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ABSTRACT

This report familiarizes educators with the general nature of various electronic teaching systems. The material is organized into major chapters on audio equipment, visual display equipment, television teaching systems, computer assisted instruction, and student response systems. Other chapters describe several systems and approximate equipment costs, and illustrate a typical physical layout and basic components of the system discussed. Appendixes contain a glossary of the most commonly used technical terms dealing with electronic teaching aids, the names and addresses of major manufacturers of electronic teaching equipment, a bibliography of suggested readings, basic information data sheets, and a list of other EFL publications. (Data sheets pp. 125-161 may reproduce poorly because of marginal legibility.) (MLF)

Educational Facilities Laboratories, Inc. is a non-profit corporation established by the Ford Foundation to help schools and colleges in the United States and Canada with their physical problems by the encouragement of research and experimentation and the dissemination of knowledge regarding educational facilities.

instructional hardware/ a guide to architectural requirements

EFL a report from educational facilities laboratories

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PREFACE

This manual was based on a report describing the use of new teaching equipment prepared by Building Systems Development, Inc. for the Great High Schools Project.

Educational Facilities Laboratories felt that the report warranted a wider distribution. An editorial team of Donald P. Ely (Director, Center for Instructional Communications, Syracuse University), Frederick G. Knirk (Associate Director for Academic Affairs, Center for Instructional Communications, Syracuse University), and Charles N. Farmer (Medical Audiovisual Systems Officer, National Medical Audiovisual Center) reorganized, rewrote, and updated information for those media specialists and architects who are attempting to design the school of tomorrow today. Perhaps this manual will provide some of the specific assistance which is required.

Obviously this information will become obsolete quickly; in fact, if this report is still on your bookshelf in 1972, we suggest you throw it away.

Educational Facilities Laboratories

Chapter I

INTRODUCTION

A. AIM OF THE REPORT

This report aims to familiarize the educational community with the general nature of various electronic teaching systems.

It is not the intent of this report to compare the merits of specific systems produced by different manufacturers. It is also not intended to evaluate the educational values of the various systems described. The user must decide which systems should be installed, how large the installations should be, and how they might be used. He will probably be assisted by an educational media specialist and others in arriving at his decision.

B. BACKGROUND

Instructional technology emerged in the 1950's, when traditional educational practices in the U.S. began to be significantly challenged. New demands were made upon teachers–both as to subject matter and teaching method. Team teaching and teaching by television enabled the best teachers to be shared more widely. At the same time, ideas of individualized instruction began to interest the educational administrators. These ideas often presented massive scheduling problems. The ideal solution to the problem of individualized assignments would be to have one teacher per subject. The closest approximation to this ideal is to substitute individualized instruction using electronic presentation devices for the special teachers whenever possible and appropriate.

The recognition of the need for individualized instruction coincided with technological developments which made it feasible. Many of these developments in electronic and mechanical devices were the result of work done for military purposes under government auspices. Once the basic hardware (i.e., the physical components of the system) had been developed for the military, both government and industry extended their uses into other areas. However, much of the hardware now offered to education will not be significantly useful until problems of software (i.e., nonphysical components) development have been solved.

C. IMPLICATIONS OF EDUCATIONAL MEDIA FOR THE DESIGN OF LEARNING SPACES

It is not necessary to make a case for the separate provision of adequate services for portable teaching equipment. These can be easily installed in most schools. Wireless systems are also fairly easily installed.

It is also no longer necessary to make a case for standard language lab equipment or classroom television. It seems that the use of TV is inevitable and it is only a question of time (and money) before every school in the U.S. has some type of television system—though perhaps not closed circuit and perhaps only to classroom monitors rather than to student stations.

Film projectors too have been accepted as a teaching device for some time, together with all the demands which they place on schools, such as room darkening devices, dimmers for lights, and remote controls. This is discussed further in Chapter III.

Two relatively new areas involving electronic media, where important decisions will need to be made, relate to CAI and Dial Access Systems and to the extent to which all the various devices which are to be used will be integrated into a comprehensive system.

Whereas CAI really is a new way of teaching—a reordering of the traditional roles of student, teacher, and machine—dial access systems are really not much more than a very convenient technique for information retrieval and can be used to present even the most traditional lesson material.

Teachers can easily be involved in the preparation of software. The fact that almost any teacher can make a fairly successful tape recording of lesson material is another reason why dial access systems will be accepted more readily than CAI. Teachers therefore feel they have some control, and can be persuaded to accept the machine.

The extent to which educational media have been integrated into school systems in the past seems to confirm the belief that those systems which least affect the traditional role of the teacher have been accepted into school systems most readily. For instance, in a recent survey of high schools in the United States, it was found that 71 percent of the schools used language lab equipment (which permits the teacher to retain some control over lesson material); only 16.5 percent of the schools made use of television.[1]

Teachers will probably continue to make evolutionary changes in teaching procedures with the new and sophisticated hardware and software that is now available. It is incumbent upon the designer of learning spaces to provide the conditions where evolution and revolution can take place in the teaching and learning process.

[1] Mueller, Richard J., *National Inventory of Secondary School Innovations, 1967.* DeKalb, Ill.: Dept. of Education, Northern Illinois University, 1967.

Chapter II

AUDIO EQUIPMENT

A. TAPE RECORDERS AND PHONOGRAPHS

1. General Discussion

Not all electronic devices found in schools can be readily classified as belonging to one or other specific teaching system. Sometimes they may be incorporated as parts of systems (e.g., tape recorders in language laboratories), but often they are used separately. Other devices may not be used as teaching aids at all, but for related activities such as administration or library management (e.g., microfiche readers).

Since school facilities planners must consider this equipment by providing storage space and connection to utilities, a brief description of the various types has been included under this section. These descriptions should be read in conjunction with the Data Sheets in Appendix IV.

2. Equipment Types

a. Tape Recorders and Phonographs

The phonograph and the tape recorder are the two major devices available for playback of sound program materials. Both are light in weight, portable, tabletop devices which may be found as separate units or built into consoles and coupled with various other components. The normal portable phonograph or tape recorder has sufficient amplification and speaker size for use in a standard classroom without additional equipment. Larger amplifiers and speakers will permit use for large-group presentations.

(1) Phonographs. The phonograph is one of the oldest of audio devices. Programs in the form of phonograph records are available which give accurate reproductions of music, drama, and the spoken word. Storage for these records is required, and they are quite easily damaged. Extensive usage reduces the performance quality of a phonograph record. Phonographs are illustrated on Data Sheet A of Appendix IV.

(2) Tape Recorders. The tape recorder offers the advantages of the phonograph and adds some of its own. It can be used to record as well as play back live performances, lectures, other tapes, phonograph records, and student responses. Commercially prepared tapes are readily available covering nearly as wide a range of subjects as phonograph records. The introduction of the tape cartridge or magazine makes operation of the recorder simpler than the phonograph and greatly increases the life of the tape. Battery-powered recorders, capable of recording and reproducing with reasonable fidelity, allow recording under almost any conditions. These devices are illustrated on Data Sheet B of Appendix IV.

b. *Other Devices*

Included under this category are nonstandard devices such as specific types of tape recorders, manufactured under a trade name, and designed to perform a particular function.

The equipment described below is typical of this class of device:

(1) Audio-Notebook. The "Audio-Notebook," manufactured by Electronic Futures Incorporated, is a sound program source utilizing a magnetic tape with 22 master program tracks and 1 erasable recording track. The Audio-Notebook is a compact, desk-top unit, light in weight, and may be carried about easily. The Notebook is battery powered with long-life cells (see Data Sheet X).

When used with an audio-active headset, the notebook functions as a self-contained, audio-active-comparative language laboratory. The notebook may also be used with a small receiver and in conjunction with a wireless loop system as a student recorder. Finally, it may be coupled with a listening center distributor which allows as many as eight students to use one notebook simultaneously (see Fig. II-1).

(2) Dictaphone Time-Master or Travel-Master. Dictaphone Corp. makes portable, lightweight, book-sized dictating machines which can be automatically operated (Time Master), and/or battery operated (Travel Master). They can be used as program sources, either separately by individual students or integrated into a language laboratory arrangement. The machine can be used to play back prerecorded programs on special tape called "Dictabelt." Dictaphone Corp. will assist schools in the preparation of recorded programs. Some programs may also be purchased off the shelf.

B. WIRELESS TEACHING SYSTEMS

1. General Discussion

To describe wireless systems it is first necessary to clarify the term "wireless." As used by the manufacturers, this term refers to systems wherein the transmission of information is achieved without wires, i.e., radio (or RF transmission). The equipment must be energized, however, either with batteries or by being plugged into standard electrical outlets.

The basic components involved in these systems are:

–an antenna in the form of a loop (see Data Sheet C) and

–more or less standard language lab equipment, i.e., a program source and several program receivers (see Section C).

The systems were first developed as a rehabilitation strategy to overcome the problems of introducing modern electronic teaching equipment into old schoolrooms which were inadequately wired. But, because of their great flexibility, the systems are beginning to find acceptance on a much wider level.

As with standard language labs, wireless systems are very useful for the teaching of languages and business skills such as stenography, but they also have applications in education for the hard-of-hearing and for paging systems in large schools (see page 31).

The various systems produced by the different manufacturers are basically similar, though some use FM and others, AM transmission. Also, in some instances the loop is an induction loop, whereas in others it involves "modulation carrier transmission." Induction loops are activated by audio frequencies whereas modulation carriers are activated only by much higher radio frequencies (RF). The latter are not subject to extraneous audio signals such as those put out by fluorescent lights and business machines. The RF bands which may be used for these systems are regulated by the FCC.

FIGURE II-1: A TYPICAL "LISTENING CENTER"

In general, programs used with wireless systems may originate from any kind of audio source such as records, tapes, live radio, or TV. Many off-the-shelf programs are available from the hardware manufacturers who have also developed special equipment to play the programs (for instance, the Audio-Notebook and the Time-Master).

The specific systems described below will illustrate something of the range of alternatives and possibilities.

2. Description of Various Systems

a. EFI Wireless Reading System

This system is manufactured by Electronic Futures, Inc. (Northhaven, Connecticut) and includes the following items:

(1) A "Learning Loop." This is the trade name for a loop antenna which circles the perimeter of the space in which the system is to be used. The mobile and portable equipment components of the system can be used in any space in which such a loop has been installed. The loop is small, unobtrusive, and easily installed. It consists of four copper conductors (one per channel), each 0.036 in. diameter, laminated in plastic, the over-all size being no more than 5/8 in. × 1/16 in. It can be placed anywhere at the perimeter of the room—under the carpet, within the baseboard, on the wall, or at the ceiling. The best reception supposedly results when it is located on the wall, approximately 3 ft, 6 in. above the floor and parallel to it. The loop has a self-adhesive backing and is ivory colored so that it can be simply mounted to the wall and will blend with the wall color (see Data Sheet C).

The manufacturers claim that their particular loop, which is an AM modulated carrier rather than an induction loop, is not subject to external interference from power lines or adjacent room transmitters.

The maximum size of the space that can be served from one loop is approximately 10,000 sq ft and the maximum number of channels which a single loop can pick up is four. When eight channels are required, two loops must be installed.

Programs can be derived from several alternative audio sources. The most common sources are standard 1/4 in. tapes or "Audio-Notebook." Other sources include radio, TV, phonograph, and the teacher's voice (which can be broadcast through a microphone).

(2) A Mobile Teacher Console or Cabinet. This piece of equipment will accommodate two transmitter-amplifiers (which are connected to the loop) allowing up to eight lessons to be broadcast simultaneously. The mobile cabinet is used to store the program receivers and headsets when the system is not in use. This makes it very easy to transport the entire system from one location to another.

(3) Program Receivers and Headsets. Each student is supplied a portable battery-powered wireless program receiver which can receive up to eight channels. The receiver is equipped with jacks for plugging in both a student's headset and a teacher's. In this way, the teacher can monitor a student's response, which is made through the microphone attachment on the headset.

b. Dictaphone Class-Master

This is another closed-circuit radio network for classroom instruction, very similar to the EFI system described above. It differs in that:

—it uses an induction loop;

—the transmitter does not need to be connected to the loop; and

—the transmitter broadcasts three, rather than four, programs simultaneously.

c. Norelco Wireless Stenotrainer System

Again, this system is very similar to the systems described above. It differs in that it uses an overhead induction loop and FM transmission.

3. Approximate Equipment Costs

The range of costs involved in wireless systems can be illustrated by the following equipment costs:

EFI Learning loop kit	
150 ft installed	$ 60.00
Program receiver with headset	125.00
Program control–4 channel (with microphone and stand)	595.00
Cabinet for above	225.00
Base cabinet for storage	225.00
"Audio-Notebook" program source	240.00

From these itemized costs, it can be seen that the equipment for a system involving 4 channels, 4 "Audio-Notebook" program sources, and 30 receivers, effective in perhaps 3 separate classrooms, would cost around $6,000.

C. LEARNING (LANGUAGE) LABORATORIES

1. General Discussion

Learning (language) laboratories were originally developed during World War II when the Army found it necessary to give intensive training in foreign languages. After the war, the development of both magnetic tape technology and programmed instruction gave impetus to the use of learning labs within school systems, and today they are one of the most frequently used electronic teaching aids.

The essential components of learning labs are similar to those used in Dial Access Systems and described in Section E of this chapter. The latter systems are generally much larger and broader in scope, serving many more student stations, often scattered in different locations, and remote from the control center.

The typical learning lab is used primarily, though not exclusively, for language instruction. It is used by a class, on a group basis, and directed by a teacher for perhaps two or three scheduled classes a week.

2. Equipment

Essentially, standard learning labs comprise several individual learning stations, usually grouped in one laboratory, and several taped program sources, controlled from an instructor's console with cabling between. The cabling is usually installed in floor ducts or conduit and often necessitates fixed furniture positions. The instructor's console is generally in the same room as the student stations or in an adjacent room. It has a master control panel which enables the teacher to monitor, record, or communicate with any student and direct a particular program to him. Program sources are either recorded on tape or records.

The student stations are equipped for various functions including listening, responding, comparing, and sometimes viewing. The stations are described as:

a) Audio-Passive: the student listens to the recorded program through the headphones.
b) Audio-Active: as above, plus the ability for the student to hear his own voice through the headphones as he talks into an attached microphone.
c) Audio-Active-Comparative: as above, plus the ability for the student to record on tape both the master program and his own responses. The student can then play the tape for himself and compare his response with the original.

There are several variations of this system. Some learning labs are mobile; some are wireless; some are so simple that they are not called learning labs but simply "listening centers," or "learning centers." "Listening centers" usually consist of a large conference-type table with a program source at the center equipped with jacks for 10 or 12 headsets which can be stored below the table top when not in use. Sometimes these tables fold up and can be wheeled into storage or to another location.

To summarize, there are basically three types of learning lab equipment:

(1) Standard learning labs (see Fig. II-2 and Data Sheets D and E),
(2) Portable/mobile labs (see Data Sheet F),
(3) Listening centers (see Fig. II-1 and Data Sheet F).

D. TELEPHONE-BASED TEACHING SYSTEMS

1. General Discussion

Several tendencies which are prevalent in society today are giving impetus to the use of telephone communications for educational purposes. Such tendencies are the increasing costs of education generally, the merging of small school districts into large systems, and the comparative scarcity of experts to present material to the growing numbers of students. There is the need to provide quality education to students in small, outlying school districts and in-service training to teachers.

Some teaching systems such as CAI and Dial Access use the telephone or telephone lines as only one of the components of the total system. This section will focus only on those systems where the "amplified telephone" and telephone lines are the main component. Generally, telephone teaching systems are designed to reach larger numbers of students than would otherwise be possible, or those that are in locations remote from the instructor. Another aspect of these systems is that they use "live" rather than recorded instructional sources, although it is possible with some equipment to record the live lectures.[1] The following paragraphs briefly describe some of these systems.

2. Description of Various Systems

a. Blackboard-by-wire

This is the popular name of a system produced by General Telephone and Electronics (Sylvania) which is called the ECS-100 Educational Communication System. It enables groups of students in remote locations to hear a lecturer and simultaneously view his graphic material as it is being presented. The instructor talks into a regular telephone or microphone and draws or writes with an electronic stylus on a 6 in. by 8 in. writing frame which is part of a desk-top graphic transmitter. The motions of the writing stylus or pen are encoded into electrical signals describing the position of the pen in terms of horizontal and vertical coordinates. These electrical signals are transmitted over narrow-band telephone lines, together with the audio component of the presentation. The information is received at the remote classrooms with a graphic receiver assembly composed of a decoder, a storage display unit, and a TV camera. The camera picks up the display and sends a video signal to the TV screen in the classroom. Other components of the system are an instructor-audio control unit and a classroom-audio receiving unit. The instructor's unit can be connected via telephone line to a maximum of six classroom receiving units, and, by means of a switching arrangement, the instructor can receive questions from the remotely located classrooms. Indicator lights show him which station has a question.

b. Tele-lecture and Tele-writing

These two systems combined are essentially the same as VERB, described below. "Tele-lecture" is the audio component and "Tele-writing" is the graphic component of what is essentially a remote blackboard system put together by A.T.&T. (Bell System). The graphic component is usually equipment designed by firms other than the telephone company, such as Victor Comptometer (who make VERB), just as the audio component of VERB's system is actually provided by the telephone company.

c. Tele-class

Tele-class is similar to tele-lecture except that the "class" is dispersed and made up of individuals in different locations who are not able to attend regular classes (because of physical handicaps or other such reasons). A

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[1]It is quite feasible to integrate these telephone teaching systems into a dial access system. This is especially useful when taped material on the subject is forwarded to the schools ahead of time so that the students are ready to discuss the topic with the remote lecturer during the "tele-lecture."

