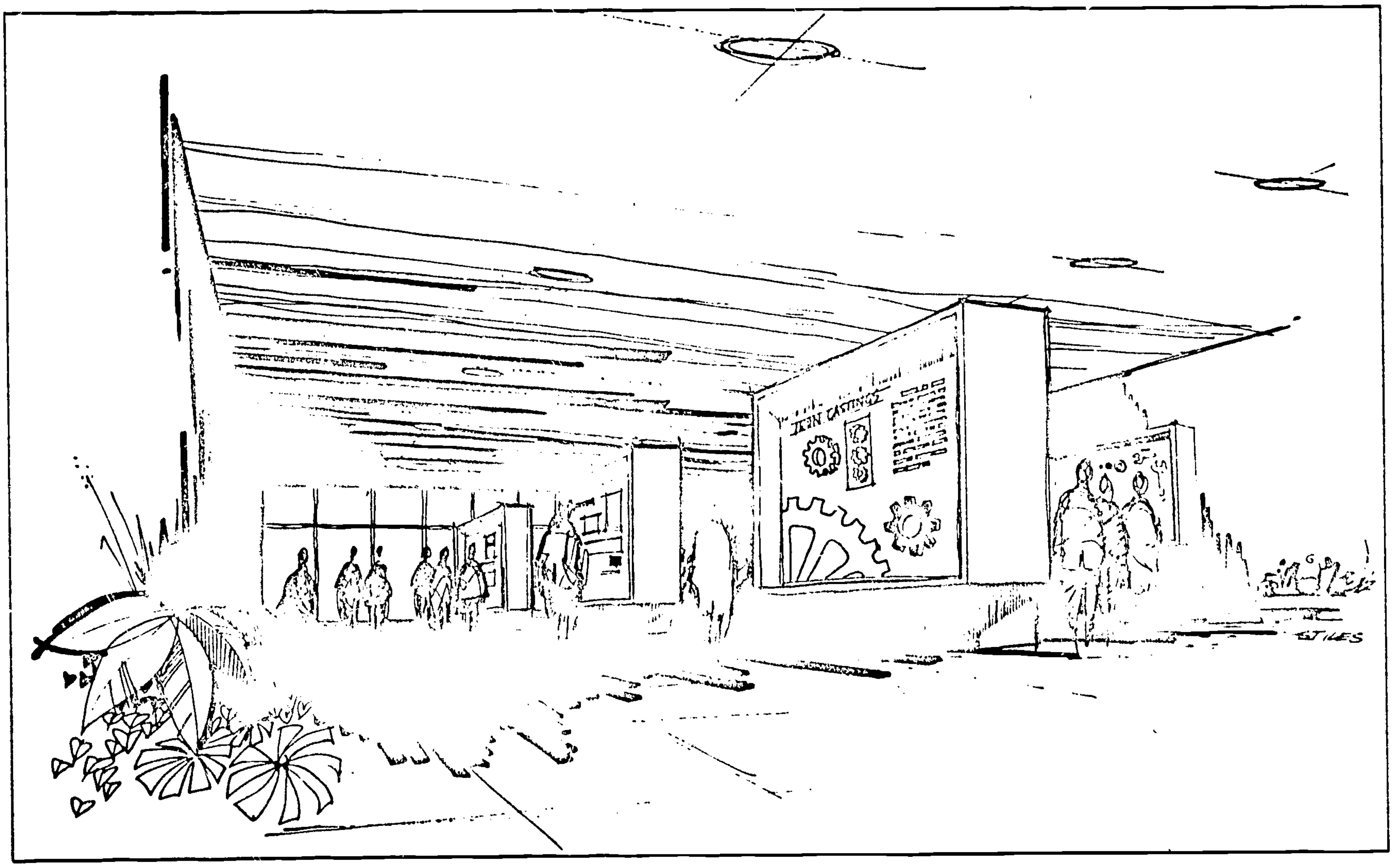
Plumbing system shall provide for water, waste, gas and storm drainage.