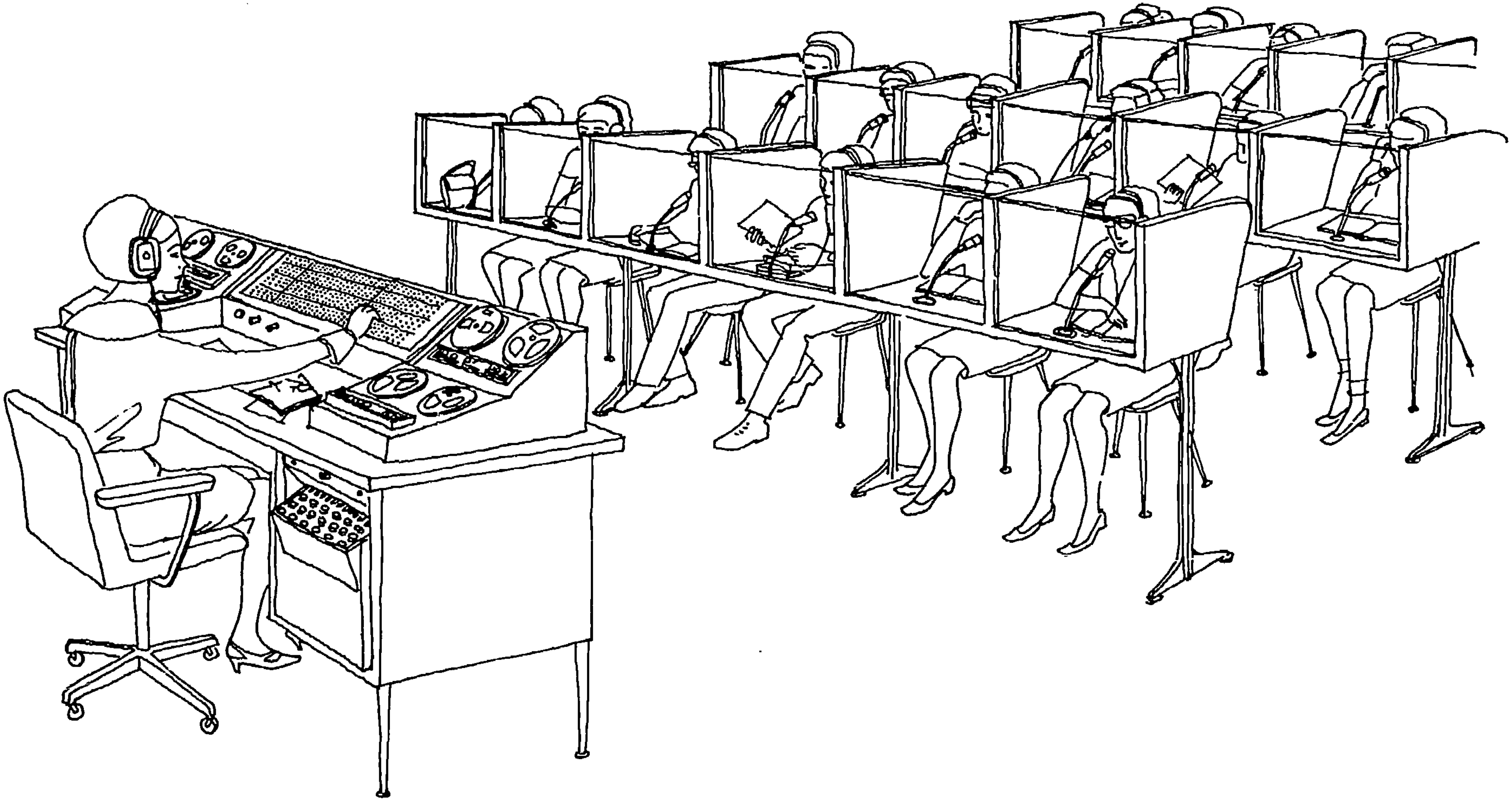

FIGURE II-2: A TYPICAL LEARNING (LANGUAGE) LABORATORY

special switching device, at the instructor's console enables the teacher to speak to all pupils at the same time or to any one of them separately. Instead of speakers at the receiving end, each pupil is equipped with a lightweight headset (headphones and microphone). This system, like all electronic teaching systems, has great potential for integrating community facilities (such as pediatric hospitals) into school systems. It also has the advantage of being much less expensive than other systems since it uses existing telephone lines and does not require special closed circuit cable distribution systems.

d. VERB (Victor Electrowriter Remote Blackboard)

VERB accomplishes essentially the same task as the Sylvania system described previously, enabling students at remote locations to receive both audio and graphic material presented by a lecturer at a central station. The number of student reception points is not limited, however, and the means of receiving the visual material is different. Here, the instructor draws or writes with a stylus on an acetate film surface of a small desk-top machine called the Victor Electrowriter. The information is passed through a "data-phone" for transmission over two regular telephone circuits–one for the audio and one for the graphic components of the lecture. (See Figure II-3.)

A stylus on the desk-top receiver automatically records the graphic information onto acetate film and this information is then projected onto a regular projection screen by means of a specially adapted overhead projector. The size of the projected image can vary between 3 ft by 5 ft to 9 ft by 12 ft depending upon the distance between the screen and the projector. The largest image is produced when the projector is about 50 feet away from the screen (see Data Sheet G).

The VERB system differs from the Sylvania system in that the information is transmitted more quickly and can be reproduced from the acetate film for permanent record, in conjunction with a standard tape recording of the audio component. It is also possible to use it for two-way graphic communication as well as two-way audio communication. In this case, "transceivers" are used in place of the receiver and transmitter.

It is also now possible to record the graphic and audio components of the lecture onto special tape machines attached to the transmitter. In this way, lectures can be preserved on tape and the system utilized not only for live, large-group instruction, but also for individual "dial access." This taped lecture system is called VETS, Victor Electrowriter Taped Systems.

3. Space and Service Requirements

The space requirements for VERB are not much different from an ordinary classroom or lecture space using a standard overhead projector. The throw of the projector will affect the size of the screen which, in turn, will permit different size audiences to participate. The transmitter and receiver are portable, desk-top equipment requiring only a regular electric outlet. Each is also connected to telephone lines through a "data-phone" which is leased to the user by the telephone company. A data-phone is slightly bigger than a regular telephone and can be located either below the desk top or alongside the Electrowriter. The rest of the equipment required to complete this system consists of audio components which are also furnished by the telephone company. These include the 'phone or microphone at the transmitting end, and also the amplifiers and speakers at the receiving stations.

4. Approximate Equipment Costs

Remote blackboard systems are generally installed where the actual presence of the lecturer would be much more costly than the cost of the equipment. For instance, in the summer, many school districts operate with much smaller faculties than normal. Instead of paying to bus students from surrounding schools in order to share a teacher at a central location, it might prove less expensive to install a remote blackboard system throughout the school district. San Mateo High School in California is planning to install a VERB system for this reason. Until now there have been very few high school installations and most of the existing VERB systems (approximately 150) have been installed within universities and industry.

In order to get a rough idea of the costs involved, the following approximate figures have been included:

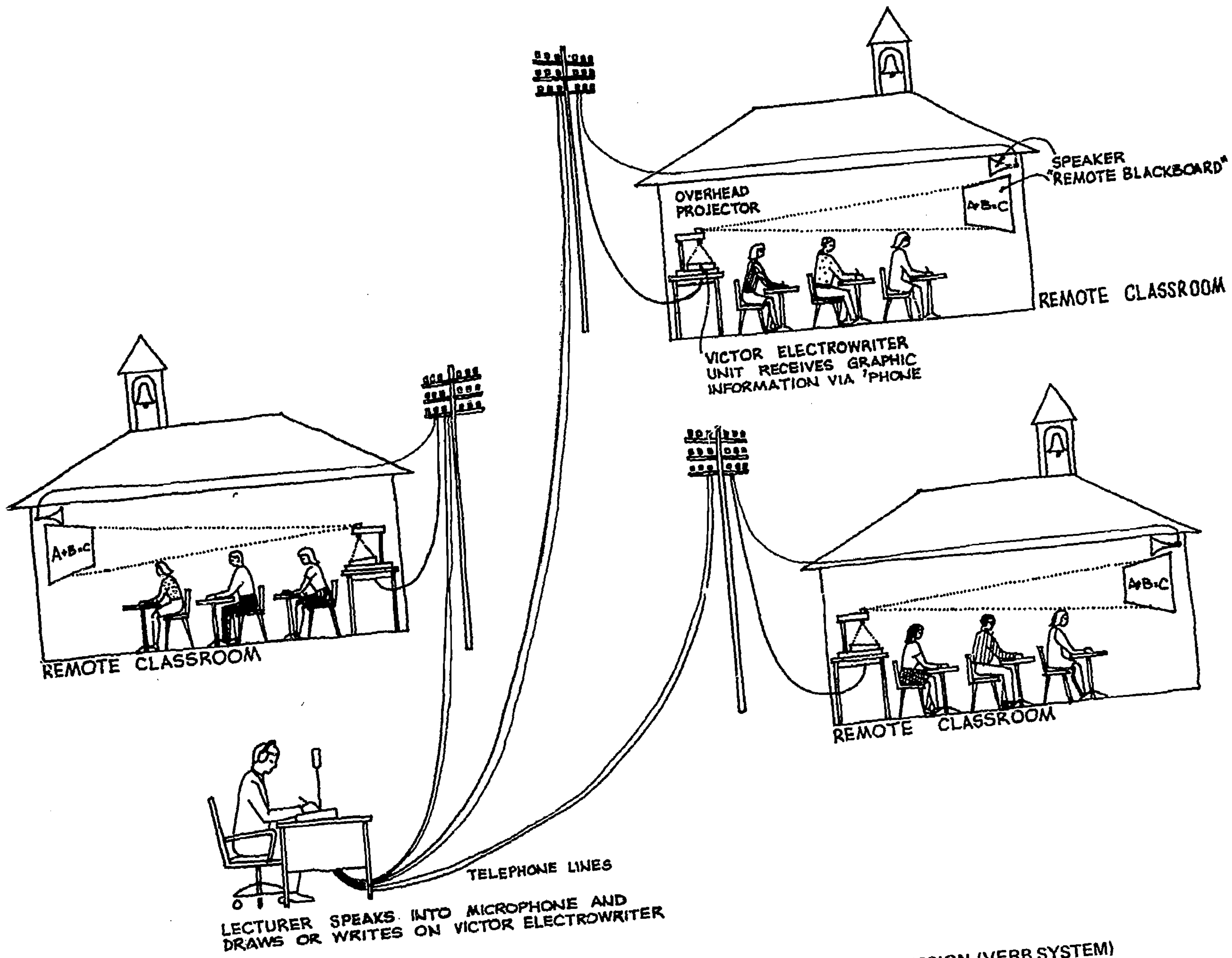

FIGURE II-3: "REMOTE BLACKBOARD" SYSTEM USING TELEPHONE TRANSMISSION (VERB SYSTEM)

	Sale Price	Delivery and Installation	Maintenance/Yr.
VERB Transmitter	$ 809	$30	$ 78
VERB Receiver	$ 995	$30	$ 90
VERB Transceiver	$1,560	$40	$150
Overhead Projector	$ 595	$15	

From these basic prices, the following approximate equipment costs can be deduced:

	Number of Remote Classrooms				
	1	2	5	10	20
One-Way Graphic Communication Cost in Dollars	2,500	4,000	9,000	17,000	34,000
Two-Way Graphic Communication Cost in Dollars	3,800	6,000	13,000	24,000	46,000

To these figures must be added the cost of items such as the projection screens, the cost of leasing telephone equipment and of the actual telephone message units used for each lecture. The latter costs are regular phone charges (usually long distance) multiplied by two.[2]

E. DIAL ACCESS INFORMATION RETRIEVAL SYSTEMS (DAIRS)

1. Definition of Dial Access Information Retrieval Systems (DAIRS)

Dial Access Systems consist essentially of a means of remote control which permits any number of individual students to achieve separate access to any number of continually available audio and video programs—usually recorded on magnetic tape. The means of remote control may be any device capable of connecting the student via a switching mechanism to the selected program. (See Figure II-4.)

2. General Discussion

a. Background to the Development of Dial Access Systems

It has become increasingly common over the past few years for students to study at their own pace at individual locations, and to have access from these locations to many sources of audio or visual information such as slides, filmstrips, audio tapes, records, etc.

Individual access, however, has become more and more complex and indirect as the number of users has grown and as the quantity of available information and variety of audiovisual devices has increased. By the late 1950's it became evident that access to audiovisual information needed to be simplified and rationalized. It was in response to this need that dial access systems were adapted from their original use as language labs to their present major use as direct automatic access libraries of recorded programmed audiovisual information. They can also be designed so that access to live as well as recorded programs can be achieved from the same student station.

A Dial Access System is essentially no more than the coordination into a system of what was previously a multitude of separate, uncoordinated, audiovisual components.

[2] These cover the cost of the two circuits—audio and graphic—used for each connection between the lecturer and a classroom. If the lecture is not given on a regular scheduled basis, it is customary to inform the telephone company ahead of time that a "conference call" will be placed so that they can make sure the necessary circuits will be available.

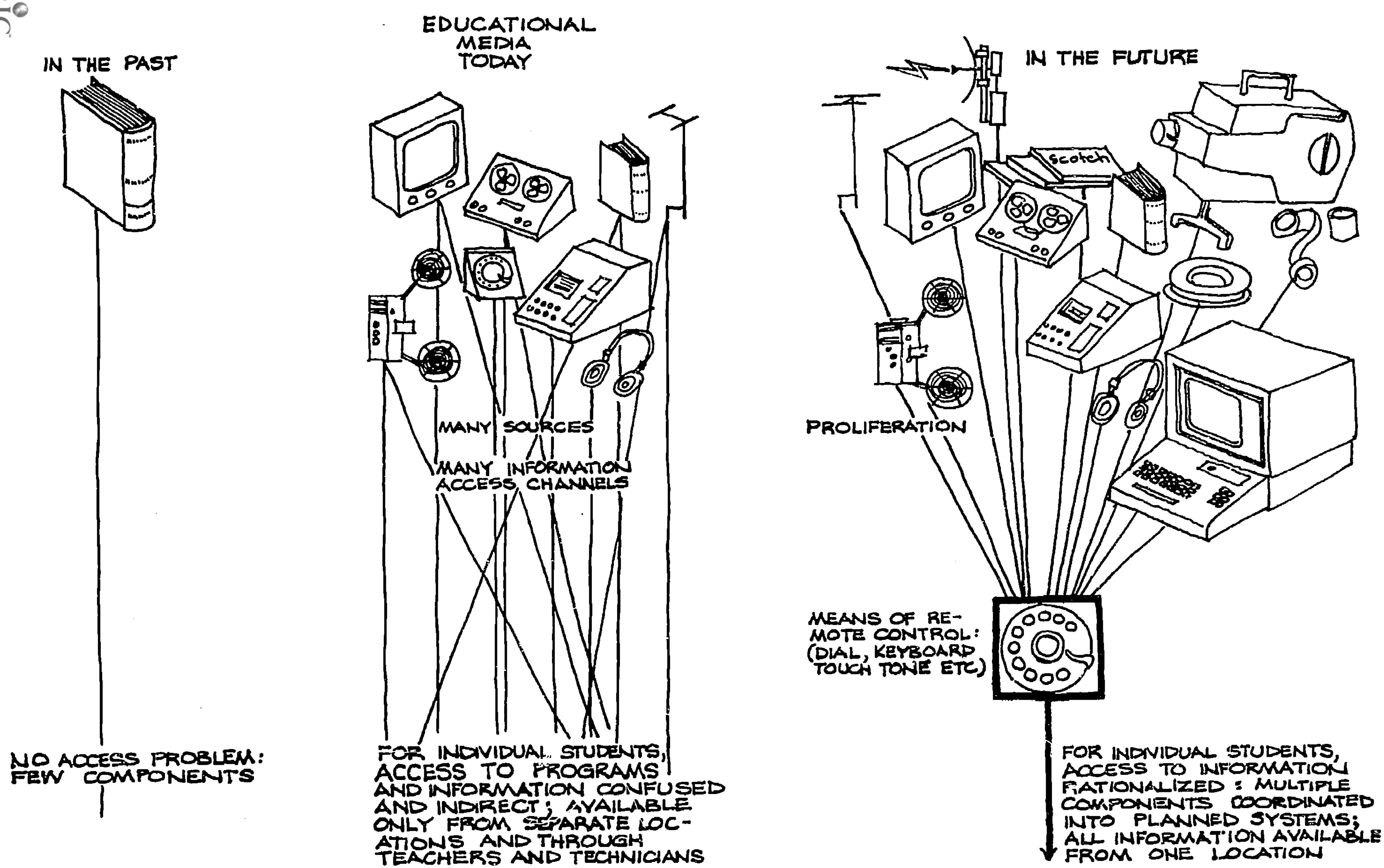

FIGURE II-4: TRENDS IN DEVELOPMENT OF EDUCATIONAL MEDIA AND TEACHING AIDS

b. Current Status of Dial Access Systems

Dial access systems (as distinct from language lab equipment) have been in use for only a few years[3] but there are already approximately 250 installations at all educational levels in the United States. The vast majority of these installations are being used as foreign language laboratories even though most of them can be, and expect to be, adapted to other instructional uses at some future date.