Special

Service Column—In all instructional modules and demonstration areas service columns (which provide electric, hot and cold water, air, waste, natural and special gases, liquids and audiovisual outlets) shall be provided.

Lighting—Landscaping—Well planned lighting will give the building interesting effects after dark as well as during the day. Since the facility will be used during the evening, adequate lighting in the parking areas is necessary.

Utilities—Underground services are planned with the capability of expansion considered.



Lounge and Exhibit Area

Pedagogical Hardware

The Technology-Resource Center will provide the most effective and up-to-date pedagogical hardware. It should serve as a "showplace" for the effective utilization of such aids and a nucleus for recent innovations in teaching-learning media.

Illustrations of the types of aids considered for the modules and other teaching-learning spaces are:

White Chalkboard (Necessary for teaching wiring for data processing)
Multi-track Chalkboards, Bulletin Boards, Flannel Boards, etc.
Rear Screen Projection
Closed Circuit TV
Projection TV (for magnification in modules)
Student Response Stations in Multigroup Instructional Area
Chart Racks
Display Racks
Data Retrieval System

Site Planning

LOCATION

Centralized location with respect to schools utilizing this service—easy accessibility from highways and turnpikes for deliveries.

SIZE OF SITE

A ten acre site would seem to be desirable to facilitate the building complex, demonstration area, parking and service roads.

GROWTH

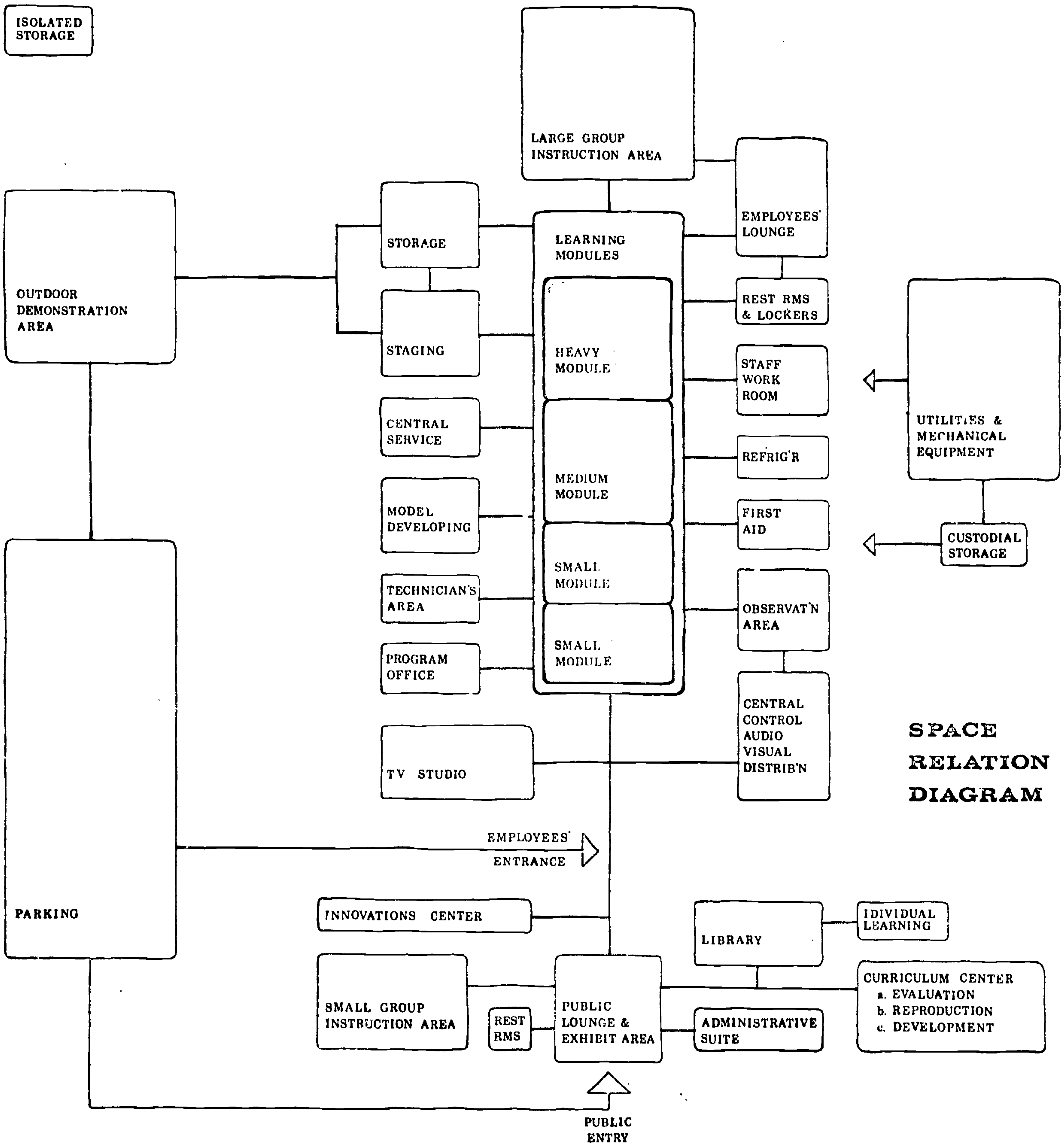
Additional module group could replace outdoor demonstration and be connected to Resources Center.