As language labs, these installations provide access to audio information only. But as the use of dial access systems spreads to other disciplines and the cost of video components is reduced, more and more installations will accommodate both audio and video program material.

Terms which are used to describe the various systems include "Dial Select," "Random Access," "Remote Access," and other similar phrases. Different terms sometimes denote real differences in the techniques used but the basic elements of the various systems are similar. It is becoming customary to refer to all of them as dial access systems.[4]

c. Advantages of Dial Access Systems

The first question asked when considering the installation of a dial access system is what advantage does it present compared with normal library access (i.e., the advantages of a "remote" vs. "direct" information retrieval system).

The following enumerates the claimed advantages of dial access systems:

Provides learners/teachers with "immediate" access to selected audiovisual materials.

Provides fuller utilization of audiovisual material resources because of convenience and ease of operation.

Avoids rigidities of mass media that operate on a scheduled time basis (compare TV, radio).

Frees teachers from repeating factual content and enables them to spend more time with students on conceptual ideas, discussions, counseling, remedial work, application of factual materials.

Individualizes instruction—permits the slower student to progress at his own pace.

Provides review for those who need it; e.g., students missing lectures for health or other reasons.

Provides telephone long-distance hook-up for lectures by outstanding teachers.

As a dissemination system, it provides flexibility—individual, small group, or classroom use.

Offers effective in-service and pre-service training:
—Immediate playback.
—Chance to observe good and bad training.
—Observable performances that can be measured.

System can be expanded by:
—Adding to the number of program sources.
—Increasing student-classroom receiving stations.
—Adding video to audio reception.

d. Problems With Dial Access Systems

Obsolescence. Dial access systems are changing rapidly due to a technology which is constantly improving. For instance, electromechanical switching devices are being replaced by electronic devices. Also, it is claimed that video programs will soon be drastically reduced in price by a system now under development

[3]Chester Electronics Laboratories claims to have "pioneered" these systems in 1960 with the introduction of Chester Dialog.
[4]The term "dial access" derives from the original mechanism used to connect a student with a selected program stored at a remote location, namely a telephone-type dial selector.

at CBS Laboratories.[5] Some purchasers are therefore holding back on the procurement of video program access.[6] However, many feel that the problem of possible obsolescence is far outweighed by the advantages gained from immediate installation.

Another argument against delay is that equipment life is from 7 to 10 years and components of "primitive" systems can be replaced by improved ones as equipment wears out.

Incompatibility of Systems. After an institution has analyzed its needs and requirements for dial access systems, it is necessary to survey the various manufacturers' systems thoroughly. Not all systems can cater to all the requirements an institution may list and it is not usually possible to combine components of one system with those of another. This problem may disappear in time, but at present an institution must regard itself as "married to one manufacturer."

This is a serious consideration because some manufacturers who provide particular design advantages may not provide good service or may be tardy in providing replacement parts, etc.

It is also necessary for an institution to be careful when obtaining bids for an installation which is to be phased over a period of time. The initial bids should request reasonable guaranteed costs for additions to the system.

3. Software for Dial Access Systems

Dial Select Programs can be made available from the following sources:[7]

Audio: Audiotape, records, Phonovid, Tele-lectures.

Video: Videotape, Blackboard-by-wire, ETV, Commercial TV, CCTV (including 2500 MHz ITFS), Camera Chain (TV cameras), Film Chain (16mm movie, 35mm slides, filmstrip, TV camera), Microscope Chain (microscope, TV camera).

The most common program source is audio tape, but video displays are becoming more and more frequent. Much of the program software that is being used at present is commercially prepared and packaged, but there are advantages to faculty-prepared programs. For this purpose, the school should be provided with adequate facilities, such as TV studios, graphic studios, recording facilities, etc., for the preparation of audiovisual materials.

Strategies necessary to involve faculty in the acceptance of dial access systems or the preparation of program materials will not be discussed here. For the educator and the architect, it is sufficient to know that this can be a problem and very time consuming. There is also no guarantee that the investment will be worthwhile, i.e., that all faculty-produced programs will be useful.

4. Dial Access Systems Options

There are several options available at each decision point in the design of a dial access system. For instance, at the most fundamental level there is the option regarding the type of program sources; will video programs be included? Will live as well as recorded programs be available? (See Figure II-5.)

This section will deal primarily with the size of systems, the degree of student control of programs, and the manner in which programs are made available to individual users. Most of the following titles or headings used to describe the various options for achieving access to programs are based on A.T.&T. terminology.

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[5] Basically, EVR (Electronic Video Recording) is a playback device, which uses a seven-inch cartridge containing up to an hour's playing time of film and which plays through any conventional television receiver. This improvement is expected to be available in the 1970's.

[6] One way of overcoming the problem of obsolescence might be for schools to lease equipment instead of purchasing it as is now the customary practice. School budget considerations may affect the leasing vs. purchasing issue, however.

[7] All these sources are described more fully in other sections.

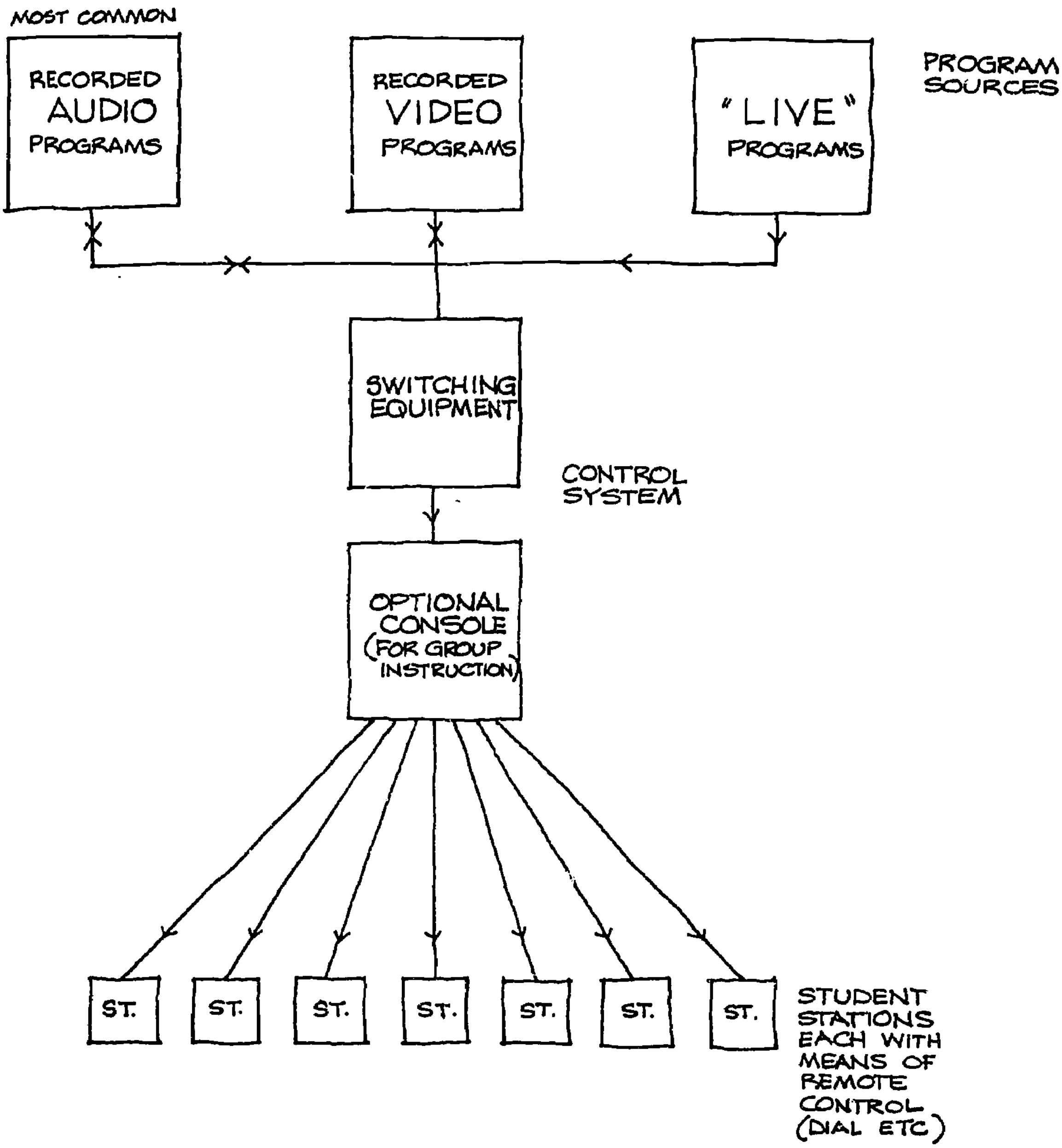

FIGURE II-5: BASIC COMPONENTS OF DIAL ACCESS SYSTEMS

a. *The Direct Access Technique*[8]

This option which also could be labeled "Automatic Access" or "Student Control" permits individuals to gain direct access to the information desired by "dialing" a code number listed in a catalogue of programs. Access is automatic—usually by means of a telephone-type switching mechanism—and immediate, provided the program has not already been dialed into use by another student. In most systems, if the program is already in use and if the student wants to hear it from the beginning, then he must wait until the last user has finished with it. For this reason, the direct access technique is used mostly for short, taped programs.

b. *The Random Access Technique*

"Random access" is the ultimate goal of dial access systems. It describes a system whereby any segment of any program can be automatically retrieved for immediate use without waiting. Ampex produces a system which uses dubbing techniques to give all users immediate access to any audio program with a maximum waiting period of only one minute. Chester Laboratories has produced a "Serial Information Dial Access Control System," called SIDAC, which permits users to listen to segments of a tape. This technique has obvious advantages over others but is more costly.

c. *The Media Staff Technique*

A more appropriate title for this option would be "Indirect Access Technique." The technique is no more than dialing the operator or attendant in the control area and asking him to play a selected program over which he has manual control. This is the usual way in which taped video programs are made available to individual users since automatic access is so costly at this time.

d. *The Scheduled Access Technique*

This option is employed to eliminate the waiting period from a simple direct access system. If different users, for instance, dial the same recorded program at the same scheduled time, all of them can listen to it simultaneously from the beginning without incurring any waiting time. A program schedule is particularly necessary if live programs are included in the system or if ETV programs are to be made available through the dial access system. Scheduled programs can either be manually operated or time-switch controlled.

e. *Restricted Access Technique*

The techniques described above permit any student to dial any program. However, there are occasions when certain lines might need to be restricted from receiving certain programs—either because of the nature of the information or for testing purposes. One solution using standard equipment would be to disclose the catalog or directory number of the test program only at the appropriate time. Or, if the selected system includes a stored-program computer as part of its switching mechanism (e.g., North Electric Datagram System), this technique can easily be programmed into the system, providing the flexibility of randomly restricting any student position from receiving any program.

f. *Master-Slave Technique*

Sometimes it is required to remove the control of the student station from the student. This can be achieved by means of a console which physically intercepts the wire between the student station and the switching equipment. If there is a computer switching control, the computer can be programmed so that any station can become the "master" (for use by the teacher) and any other stations can become the "slaves" to the master, receiving only the program dialed by the master.

g. *Off-Campus Student Access*

More and more schools are beginning to cater to off-campus students by extending their dial access systems through "recorder couplers" to outside telephone lines. By attaching audiotape recorders (which are scheduled to play at regular intervals) to telephone equipment similar to that used to handle weather calls, large-

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[8] Sometimes "direct access" is used as a term to describe the usual way in which information is obtained from a library, i.e., by the person himself, without electronic means. Used in this way, it is another alternative to "dial access" (i.e., remote access).

class lectures can be made available to off-campus students over their own telephones. The implications of this technique for adult education are enormous.

Other techniques can be arranged to satisfy the particular needs and objectives of an institution.

Factors influencing other systems options include the following:

Magnitude of the Operation. How many students are involved, how many subject areas must be incorporated into the system, and what is the geographic size of the institution.

Educational Goals. Will the system be used essentially as a homework supplement or designed to enrich the curriculum?

Costs. Costs may affect the way in which the system is to be used. Will each student be assigned his own carrel or not; will the system be decentralized?

Convenience and Ease of Accessibility of Materials. How many program sources are required for the. number of student stations? Will the system require video as well as audio?

Maintenance. Does the system have a high degree of performance reliability; how many service personnel are required to operate the system?

5. Hardware and Space Requirements for Dial Access Systems

Apart from television studios, graphic studios, etc., which are part of sub-systems that might be incorporated into dial access systems, the major spaces to be considered are the user locations and the information storage (and control) area. The major hardware elements are located in these spaces. These are as follows:

a) At the User Location:
   (1) Means of Remote Program Selection
   (2) Intercom Equipment
   (3) Equipment to Receive (and sometimes Record) Audio Information
   (4) Equipment to Receive Video Information

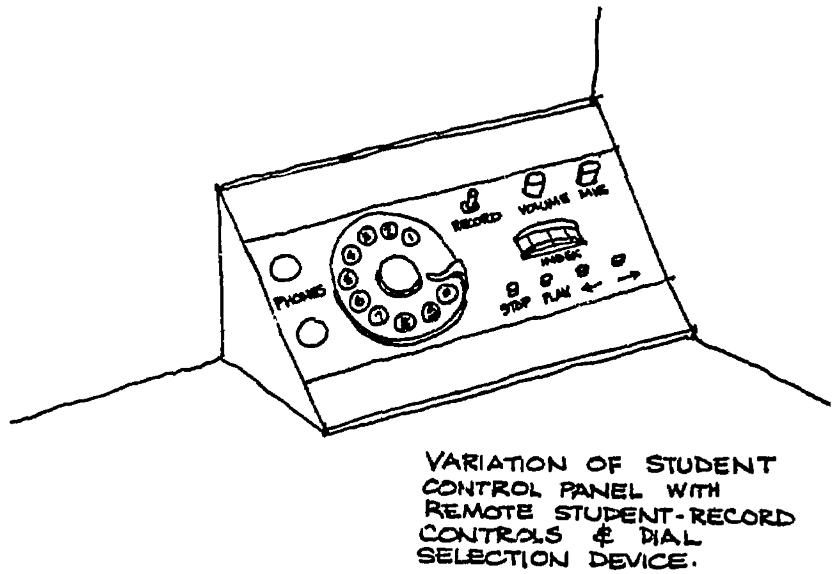
b) At the Information Storage and Control Area:
   (1) Recorded Audio Program Origination Equipment
   (2) Recorded Video Program Origination Equipment
   (3) Equipment to Receive and Distribute Live Video Programs Within Dial Access Systems
   (4) Mechanism to Connect Users with Selected Programs

a. The User Location

In dial access systems, the user location is usually an individual study carrel[9] although it may be a small-group seminar room, an ordinary classroom with dial outlet, a laboratory booth, etc. Location of the carrels or rooms might be anywhere in the school plant or even off the site in other schools, dormitories, or private homes.

Preliminary investigations suggest that usage of dial access systems increases when carrels are installed in dormitories and student centers or other places which are easily accessible. Easy accessibility must be considered in relation to requirements for supervision, however. Different student populations will require different degrees of supervision to minimize abuse of electronic equipment. This is not such a problem when each student is assigned his own carrel or where all carrels are in one central area (which seems to be the

[9] For convenience, user location will be referred to as though it were a carrel designed to accommodate the necessary receiving, recording, and selecting equipment and also any supplementary materials needed for the lesson such as textbooks, etc. Typical dial access carrels are shown in Figure II-6, and the kind of equipment which might be used at these carrels is indicated in the matrix shown in Figure II-7.



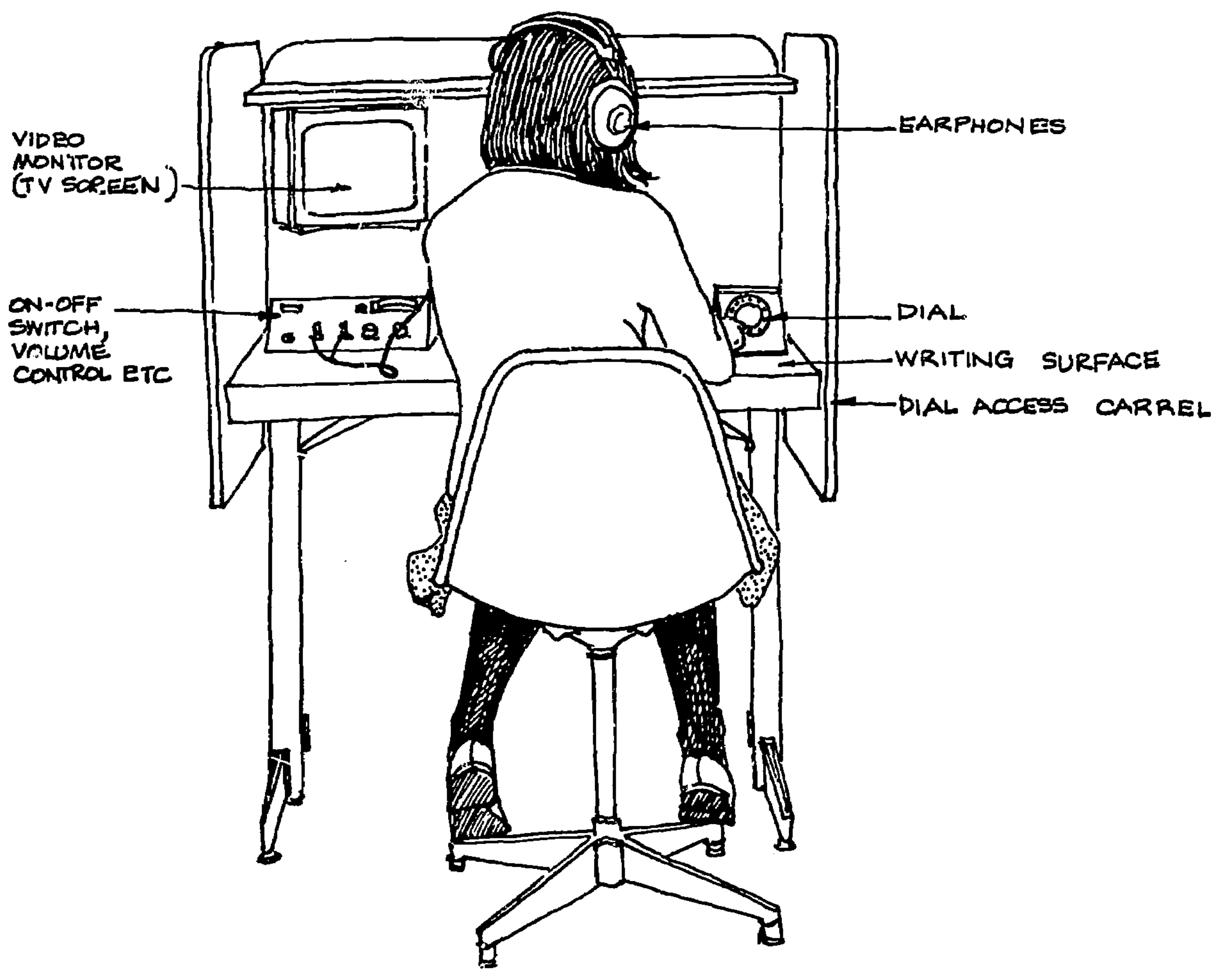


FIGURE II-6: DIAL ACCESS STUDENT STATION

EQUIPMENT FUNCTION	DEVICE	STUDENT POSITION TYPE: A	B	C	D	E
SELECT	DIAL	X	X			
	TOUCH-TONE			X		
	KEYBOARD				X	X
LISTEN	EARPHONES	X	X	X		X
	SPEAKER				X	
RESPOND	TEACHER CALL					X
	MICROPHONE		X	X		X
	INTERCOM PHONE					
RECORD	TAPE RECORDER AND CONTROLS					
	CONTROLS ONLY			X		X
VIEW	TV SCREEN				X	
OTHER	ON-OFF SWITCH	X	X	X	X	X
	VOLUME CONTROL	X	X	X	X	X

FIGURE II-7: TYPICAL EQUIPMENT CHOICES FOR DIAL ACCESS USER POSITIONS

most usual configuration), but a system of equipment control must somehow be developed if carrels are scattered.

The equipment at each carrel will vary depending upon the functions the student is required to fulfill. For instance, he may select a program and listen to it. Or he may listen to one selected by the teacher from another location. Sometimes a student-response function is added to the equipment or a student may record his own responses.

(1) Means of Remote Program Selection

A telephone-type dial selector at the student position is the most commonly used device for achieving access to remote recorded programs. As the telephone companies change to the more rapid and convenient "Touch-tone,"[10] so also will dial access systems tend to use this device more and more. Other means of remote program selection include a keyboard, such as a teletypewriter, or any other electronic device capable of activating a switching mechanism or other type of program control (see Fig. II-8).

(2) Intercom Equipment

At times it is necessary for the user to contact the operator in the control room or the teacher at the console or some particular difficulty is encountered during the course of a recorded lesson. This can be accomplished by means of a "teacher call" button which activates a visible or audible signal in the control area or at the teacher's console. A regular intercom telephone or a microphone enables the user to communicate with the operator.

(3) Equipment to Receive and Record Audio Information

Audio programs are generally received at the student station through headphones, although sometimes side panels of individual study carrels have small built-in speakers. Speakers might also be used in seminar rooms and classrooms. A microphone enables the student to record his own voice when required by the program to do so.

In some systems, a tape recorder might be located at the student station. But it is more common to find only the tape recorder controls at the student station while the tape recorder itself is located in the control room. Not all positions would require this recording ability.

One way in which the student-record unit might be used is as a testing device. The student records material to be reviewed later by the instructor.

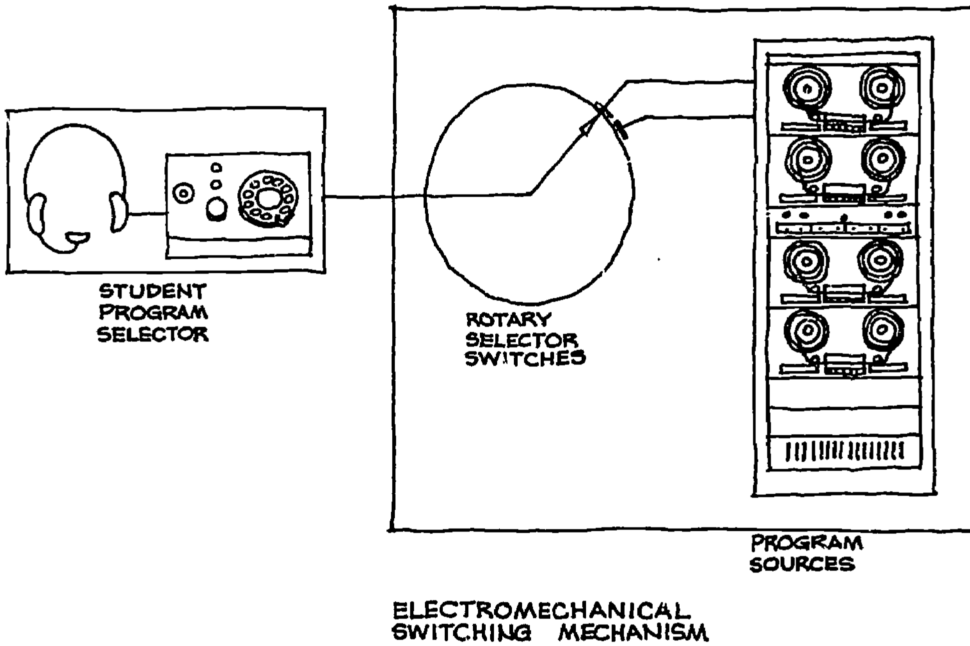
(4) Equipment to Receive Video Information

Video information is received at the student station by means of a small TV screen, usually 9 in., as shown in Figure II-9.

The screen may be a "video monitor" which receives video signals only, in which case a separate audio cable would carry the audio signal to the earphones or speaker. Or, it may be a "VHF receiver," which receives RF[11] VHF signals carrying both the video and audio components.

VHF receivers can be equipped to receive not only regular RF signals but also video signals. The question of whether to use a video monitor or a VHF receiver is dependent upon the whole system design (see Chapter IV).

[10] "Touchtone" is a trade name for a push-button type selector. The reason why Touchtone is more rapid and convenient is that whereas the telephone dial sends out *impulses* which trigger crossbar switching to activate a signal, Touchtone is already at the signal stage. At present, Touchtone is still more expensive than the normal telephone dial but is also more flexible, since it is easily adaptable for use in conjunction with other systems such as Student Response Systems.
[11] RF is the abbreviation for radio frequency, which encompasses the range including VHF (very high frequency) signals. See Glossary for other terms and abbreviations.



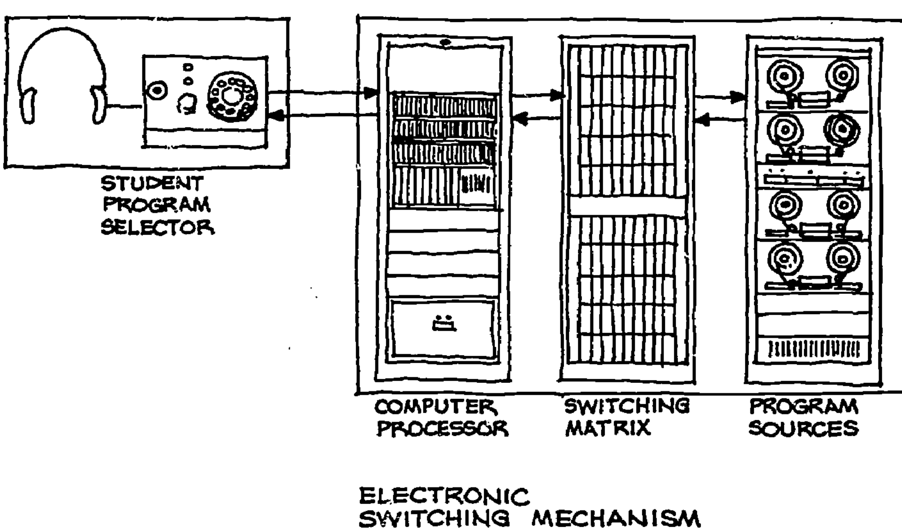


FIGURE II-8: ALTERNATIVE SWITCHING MECHANISMS

FIGURE II-9: STUDENTS AT AUDIO/VISUAL DIAL ACCESS CARRELS
EACH RECEIVING A DIFFERENT PROGRAM

It is also possible to make video information available to students by locating nonsystem components such as slide projectors, regular small TV sets, etc., at the student carrel. The carrel must then be designed to accommodate this extra equipment as well as to provide automatic access to remote programs. Supervision of carrels becomes more important when loose equipment is used.

b. The Information Storage and Control Area

This area is referred to by different terms such as "Source Location," "Central Lesson Library," "Library," "Control Room," etc. It is the place where recorded programs, switching mechanisms, and distribution equipment are usually located. Sometimes a control console is also located in this area.

For reasons of economy, the control room should be located so that distribution lines (telephone and coaxial cable) between it and the greatest number of student stations are kept as short as possible. It should also be related to the recording area and the materials resource center. The information storage area can be a part of the materials resource center.

(1) Recorded Audio Program Origination Equipment. In one type of dial access system (Chester), recorded audio programs are stored on reel-to-reel tape units in banks of "program transports" (see Fig. II-10). When a selected tape is dialed, four different monaural programs which might be recorded on the one tape play at the same time. These might all be listened to by different users, or, if desired, all users could listen to one program simultaneously. At the end of the program, the tape rewinds automatically and is ready to be dialed into use again.

A basic disadvantage with this system, however, is that if a student dials into a 15-minute program 5 minutes after someone else has dialed into it (or into any one of the other three programs on the same tape), he

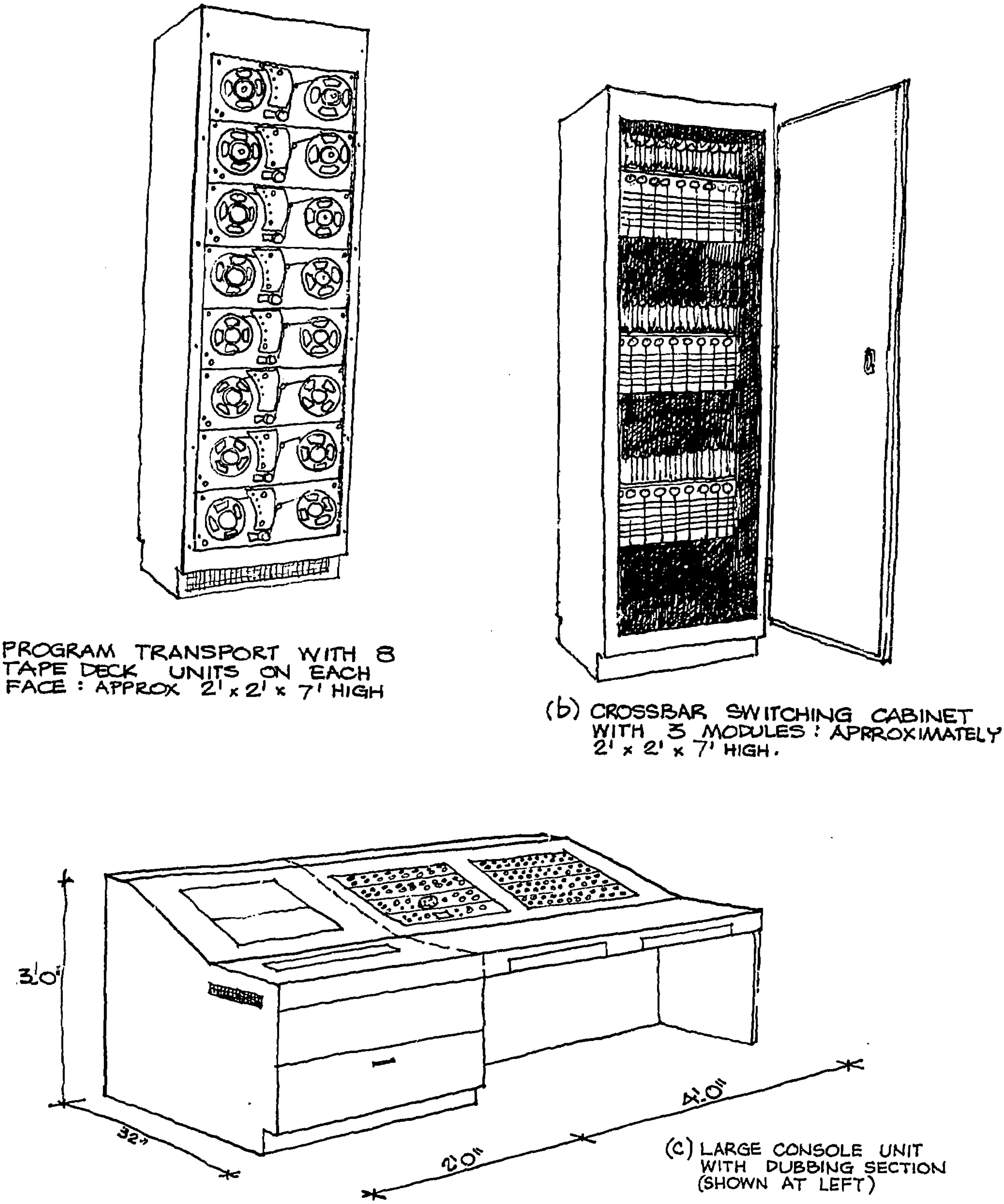


FIGURE II-10: TYPICAL EQUIPMENT COMPONENTS IN DIAL ACCESS INFORMATION RETRIEVAL SYSTEMS (CHESTER DIALOG ILLUSTRATED)

has to wait 10 minutes before he can hear it from the beginning. The Ampex system (called Random Access) has overcome this problem in the following way: all programs are recorded on master tapes which are 1 in. wide, endless loop, 32-track tapes containing 32 programs each. When a student selects a particular program on this master tape, it is swiftly transferred from the master tape onto a student buffer tape. This "dubbing" process takes a maximum of one minute since the transfer takes place at 40 times the listening speed.

Both the master tape and the buffer tapes are located in the control area. The buffer tapes are connected to the student stations. Once the program has been transferred onto the buffer tape, the student can listen to it as often as he likes. When he is finished with it, the program is erased from the buffer tape which is then ready to receive the next selected program. A simplified diagrammatic layout of this system is shown in Figure II-11.[12]

Some systems allow for programs to be shut off and rewound without having to play through to the end. Other variations might include the use of magazine, cartridge, or cassette program sources instead of reel-to-reel sources.[13]

Audio programs are available on records as well as on tapes. The advantage of tape units over record players is that communication can be in two directions—from student to source and source to student—and tape units are more easily integrated into automatic dialing systems. Since it is also easy to transfer audio information from records onto tapes (but not vice versa), it is customary to find tape players are the major sound component in a dial access system.

Two or three turntables might also be included since they can be used for dubbing programs from records onto tape and to play programs selected by a listener using the "Media Staff Technique" (see page 17). Also, standard turntables can be used for Phonovid[14] "records."

(2) Recorded Video Program Origination Equipment. Recent developments have encouraged manufacturers of dial access equipment to consider the addition of video capability to their systems. Because of technological and cost factors, however, most installations still tend to limit automatic access to audio programs. A user can nevertheless receive video programs by using the "Media Staff Technique" (see page 17).

Reasons for the increased cost of automatic video information retrieval include greater cabling costs and the fact that, unlike audio, video tapes can accommodate only a single recording track limiting them to only one program per tape. Therefore, for the same number of programs, four times as many tape units are necessary for video as compared with audio programs. If one adds to this the fact that video tape and video tape recorders are both more expensive than audio tape and audio tape units, the added cost makes direct access video programs almost prohibitive to all but the most well-endowed institutions. The situation is changing very rapidly, however, and in the next few years recorded video programs will no doubt become standard components in most dial access systems.

Besides videotape, other possible sources of recorded video programs include Phonovid records, slides, filmstrip, and film. It is conceivable that any or all of these media could be so arranged in film chains[15] that

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[12]The diagram has been simplified by omitting the flow of commands from the computer controller to the audio switching device and the buffer tape. Also there is feedback to the student position regarding the status of the equipment (via the computer controller) which has not been shown on this layout.

[13]Magazines, cartridges, and cassettes are all essentially the same, i.e., the two reels are packaged in one container. The advantage of this magazine-type loading over reel-to-reel is that the tape does not need to be adjusted, threaded, or handled in any way, and the package is much more compact. However, their limited size also limits the length of programs or reduces their fidelity (since decreased speed of tape decreases fidelity). Also, the repair of tape may be a bigger problem with magazine-type loading.

[14]Phonovid is manufactured by Westinghouse Electric. Sight and sound information come from the grooves of a record. Up to 400 pictures–TV stills–and 40 minutes of sound can be recorded on two sides of a 12 in. L.P. A standard turntable and a TV receiver combined with a special scan converter form the total system. Phonovid is not a common item.