ORIENTATION

The main consideration would be the projection of the outdoor demonstration from the prevailing winds.

ROADWAYS, TRAFFIC AND WALKS

Ease of delivery and access to building from parking areas is important. Parking is planned at the rear to eliminate "Shopping Center" appearance.



Space Relation Diagram

Panel of Consultants

The following individuals participated as members of the panel or assisted in other ways in the research project:

Ohio State University	Professor and Chairman—Agricultural Chairman
University of Texas	Specialist—Distributive Education
Warren City Schools, Warren, Ohio	Building Consultant Specialist
Leeds & Northrup Company	Technical Consultant
New Brunswick, New Jersey	Director—Middlesex County Vocational-Technical H. S.
State Department of Education, New Jersey	Director—Professional Services
Rutgers - The State University	Assistant Professor Vocational-Technical Education
New Brunswick, New Jersey	Architectural Consultant
Rutgers - The State University	Research Specialist
State Department of Education, New Jersey	Director—Technical Education
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State Department of Education, New Jersey	Director—Distributive Education
Rutgers - The State University	Adviser—Technical Education
State Department of Education, New Jersey	Director—Vocational Education in the Comprehensive H. S.
Rutgers - The State University	Teacher Education
Rutgers - The State University	Associate Professor—Trade and Industrial Education
State Department of Education, New York	Trade and Industrial Education
Oklahoma State University	Director—Industrial Education
Rutgers - The State University	Lecturer in Education Vocational-Technical Education
Rutgers - The State University	Chairman, Home Economics
Rutgers - The State University	Chairman, Department of Vocational-Technical Education
Rutgers - The State University	Director—Curriculum Laboratory
University of Illinois	Head—Home Economics Teacher Education
University of Washington	Professor—Audio-Visual Education
Rutgers - The State University	Associate Professor of Education
Richmond Professional Institute	Professor—Business Education
State Department of Education, New Jersey	Supervisor—Business Education

* Principal Consultants for Research Project.

A [illegible] Technology Center

[illegible] of a [illegible]

A research project supported by a grant under the provision of Section 4(c) of the Vocational Education Act of 1963.

[illegible] University Group

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XIII. BIBLIOGRAPHY

A BIBLIOGRAPHY ON TECHNICAL EDUCATION

September 27, 1966

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