[15]A typical film chain consists of a TV camera, a 16mm movie projector, a 35mm slide projector, and a filmstrip projector. The camera picks up the video information from one or another of these instruments and distributes it via cable to the various TV receivers.

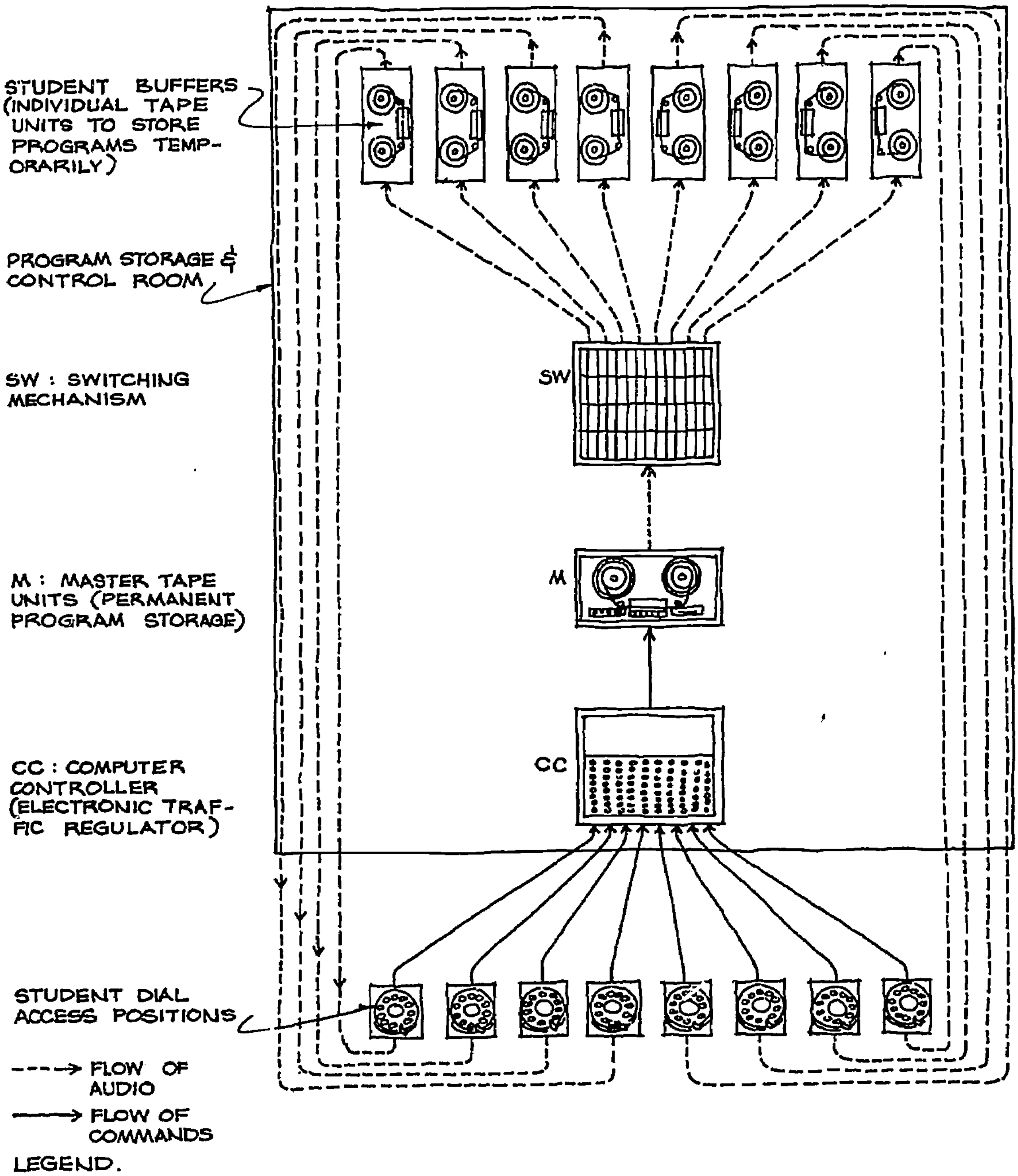


FIGURE II-11: BASIC COMPONENTS OF A "RANDOM ACCESS SYSTEM"

they could be mechanically operated and dialed into use by direct access techniques. However, it is still much more feasible to regard these program sources as peripheral to the main dial access system with access obtained through operators in the control area.

(3) Equipment to Receive and Distribute "Live" Video Programs Within Dial Access Systems. In dial access systems, "live" video programs include both live performances as they occur within the school and also any incoming television programs. The latter includes commercial and ETV programs and also closed circuit programs which have originated outside the school.

"Live" video programs may be recorded onto videotape, in which case they become part of the library of recorded video programs. They can also be routed through the television receiving and distribution equipment to the student stations. In the latter case, a scheduled dial-access technique would be necessary.

Figure II-12 shows a simplified block diagram of the integration of television and dial access systems. The origination equipment necessary to produce live CCTV programs and to receive and distribute programs originating outside the school is discussed in Chapter IV.

(4) Mechanism to Connect Users with Selected Programs. In any dial access system, the key component is an electronic or mechanical switching device which connects the users with their selected programs. A very small, simple dial access system might not require any on-site switching mechanism but might be tied to an existing telephone exchange. A very large, complex system, on the other hand, might use a combination of computer, on-site switching mechanism, and interface equipment between the on-site mechanism and off-site, regular telephone exchange. The type of mechanism specified will depend upon the complexity of the particular system and the supplier of the system equipment. The sophistication of the mechanism may range from what the manufacturers call a "solid state logic device" or a "computer processor" to a simple mechanical rotary selector switch (see Fig. II-8).

The state of the art is no longer at the stage of mechanical switching, and most systems today use electronic devices. The "solid state (i.e., transistorized) logic device" in the Chester System comprises circuitry which "addresses" the electronic crossbar switch. The "computer processor" in the Ampex System is an electronic device which acts as a traffic regulator, holding calls from users until they are ready to be acted upon. At this stage of development, no system uses a general purpose computer but the North Electric Company System[16] does use a special purpose "stored program computer processor."

This device controls the operation of the system not by the way it is wired (as with other mechanisms) but with the information contained in its "memory," i.e., the stored program. Therefore, changes in the operating procedure of the system can be effected by changing the program rather than by changing wiring or adding hardware.

It is apparent that this type of switching control provides a great deal of flexibility within the system and allows for future changes. If an installation is large enough to warrant the additional cost of such a device, it presents many added advantages.

One of these is the ability of the computer processor to record "traffic patterns," i.e., the number of times a program is requested, which carrels are most frequently used, and other useful information.

The use of general purpose computers in place of other switching mechanisms will probably evolve if and when CAI and Dial Access Systems are integrated into the same system. At that time, the computer would be used not only to connect users with programs, but also to store programs, present lessons, evaluate performance, and track the students onto the correct instructional course.

[16]This is the system used in two of the largest installations in the country—namely those at Oklahoma Christian College and at Ohio State University.

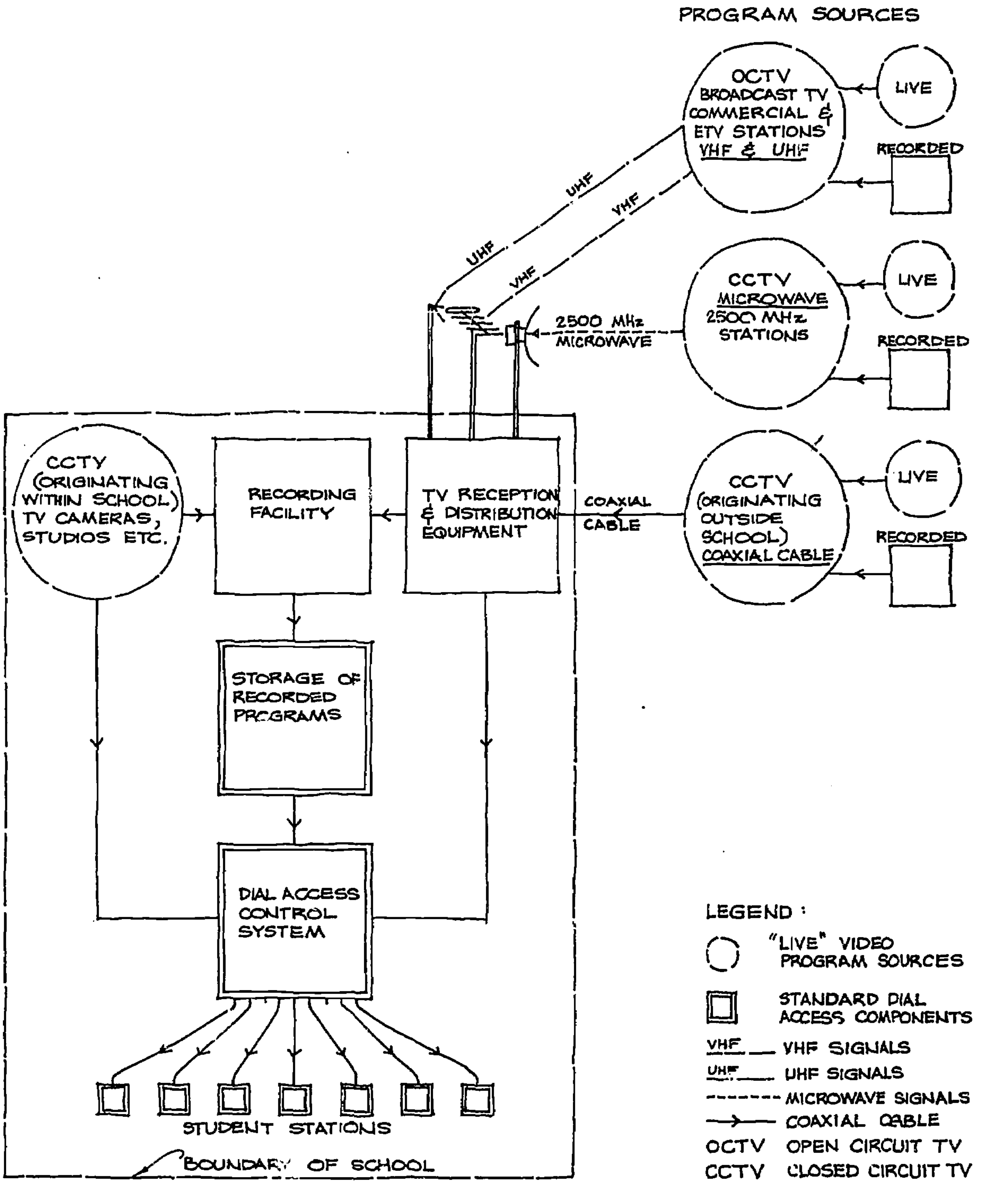


FIGURE II-12: RELATIONSHIP OF "LIVE" VIDEO PROGRAM SOURCES AND EQUIPMENT TO DIAL ACCESS SYSTEM

The most common on-site switching mechanism used today is the crossbar switch, similar to that used by a normal telephone exchange. The biggest difference between the two is that dial access systems must be designed with the assumption that all students will be using the system at the same time whereas the telephone exchange is designed on the basis that only 15 percent of the subscribers will do so. Typical switching equipment differences between various systems are shown in diagrammatic form in Figure II-13.

(5) Approximate Costs of Components of Dial Access Systems. The range of costs of dial access systems is large, depending on many variables such as the type and number of program sources, the number of student positions, the distances between carrels and program sources, and the complexity of the system. For instance, a random access system might cost six times more than the simple system illustrated in Figure II-5.

The following figures are given only as an indication of the approximate range of prices of components of typical dial access systems.

As a rule-of-thumb:

10 student stations + 20 audio programs = $8,000.
(i.e., 5 tape decks)

Other rule of thumb costs:

System with audio capability only:
over 20 stations = $1,000/station

System with audio-video capability:
over 10 stations = $6,000/station

The cost of electronic equipment at student stations can be derived from the following approximate figures:

Control plate with dial	$ 50.
Control plate with Touchtone	120.
Headset with microphone	35.–85.
9 in. video monitor[17]	225.
Wiring (audio only)	25.

If student-record function is also added to the student station, the following approximate costs are incurred:

At control plate	$ 12.
Remote tape deck	460.
Additional wiring	25.

These figures, when added to the cost of the carrel furniture itself (approximately $50–$150) indicate that an elaborately equipped student station could cost as much as $1,100, while a simpler student station equipped for audio only might cost only $160. Cost of student stations is also affected by their arrangement since furniture costs for grouped carrels are less than for separate carrels.

(a) Cable Costs for Dial Access Systems

Cable carrying video signals can be as much as 5 to 10 times as expensive as cable carrying audio only. Even so, the cost of building cable in as part of an over-all dial access system is only a fraction of the total system cost. This is not the case, however, when the system encompasses long distances, integrating several schools. In that case, audio links can be made via the regular telephone lines, but it would be necessary to dig trenches or lease telephone poles to carry video cable over the long distances. This can be very costly, and it may sometimes prove less expensive to install microwave links in place of cable links. For specific costs of various types of cable, see Section F.

[17] Video monitors are more expensive than VHF receivers (regular TV sets).

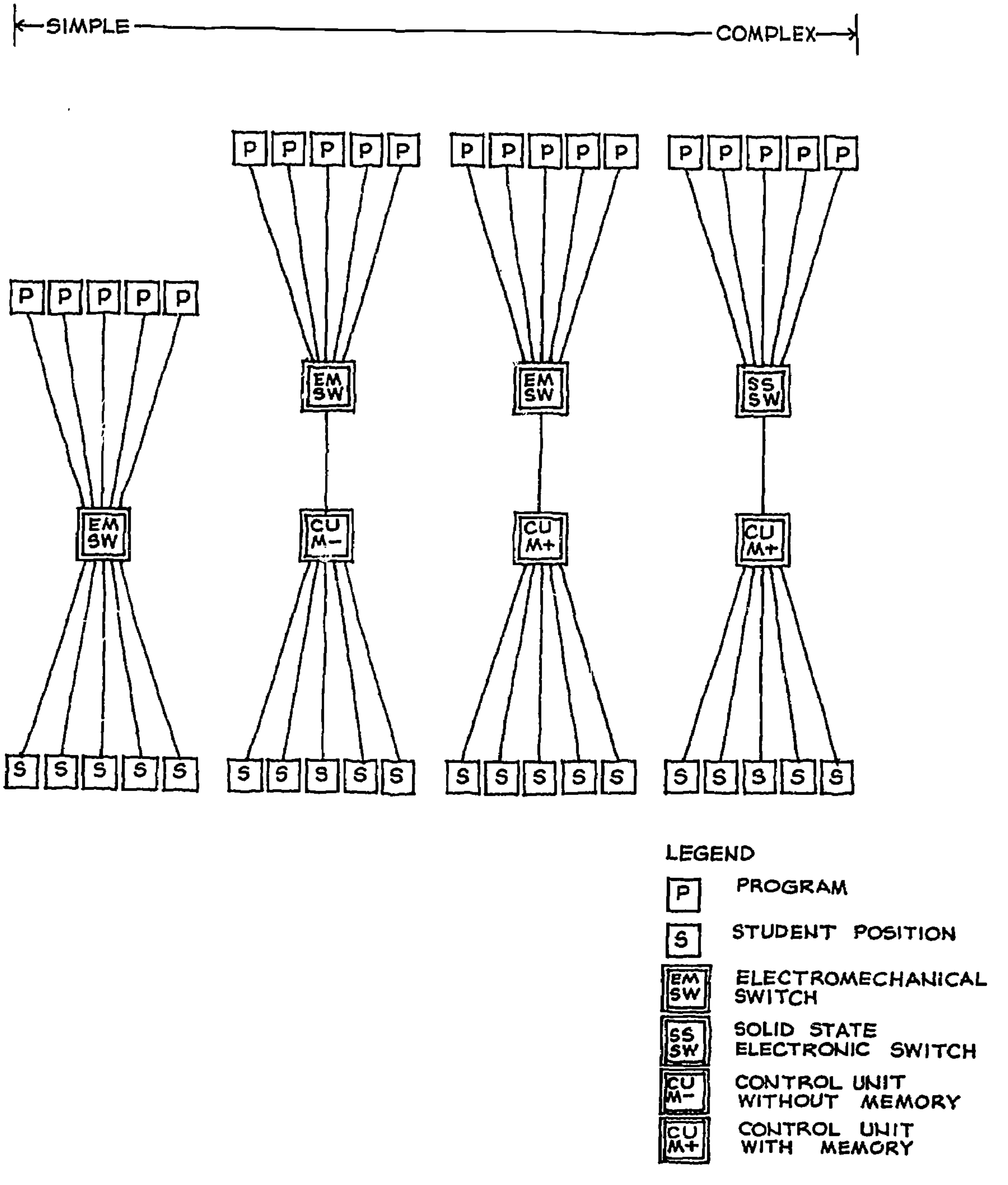


FIGURE II-13: SWITCHING AND CONTROL EQUIPMENT OPTIONS FOR DIAL ACCESS INFORMATION RETRIEVAL SYSTEMS

(b) Over-all Costs of Dial Access Systems

To get an approximate idea of the range of costs of typical systems, the following figures have been included. These were derived from a survey of existing systems which showed that initial installation costs varied between $10,000 and $100,000.

Of 35 colleges visited, 8 spent $100,000 or more.

Of 10 junior colleges, 1 spent $100,000 or more.

Of 25 secondary schools, 1 spent $100,000 or more.

Cost/effectiveness criteria have not yet been developed for dial access systems. No measurements exist to make it possible to evaluate cost/unit of learning rather than the cost per student hour.

F. CABLED DISTRIBUTION SYSTEMS

1. General Discussion

This section deals with the distribution of audio and video information generally, and applies to most teaching systems described in this survey which utilize telephone and/or television (or other audio and video information) as one of the components.

Because of the highly specific nature of computer installations, however, including the rigorous limitations on cable lengths between components of a CAI system, the subject of CAI cabling requirements has been dealt with separately in Chapter V which covers all aspects of Computer Assisted Instruction.

2. Methods of Distribution

Audio and video information signals can be distributed by wireless broadcasting and by various types of cables depending on the frequency and type of signal.

a. Audio Information

Audio programs can be distributed over telephone cables or audio cables. The difference between the two types of cable is that audio cable is shielded to prevent the cable picking up external signals in low level signal strength applications, whereas telephone cables used on medium and high signal strength applications are unshielded. The term "telephone cable" is generic, defining the construction of the cable, and it is used in the communications field for many applications having no relation to telephone systems.

Audio programs can also be distributed by "wireless distribution" where an antenna cable is looped throughout the building concealed in ceilings or walls, and in new construction sometimes concealed within concrete floors. In effect it is a distributed antenna, and, while not a commonly used medium for programmed distribution, could be used for *one-way* broadcasting of audio programs. A typical application for a wireless audio system is an in-house paging system (e.g., doctor's call).

One related method of one-way audio distribution that has had occasional use in institutions is to superimpose the audio program on the electrical power system within the building. Simply by plugging into a receptacle, sufficient signal strength is radiated from the power cord to enable the receiver to operate. Every convenient receptacle then becomes a communications outlet.

b. Intercom System

The intercom system allows communication between different areas of schools, e.g., between classrooms and the school central office. Intercommunication can be achieved in several ways; either graphically by means of devices such as Victor Electrowriter (see page 10), or closed-circuit television, or telephone (Centrex System), or paging and public address systems.

At least one manufacturer (Webster Electric Company, Inc., Racine, Wisconsin) has a system combining any or all of three intercommunication techniques (Teletalk). The building can be zoned according to the

specific needs of each particular area. For instance, where privacy is desired, a telephone intercom would be installed; however, a loudspeaker system would probably be required in a gymnasium.

Typical school installations consist of a desk-sized control console located in the school central office and a small, wall-mounted two-way speaker (transceiver) in the classroom. The system may be activated from either the central console or the remote transceiver. Some systems allow classrooms to call one another, while most require such a call to go through the central console.

The central console varies in size with the number of areas served. For instance, one manufacturer (Sound Systems, Inc.) makes a small center which can serve a maximum of 50 rooms. It can be as small as 22 in. wide by 16 in. deep by 16 in. high (Bogen Series 14). Sometimes a record player and FM/AM tuner come as part of the central control unit, which increases the width to approximately 40 in. (Bogen Series 12A). When 150 rooms are served, the unit becomes desk-size–42 in. wide by 42 in. high by 28 in. deep.

These central consoles sometimes include built-in microphones—called monitor speakers—or they may be equipped with telephone or microphone devices.

The intercom transceiver may be a desk-top monitor speaker, a telephone, a wall-mounted speaker combined with a microphone, or any similar device.

c. Video Information

Television picture information is generated in the camera as a "video" signal in a low frequency bandwidth approximately 70 Hz to 4.5 MHz. Simultaneously, the audio portion of the program is generated as an "RF" signal. For normal commercial TV systems the "video" and "RF" signals are mixed and translated into "RF" signals for transmission.

The terms "video" and "RF" are trade designations and, in fact, "RF" signals lie within the VHF and UHF spectrum. There are, however, some applications where the "video" signal generated in the camera is not translated but is transmitted over cable directly to receivers. These applications often use special high resolution cameras and receivers[18] with faster scanning rates than the standard entertainment models that have 525 lines. A typical application would be in a medical facility where X-ray films are transmitted by "video" distribution because a fine picture resolution is required to detect such things as hairline fractures.

Note that "video" signals can only be distributed on cables, and only one program can be distributed on a single cable. The audio portion of the program must also be distributed on a separate audio cable. "Video" signals are distributed over standard coaxial cable described later in this section.

Standard "RF" television signals can be distributed over several media—wireless broadcast, telephone cable, and coaxial cable. Wireless broadcast of TV programs (other than over the "open-air") is technically possible, but not a practical consideration due to a lack of commercially available equipment.

Slow scan TV pictures can be transmitted over telephone cables, but by definition this limits the picture to more or less stationary objects. This is, however, useful in the transmission of numerical data and still pictures.

Most MATV systems use coaxial cable on which up to 20 different channels (or programs) can be distributed simultaneously.

3. Size and Layout of Cable Ducts

The required size of cable ducts will be affected both by the method of distribution and by the number of systems which a school plans to install, such as dial access, open circuit television, closed circuit television,

[18] Resolution describes the details that can be distinguished on a television screen. Vertical resolution refers to the scanning lines one sees on the screen. Horizontal resolution refers to the number of variations within each scanning line, and is variable according to the bandwidth used.

etc. Although it is feasible to combine some of these systems, it is still current practice to install them independently.

The same coaxial cable system used to distribute TV programs originating outside the school (both open and closed TV systems) could be used to distribute those originating in-house. Special devices (directional couplers) would also enable the system to be used for two-way distribution (see pages 51-52).

When estimating the size and layout of ducts for electrical and electronic systems, the following factors must be taken into account:

- How many separate distribution systems must be installed? (E.g., telephone, public address, open circuit TV, CCTV, Dial Access, CAI, lighting, power, etc.)
- Can any systems be combined into one cable distribution system; what are the cost benefits to be derived?
- What distance, if any, must be maintained between power cables and those carrying information?
- Which wires or cables require protection by conduit for mechanical protection or other reasons?
- What type and size are the various cables?
- What size are the various cable connectors and supports?

In order for the designer to have some idea of the range of sizes involved, the following paragraphs describing typical cables have been included.

4. Description of Various Components

a. Coaxial Cable

Coaxial cable used in most TV distribution systems is made up of a single conductor surrounded by a concentric metal shield with a dielectric between them. The shield, usually made of copper or aluminum, protects the signal from outside penetration and also prevents radiation of the signal to the outside. Most coaxial cables have a protective jacket of PVC or some similar material which provides protection from mechanical damage. This outside jacket is not always provided when the cable is used aerially, although in these applications the distance spanned between poles is sufficiently long for a steel messenger wire to be attached to carry the load. In designing aerial cable systems, it is necessary to consider wind effect on ice-covered cables and other natural phenomena.

Two common types of coaxial cable used are RG11/U and RG59/BU. Each is of similar construction, but the former has a larger diameter resulting in considerably less signal loss per unit length. It is proportionately more costly.

b. Telephone Cable

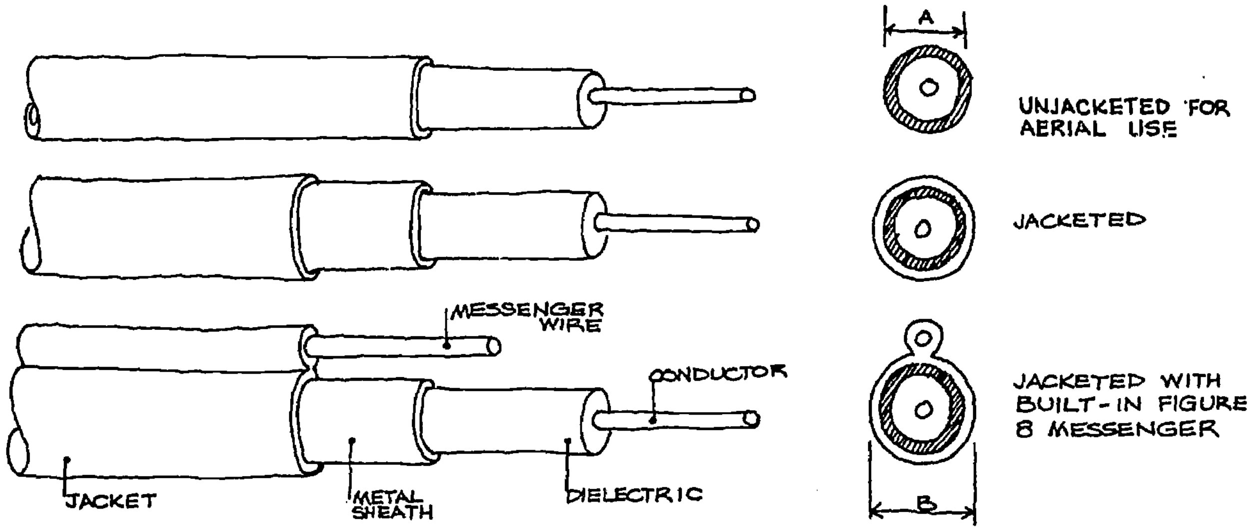
Telephone cable is made up of "twisted pairs" of wires, each pair constituting one circuit. Many pairs can be assembled within one jacket (common cables are 26 pair, 52 pair) and are color coded to assist in identification. The term "telephone cable" is generic, and, as stated previously, the use of this cable is not limited to telephone systems.

c. Audio Cable

Audio cable is similar to telephone cable with the addition of a metal shield, similar to the shield used in coaxial cable. A ground equalization conductor is also used in conjunction with some pairs.

d. Conduit

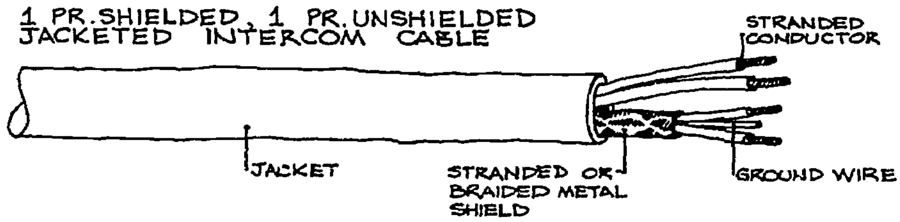
Both audio and RF cable can be pulled through conduit and other raceways more easily than power cables. The limitation in length of pull is dependent on the physical strength of the cable, which will distort and break up if too much force is used. Generally, a limitation of two 90° bends (or four 45° bends) is considered a maximum, and in straight pulls runs of several hundred feet are practical. The use of conduit for



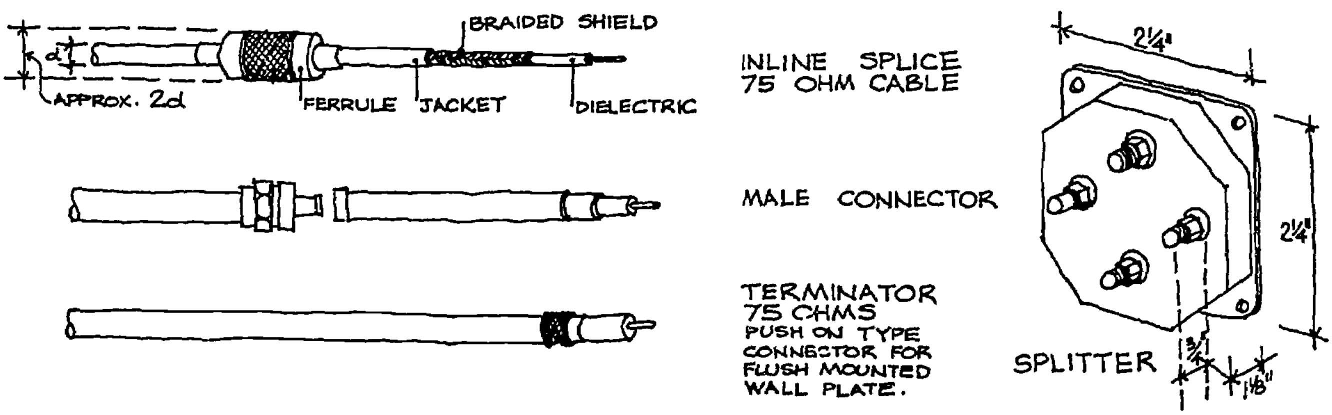
NOTES:

	INTRA-BUILDING	LONG DISTANCE
METAL SHEATH:	COPPER BRAIDED	ALUMINUM
DIAMETER A	—	0·412" – 0·75"
DIAMETER B	0·245"	0·48" – 0·85"
BENDING RADIUS	NEGLIGIBLE	4" – 8"

COAXIAL CABLE FOR TV TRANSMISSION



TYPICAL AUDIO CABLE (4 CONDUCTOR)



TYPICAL CABLE FITTINGS

FIGURE II-14: TYPICAL CABLES AND CABLE FITTINGS

communication cables is not a physical necessity, as is the case with power cables, but one of practicality. In many buildings telephone cables are run exposed above removable ceiling tiles. The cables are not then always accessible for replacement, and additions to the system require the removal of the ceiling which is not always convenient. Conduit for communications cables can be flexible steel conduit, electrical metallic tubing (EMT), or plastic conduit. Floor trenches, cellular flooring, underfloor duct, and surface wireways are also used to distribute communications cables. (See Figs. V-14, V-15, V-16.)

e. Cable Fittings

Cable fittings include connectors, splitters, jacks, and terminators, and are too numerous to be elaborately discussed in this survey.

5. Typical Cable Costs

The material cost for cable is roughly as follows:

Aluminum-sheathed, unjacketed RF cable (for aerial use only):

0.412"	$ 90/1000 ft
0.5"	$125/1000 ft
0.75"	$250/1000 ft

RG59/BU cable .... from $28 to $32/1000 ft depending on quantity.

RG11/U cable ..... from $87 to $90/1000 ft depending on quantity.

Telephone cable:

4 pair	$ 42/1000 ft
7 pair	$ 70/1000 ft
27 pair	$240/1000 ft

Chapter III

VISUAL DISPLAY EQUIPMENT

The use of film for storing visual information is not a new instructional medium or technology. Film can take several forms—slides, 16mm films, overhead transparencies, etc. The various film formats require different types of projectors. Each type of projector is made by many manufacturers, and they vary in light output, controls, cost, dependability, maintenance requirements, ease of operation, heat, and noise.

Ideally, projection equipment should be encased in a "projection box" with a sound absorbing liner. This is especially necessary in rear projection areas serving several rooms at the same time. Screens may be designed for rear or front projection. They vary in brightness ratios, contrast ratios, reflection, and viewing angles. Each type of screen has advantages and disadvantages as discussed later. The various types of projectors can be housed on mobile carts or on permanent stands. These can be located either behind the screen (rear projection) or in front of it (front projection). In either event, the controls for the equipment and the lighting should be convenient to the instructor and easy to operate (see "Lectern Control Panel," page 44).

The design of spaces for effective film projection systems requires detailed knowledge of all the various components which may become part of the system. This chapter surveys the range of components and many of the factors which must be considered by an educational facility designer.

A. SLIDE AND FILMSTRIP PROJECTION

Probably the most popular size slide format is the 2 in. by 2 in. framed transparency. Slide mounts are available in cardboard, metal, glass, or plastic having 2 in. square outer dimensions. This format easily allows teachers to arrange or rearrange a series of still visuals. Slides are simple to prepare and can be semipermanently arranged for viewing or storage in trays. This ability to easily rearrange the sequence differentiates slides from the filmstrip.

Slides may also be bound in mounts measuring 2 1/4 in. by 2 1/4 in. and 3 1/4 in. by 4 in. (see Data Sheet L). These larger slides are relatively easily produced by teachers using glass, plastic, or acetate or by photography. It is not possible to refine or draw upon a slide or a filmstrip when it is being projected.

A filmstrip is a 35mm film upon which still visuals are arranged in a fixed order. Sound may be added by a phonograph recording or audiotape which may be synchronized with the visuals. Silent filmstrips are more commonly used for education, possibly because they can be stopped at any time for comment or discussion and frames can be repeated or bypassed. Mechanically, silent filmstrip projectors are simple enough for

young students to operate. Room darkening facilities are required for optimum use of this equipment. A filmstrip projector may be semi-permanently set up in a viewing corner of the classroom for the students to use by themselves (see Data Sheet L).

B. OVERHEAD PROJECTION

The overhead projector is usually situated in front of the student audience. It is used to project transparencies and other visuals onto a screen (see Fig. III-1). The translucent "table" of the overhead projector can also be used by the instructor as a demonstration table for performing experiments, writing, and drawing. Overhead projectors can be built into custom-built teacher lecterns or desks. The technique of overhead projection combines many of the advantages of the chalkboard, filmstrip, and slides and is becoming very popular as a permanent classroom teaching tool. There are many advantages. The teacher faces the class. Large, clear images can be achieved in normal room light (see Data Sheet N).

C. OPAQUE PROJECTION

This projector allows book pages and other opaque materials to be projected directly on the screen without the need for intermediate photography. Opaque projectors are not common items of classroom equipment. When they are included in classrooms, they are generally located near the front of the room between the audience and the projection screen (see Data Sheet O). The size of these projectors and their location in front of the students may sometimes restrict the view of students seated directly behind the projector. The opaque projector requires complete room darkening facilities.

D. MOTION PICTURE PROJECTION

A 16mm motion picture projector can be found in almost every school in the United States. Recent technological advances have brought a widespread use of 8mm motion picture equipment in educational circles. Projectors using other film sizes are unusual. While most projectors can be used for rear or front projection, some are available with built-in rear projection screens (see page 40 in this chapter for a discussion of screens).

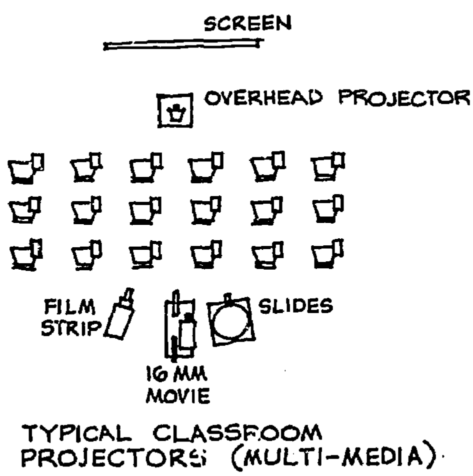


FIGURE III-1

The physical specifications and space requirements for 8mm and 16mm projectors can be found in Data Sheet P. Viewing angles and seating arrangements can be found in many sources (Data Sheets P, T, U, V, and W). If projection equipment is used within a classroom for extensive periods of time, heat and noise from the projector may become a problem requiring additional ventilation for the room or the isolation of the projector in some type of enclosure. It is most desirable to locate the projection equipment in a projection booth whenever possible (Data Sheets S and U). If extensive use of films is expected or if a film library is to be developed, a film maintenance activity should be planned (Data Sheet Q).

Power requirements for projection equipment and their costs can be found in the annual *NAVA Equipment Directory* published by the National Audio Visual Association.

E. FILM LOOPS (SINGLE CONCEPT FILMS, REPEATING FILMS, CARTRIDGE FILMS)

The film loop is a new method of packaging short film lessons. Special equipment cartridges allow the film to be shown and automatically rewind it while running. This technique is particularly valuable where a film must be shown over and over again, either with or without the aid of an operator. The teacher presses the start button, and the projector automatically shuts off at the end of the film but is ready for the next teacher to use.

Single concept films have been developed to facilitate programmed instruction. Films which deal with one highly specialized subject may run for only one or two minutes. The films are usually produced on 8mm film stock. The formats vary, and the films and cartridges are often not interchangeable between machines made by different manufacturers.

The projectors and their specifications are similar to those for the motion picture projectors discussed above. The 8mm projectors are usually small and often have a limited light output which serves a small group of students (or an individual) better than a large group of students (see Data Sheet P).

F. MICROFORMS

In an effort to store and retrieve vast quantities of information efficiently many microform systems have been developed. Although microfiche, microcard, microfilm, and other microform systems are highly effective in reducing the area needed to store information, support space for microform readers to enlarge these microimages to readable size is required.

Microform readers are usually desk-top devices with built-in projection screens. They are light in weight and may be either portable or permanently mounted. Reader-printers can reproduce paper copies of the microform images. They are larger and heavier than microform readers and are generally mounted permanently to a table or a movable cart. Microfilmers (which photograph or otherwise record the information) are large, console-size devices and would only rarely be installed in school buildings.

Microform equipment may be found in an administrative center where records are kept, in the library, or in an instructional resources center.

Microform readers may also be located in carrels (see the student carrel section on page 44 for space requirements). The maximum allowable light level in areas where they are used is 70 to 80 fc. These projectors are usually quiet but produce heat which must be dispersed if a number of readers are to be grouped in one area.

G. ROOM DARKENING AND AMBIENT LIGHT

The permissible background illumination—or ambient light level—of a room during the presentation of visual media is determined by the type of media, the mode of projection, and any functions other than viewing which are to take place at the same time. For instance, notetaking during a film presentation will require a higher ambient light level than is normally desirable for viewing alone.

The characteristics of front screen projection require a lower ambient light level than rear screen. The use of more highly reflective projection screens has reduced this difference somewhat, but high reflectance screens tend to produce visual "hot spots" which reduce their effectiveness.[1]

The Association of Motion Picture and Television Engineers has established ambient light levels for various *front* projection media as follows:

Television projection	5 to 10 fc
16mm film, projector with normal lumen output	5 to 10 fc
16mm film, projector with high lumen output	15 to 25 fc
35mm film, projector with normal lumen output	15 to 25 fc
35mm film, projector with high lumen output	25 to 35 fc

It can be seen that with the use of high lumen output projectors and reflective screens sufficient light can be allowed in the room for limited notetaking.

One of the chief advantages of the *rear* screen projection system is that, with screens of classroom size up to 48 in. by 48 in., there is no need to dim the lights of the room during presentation. With larger rear screens for auditorium and large group viewing, dimming becomes necessary, the levels recommended being approximately the same as for high lumen front projection.

Television monitor or receiver viewing is actually enhanced by the ambient light level. A background level up to 70 fc is recommended by IES for normal classroom TV viewing. The location and design of light fixtures is crucial, and bad design can easily destroy the effectiveness of this medium.

The normal, protective glass plates in front of the screens of television sets are highly susceptible to glare and reflection problems. These problems may be overcome by the use of either a glare-reducing screen plate, a unit hood, or both. Mounting the unit high above the floor and tilting it slightly downward also tends to reduce the glare and reflection.

Similar problems are encountered with other electronic devices which have a glass-fronted screen. These include some teaching machines, small rear screen projection units (image projectors), and the CRT displays in CAI terminals. The lighting layout and design of the spaces in which these devices are to be used requires careful consideration to avoid reflection and glare problems. When many, separate individual student carrels are housed within the space, the lighting must be designed to avoid shadows caused by carrel side panels, etc. Merely providing a uniform adequate foot-candle level at desk height is not sufficient for rooms containing carrels and terminals.

In general, when ambient light levels are required to remain high during presentations of visual media, the design and placement of lighting fixtures becomes crucial. A few general considerations are presented here.

(1) The lighting layout should be designed so that the student is not consciously aware of the room lighting either by direct sight or by reflected glare.

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[1]Eastman Kodak has recently developed a highly reflective metalized front screen that reputedly eliminates the need for room-darkening devices. There are apparently certain disadvantages from the point of view of school use, however. The screen is very susceptible to damage, the available screen sizes are somewhat limited, and the viewing angle is the smallest of any screen.

(2) There should be little or no room light falling on the presentation screen or display surfaces.
(3) If notes are to be taken, the light level on the writing surface should be the same as the light level on the screen, and about 10 times the background lighting level.
(4) Provision should be made for providing the same light level on any other display used as on the screen.
(5) Expert opinion seems to be nearly unanimous in condemning natural light in any spaces where projection is taking place. In a properly designed presentation space, natural and artificial light must be controlled.

H. PROJECTION SCREENS

The screen receives the image produced by the projector and displays this image either by direct reflection—front screen projection—or by transmission through a translucent medium—rear screen projection.

When the projectors are set up in front of the projection screen, the system is termed "front projection." This is the conventional way in which film is projected and is currently the most widely used projection system. The projectors are usually set up on stands or mobile carts behind the audience at the rear of the room. Equipment is readily available and easy to operate (see Fig. III-2). There are certain disadvantages, however, resulting from the need to darken the room. These disadvantages include the loss of student/teacher contact and the difficulty of taking notes. Some new types of screens may eventually eliminate the need to darken rooms (see Data Sheets S, T, and U).

In "rear screen projection" the projector is behind the screen instead of behind the audience (see Fig. III-2). Rear screen projection offers many advantages. One is the ability to operate without totally darkening the room because of the much brighter screen image which results. Watching rear screen projection is much like viewing television, and like television, screen size can be critical in large rooms or for large groups. Rear screen projection may be:

—Self-contained: in which the projector itself holds all the elements needed to show a sound motion picture.
—Rear Projection Cabinet: where the projector is mounted in a cabinet, which in turn holds a screen on which the image appears.
—Built-in: the rear screen is mounted in a wall and projection is done from a room in back of the wall.

The latter type of rear screen projection eliminates the problem of noise interference and heat dissipation by separation of projection and viewing areas.

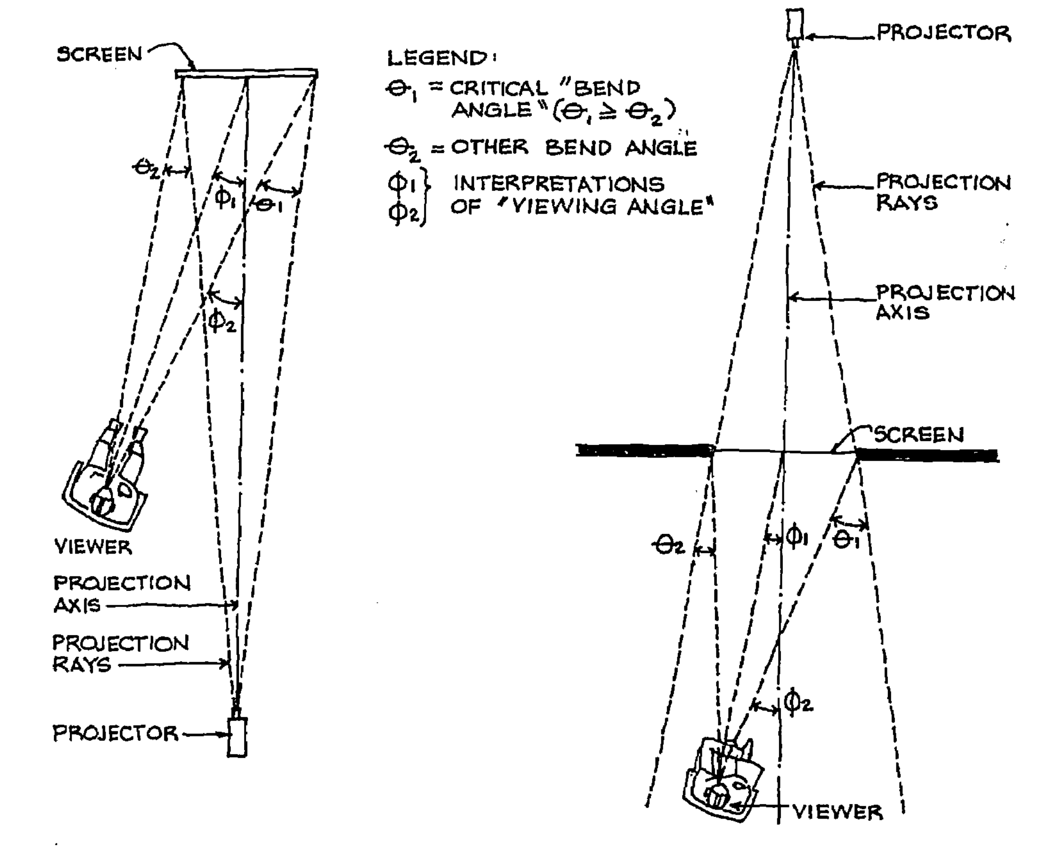
An increasingly common plan found in recent school design is the central core projection room surrounded by fan-shaped classrooms. The rooms are separated by large, rear projection screens backed (or integral) with plate glass for sound isolation (see Fig. III-3).

With this type of plan, it is also necessary to isolate the shared rear projection room from light-spill from lighted classrooms. The simplest such device would be a blind or drape which can be drawn aside by the projectionist when the screen is to be used.

To minimize unnecessary interference of classes, doors between the projection room and surrounding classrooms should be fitted with a peephole (or wide angle lens).

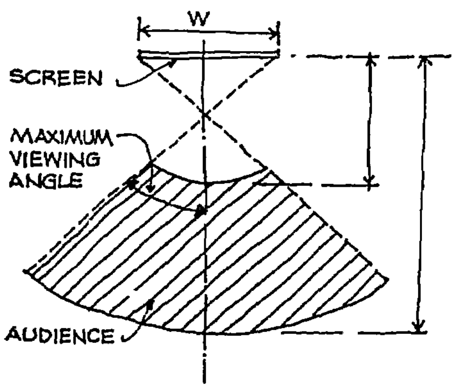
Projection equipment differs considerably. For instance, a special lens might enable various types of projectors to be set up in the same place. Sometimes projectors might slide on a track behind the screen or revolve on a "lazy susan" type circular platform.

Rear projection requires more space than other types of projection. Mirrors are usually needed to keep the space requirements to a minimum. Each time a mirror is used, however, it reduces the brightness of the



a. FRONT SCREEN PROJECTION

b. REAR SCREEN PROJECTION



MEDIUM	MIN. DIST.	MAX. DIST.
FILMS, SLIDES PROJECTED TV	2W	6-10 W
TV RECEIVER	4W	12W

C. RULE-OF-THUMB VIEWING CRITERIA

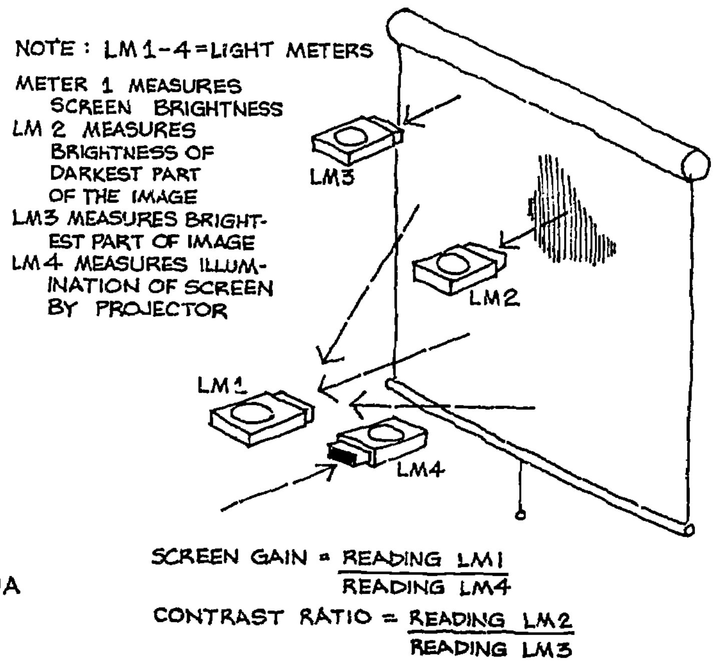


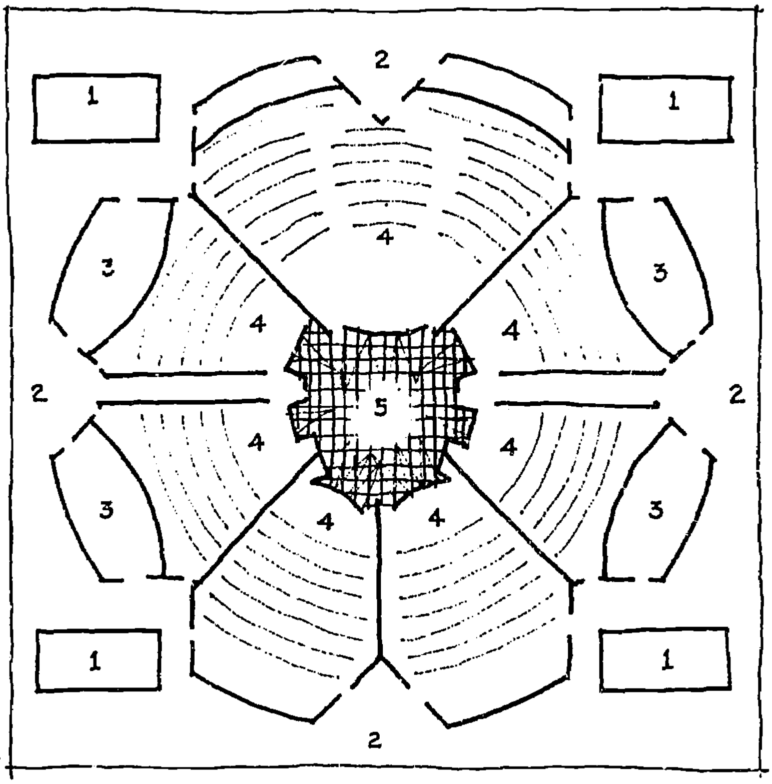
FIGURE III-2: SCREEN CHARACTERISTICS AND VIEWING CRITERIA

LEGEND:
1 STAIRS
2 CORRIDOR
3 CLASSROOMS
4 COMMUNICATIONS HALLS
5 REAR PROJECTION ROOM

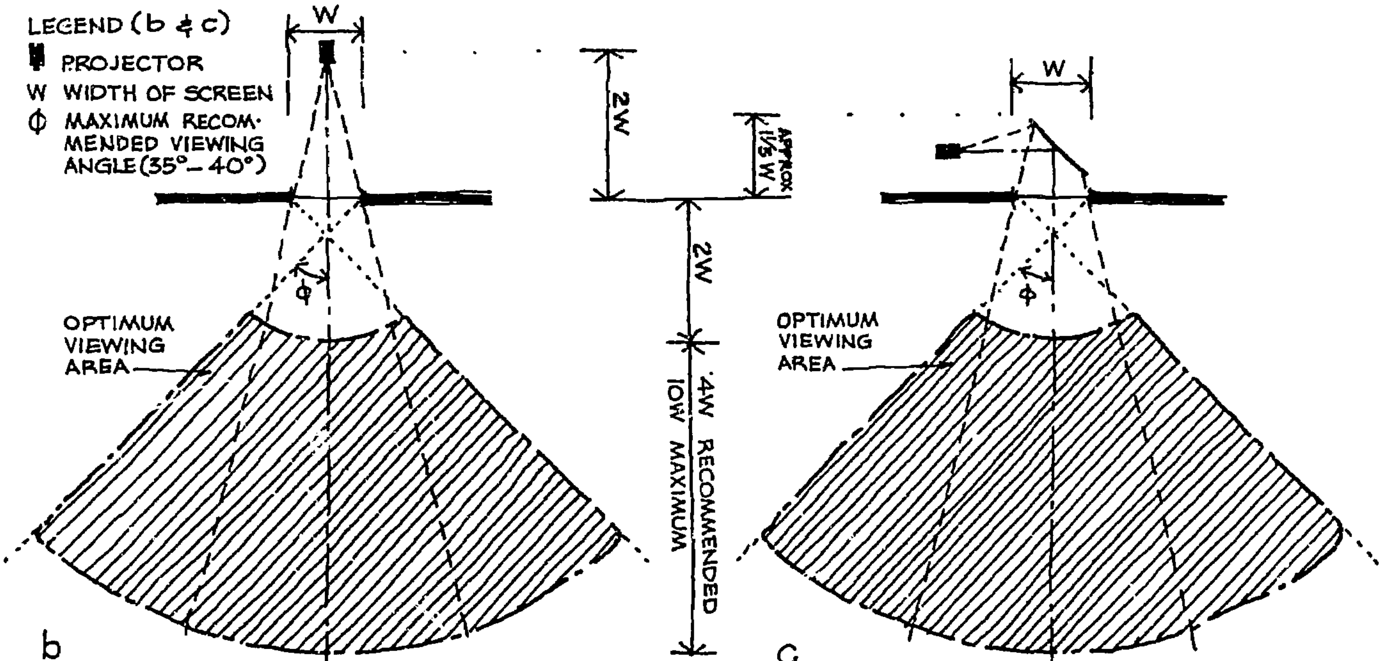
0 20' 40' 60'
SCALE

SECOND FLOOR PLAN
LEARNING RESOURCES CENTER•
COLLEGE AT OSWEGA
UNIVERSITY OF N.Y.

(TYPICAL PLAN TYPE SHOWING REAR PROJECTION ROOM)



a



b
STRAIGHT PROJECTION AXIS

c
PROJECTION AXIS BENT WITH MIRRORS

NOTE THAT LENGTH OF PROJECTION AXIS FROM PROJECTOR TO SCREEN MUST BE APPROX. 2W REGARDLESS OF THE NUMBER OF MIRRORS

FIGURE III-3: REAR PROJECTION

projected image. Another problem presented by rear projection may result from the interference of projected light beams with each other. There are many different ways of laying out equipment in rear projection rooms, with the optics of the equipment modified as necessary to fit the determined viewing screen sizes.

As a very rough rule of thumb, it can be stated that the depth (d) of a rear screen projection room should be approximately two times the screen width (the latter being determined by the size of the classroom it serves) (see Fig. III-3). When a mirror is used to bend the projected light beam, the depth is cut down by approximately 1/3 to 1/2 (see Data Sheets U and V).

The effectiveness of the screen as an image display is influenced by its physical characteristics. Standards of performance based upon these characteristics have been developed by the Society of Motion Picture & TV Engineers (see also Fig. III-2). Screen characteristics include the following:

Screen Brightness: The light intensity observed on the screen; this is the measure in footlamberts of the reflected light in front screens and of the luminous intensity in rear screens. Brightness varies with the viewing angle.

Brightness Ratio: The ratio between the maximum and minimum screen brightness as seen from a given observation point.

Contrast Ratio: The ratio of the lightest possible portion of the image to the darkest possible portion of the image. Contrast ratio is influenced by projector lumen output and by the ambient light level (see Fig. III-2).

Screen Gain: The ratio between the observed brightness of the screen at any point (the output in footlamberts, or screen brightness) and the illumination of the screen (by the projector) at that point (the input in fc) (see Fig. III-2).

Reflection Factor: The percentage of ambient light, falling upon a rear projection screen, reflected back by that screen. A very significant factor in rear projection because the lower the reflection factor, the higher the permissible light level in the audience.

Viewing Angle: The angle described at the center of the screen by the projection axis and the viewers' sight line. The point of application of the apex of the viewing angle, always along the projection axis, varies with the source—some place it at the screen, others at the intersection of edge angle lines (see Fig. III-2).

Bend Angle: The angle described by the viewer's sight line and the outermost projector ray (see Fig. III-2).

Front Projection Screens: There are two forms which front projection screens may take: display surfaces and projection screens. Display surfaces are walls or partitions which are finished in light colors against which images are projected. They behave exactly like matte screens (see below).

Projection screens are fabric or plastic sheets coated with a reflective finish. They may be rolled out of the way either manually or electrically when not in use. Projection screens come with four finishes, which are:

(1) Matte Surface: A non-glossy finish which is nondirectional; wide viewing angle.

(2) Beaded Surface: A white surface covered with tiny glass beads, giving the screen a high brightness level. The beads, however, tend to reflect light directly back at its sources, so the screen is highly directional thereby producing a narrow viewing angle.

(3) Lenticular Finish: A plastic screen with lens-like serrations which control light reflectance to provide an even level of brightness, usually reasonably high, over a specified viewing angle.

(4) Metallized Screen: Finished with a metallic pigment paint which gives the screen a high reflectance but also tends to create reflectance "hot spots," may be either directional or nondirectional.

The extreme conditions of screen application are: with a high lumen output projector and/or a large audience, use a matte finish screen; with a low lumen output projector and/or a small group, use a beaded screen.

Rear Projection Screens: Accept illumination from the projector and transmit or re-radiate the image to the audience. These screens may either be flexible or rigid vinyl plastic laminated to a glass sheet. In either case, they have a rough surface similar to ground glass to provide light diffusion.

The physical characteristics of rear projection screens vary considerably and cannot be as neatly categorized as those of front projection screens. General limitations, however, can be outlined. A screen with a low reflection factor is usually desirable as this reinforces the rear screen's advantage of permitting a high ambient light level. This means, however, some sacrifice in viewing angle. A good compromise has a low reflection factor and maximum viewing angle of between 35° and 40° (see Fig. III-3).

Optimum viewing area with either rear screen or front screen is a function of screen brightness and contrast, viewing angle, and image size (which is related, in turn, to screen size).

Size of Screen: The optimum screen width (W) for any room of Depth (D) = D/6 ft; or if the depth of the seating area (d) is known, the optimum W = d + 10 ft/6. For TV projection, the height of the screen = 75 percent W. Commonly used screen sizes are:

Classroom use screens:	40" X 40", 48" X 48", 60" X 60", 70" X 70".
Large group screens:	6' X 6', 8' X 8', 10' X 10', any special size up to 30' X 30' may be obtained.

I. LECTERN CONTROL PANEL

A teacher's control panel should be provided on the lectern for control of lights and projection equipment during mediated presentations. The lectern may be movable and should be located out of the line of projection. Equipment controlled from the lectern might include the following:

Room lights
CCTV camera
Screen
Pointer: electric flashlight outlet
Overhead projector
16mm sound movie projector; self-threading (off-on-reverse)
35mm slide projector; automatic (off-on-advance-reverse)
35mm filmstrip projector (off-on-advance-reverse)
Microphone: with amplifier control to speakers and distribution to carrels
Lectern speaker and headphone jack: to monitor carrels
Speakers: microphone and monitor

J. INDIVIDUAL STUDENT CARRELS

The equipment described in this book can be used by individuals in carrels as well as in group situations. A carrel can be relatively simple, as a place to read or write, or a complicated electronic area which may include a computer terminal and/or a dial access facility as described in Chapter II.

The sizes of carrels vary depending upon the age (size) of a child and the equipment it is designed to contain. Data Sheet H identifies some carrel specifications.

K. TEACHING MACHINES

1. General Discussion

There does not appear to be a universally acceptable definition of a "teaching machine." It can be argued, for instance, that a book or a slide projector is a teaching machine and that many "black boxes" which pass as teaching machines are no more than "mechanical page turners." Here, a teaching machine is an electronic (or electromechanical) device capable of presenting programmed instruction material for individual study. Further, it has been limited to such devices which are able to be housed complete in one location as opposed to "teaching systems" (such as CAI) which are made up generally of dispersed components or subsystems. A further limitation which has been imposed is that the "machine" is not a device widely used as a component within other systems which would be the case with slide projectors. According to these criteria, the devices discussed below are "teaching machines." They are also sometimes referred to as "programmed instructors" and, because of the association of these types of devices with the experiments of B. F. Skinner, the Skinnerian term "black box" is also sometimes applied.

In most teaching machines, questions are presented to the individual student from teaching materials either locally or commercially prepared. The material is presented through picture, written word, or audio device. The student responds either by pushing a button or writing his answer on a paper strip. Student response is recorded, and another frame is presented to the student by the machine.

The manner of selecting the next frame for presentation defines the two basic types of programmed instructors. In the simpler form–a "constructed response machine"–the machine automatically moves on to the next frame in its "linear program." If the machine is capable of presenting a "branching program," it advances to any one of a selected number of frames, depending upon the previous answer selected from a multiple choice presentation.

2. Types of Teaching Machines

a. Linear Programmed Teaching Machines

This form of teaching machine projects the first question frame of a program onto a small screen in front of the student. The student writes his response on a strip of paper provided by the machine and presses the ANSWER button. The machine then moves the student's response under a clear plastic sheet and uncovers the correct answer at the bottom of the original program frame. The student compares his response with the correct one and presses the ADVANCE button to present the next question frame.

A commercially available example of this type of teaching machine is the Mast Development Corporation Teaching Machine, also available in a sound-equipped version. It is compact (it will fit on a small desk), light in weight, portable, and easy to store. Operation by the student is simple, and the programs, which come in plastic cartridges holding up to 800 frames, plug easily into the machine.

The sound version uses a plastic belt with short recording tracks on it. The sound machine is about the size and weight of the teaching machine and is usually placed beside it when in operation (see Data Sheet Y).

There are other standard teaching machines available for linear programs. Most of these machines share certain usage characteristics. Students are usually exposed to them for periods of 15 to 30 minutes a day, a typical student's use being 20 minutes. When used with headsets, the machines produce no disruptive noise so they may be placed in the classroom without need for privacy, thus simplifying the teacher's task of supervision.

Programs may be purchased off the shelf, or they may be prepared locally by the faculty. Frames are typed, drawn, or made up of pasted items on prepared frame enlargements provided by the manufacturer. The locally prepared program is mailed to the manufacturer, who makes a master program negative on 35mm film and furnishes copies to the user school at nominal cost.

b. Branching Program Teaching Machines

The more complex form of the programmed teaching machine permits the use of a program which is responsive to student errors. This has the added advantage of allowing the student who is familiar with the material to pass quickly over it, while offering some remedial help to the student with less familiarity.

In this "branching program" or "multiple choice program," a frame with a multiple choice question is presented to the student. He selects an answer by pressing a button which corresponds to the letter of his answer on the frame. If the student has answered correctly, this button directs the machine to the next question frame. If he has answered incorrectly, the student is presented with frames containing information to help lead him to the correct response (see Data Sheet Y).

Two manufacturers who currently market the branching program devices are Borg-Warner and Welch Scientific (Borg-Warner BWES 80 and Welch Scientific Autotutor). Both of these machines are similar to the linear teaching machine described above. Although slightly larger and heavier, they are still small enough for tabletop use and are reasonably portable.

Although programs may be produced locally, prepared programs are available on a variety of subjects. Local preparation is a considerable task, requiring 15 or more hours of preparation for each short program. The services of a programming consultant are often needed.

A few books containing branching teaching programs are available, but are quite bulky and inefficient due to the number of unused frames included to cover alternative answers. Some success has been achieved with these texts in England where they are known as "nonsequential books."

c. Card Source Audio-Visual Devices

To activate this type of device, the student takes a card, similar in size and shape to a computer punch card, and inserts it into the machines. The card contains a sound track (a strip of magnetic tape) which the machine plays back over a speaker or individual headset and a drawing or picture to illustrate the sound. The card may be replayed by the student at will. The card is also available for use in language drills, with half of the sound track available for the student's response and comparison. Cards may be prepared locally, using the machine to record sound tracks.

Typical devices of this type are the Bell and Howell Language Master and Electronic Futures, Inc. Audio Flashcard System. Both Bell and Howell and E.F.I. provide a complete service for the machines. This service provides machines, blank cards, and prepared lesson series. Lesson series are available for foreign languages, English (both as a foreign language and remedial drills), reading, and prereading drills. The machines have been successfully used in preschool programs for prereading drills in associating sound, word, and image.

These machines are small, fitting easily onto a desk top, and are light in weight. They are portable and may be stored in a cabinet or drawer which can be locked for security. The units are AC powered with a small power drain. Cards are contained in heavy cardboard shipping boxes, attractively colored, and clearly marked.

d. Tachistoscopes and Speed-Reading Devices

The tachistoscope is a machine designed to increase a student's reading speed and to improve his retention rate. This task is accomplished by presenting words, letters, numbers, and symbols to the student for brief periods—as little as 1/100 of a second with some devices. By gradually increasing the number of bits of information presented, or by reducing the length of presentation time, or by a combination of both, speed and retention rate are improved.

There are several methods of quick presentation used by tachistoscopes. The shutter method is similar to the shutter and lens system of a camera, and is used for projection. Another method allows light to fall on a target (a page or a card) for the desired interval. In the two methods most widely used with individual-

use machines, a film is projected onto the small screen of a desk-top unit. In one method the entire target or slide is projected briefly; in the other, a line of print is picked out by machine and briefly displayed.

Tachistoscopic readers are similar in size, shape, and weight. They are small enough to fit on the corner of a desk top, and weigh from 10 to 15 pounds. They are AC powered and project onto a 5 in. by 7 in. or smaller screen. Projector adaptors for group work fit over the lens system of slide projectors and are usually activated by a shutter release.

e. Talking Typewriter

The talking typewriter is a much larger and more sophisticated machine. It was developed by the Thomas A. Edison Laboratories of McGraw-Edison Co., an affiliate of Responsive Environments Corporation (REC). It is described by the manufacturer as a "multi-sensory (sight, sound, tactile), multi-media, fully synchronized, computer-based learning system," teaching the language arts (reading, writing, spelling, and speech). It is not "computer-based" in the sense of CAI or CBI, as defined in Chapter V. The typewriter keys are color coded and lock in such a manner that only the correct key can be activated by the student. This serves as a reinforcement to the learning process and is apparently very effective, especially for remedial learning. A page printer and a rear screen projector are also integral with the keyboard instrument. Other components include a microphone and speaker, all operating off 110 volts.

Each unit is approximately 2½ ft deep by 4 ft wide by 4 ft high, and is enclosed in a 4 ft by 6 ft soundproof booth which the manufacturers insist is an essential component, providing the necessary "monastic setting." Each booth has two access doors with one-way glass for supervision.

The booths require air conditioning so that the environment is maintained at a temperature between 65° and 80°F. and a relative humidity of 50 percent. The total unit, including the blowers and booth lighting, dissipates approximately 600 watts.

The entire system, including the hardware, soundproof booth, maintenance, a year's supply of consumable materials (i.e., paper), and staff training, can be purchased for $40,000 per unit or leased for $12,000 per year.

f. Driver-Trainer

The Driver-Trainer is a particularly interesting teaching device that introduces a simulated environment. Many experts regard this teaching technique as one of the most effective, and there are indications that a good deal of educational research money will be directed towards "simulation" in the 1970's. The way in which simulated environments might affect learning spaces will need to be part of this research effort.

The Driver-Trainer is a machine which simulates driving conditions and situations in the class, and records student driver responses to these situations. The system described below is the Raytheon Driver-Trainer. This teaching aid consists of one or more "simulated cars," a film projection system, a central processor (which is a simple computer), a control console, and a permanent record printer.

The central processor and the film projection equipment are coordinated to simulate driving conditions to which the student responds as if he were actually driving. The simulated car is equipped with all standard controls and instruments activated by the central processor. The processor records the student responses on the controls, evaluates them, suggests corrective procedures, and then makes a record of these activities. The Driver-Trainer is installed in a special room, often in the basement since the load imposed by the cars is fairly significant. Other room requirements are for good site lines from the simulated cars to the projection screen.

Chapter IV

TELEVISION-BASED TEACHING SYSTEMS

Despite the fact that the potential of television as an instructional tool has long been realized and that it has been in use for at least 20 years, the results of a survey taken in 1967[1] show that only 16.5 percent of the schools investigated used television as a teaching aid.

The reasons television has not had wider acceptance are essentially the same reasons that have held back the full development of all electronic teaching systems, namely:

–economic constraints on school districts;
–lack of indisputable research as backup for validity of the system as a teaching tool;
–resistance to innovation on the part of faculty; inexperience and lethargy on the part of school administrators;
–failure on the part of industry to cater specifically to the education market as a separate field;
–mediocre programs;
–lack of adequate professional help in assisting school administrators to design and set up electronic teaching systems.

Many of these problems are being corrected, often with the financial assistance of state and federal governments. One problem which persisted until very recently was the lack of two-way communication in television teaching systems. This is now being solved with the integration of TV and student response systems (see Chapter VI).

The allocation of the 2500–2690 MHz frequency range to education by the FCC in 1963 and the rapid development of low-cost portable videotape recorders will also give impetus to television teaching in the future, especially to closed circuit programs originating within the school and transmitted within school districts.

The following paragraphs briefly describe program types, ways of disseminating TV programs, antennae, spaces, and equipment required to produce TV programs, different ways of displaying them, and some approximate costs.

School television programs are of two basic types–generally defined as ITV (instructional television) and ETV (educational television).

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[1]Mueller, Richard J., *National Inventory of Secondary School Innovations, 1967.* DeKalb, Ill.: Dept. of Education, Northern Illinois University, 1967.

Instructional television generally refers to those programs which are planned for a particular school system, to fulfill a specific instructional purpose within a lesson plan. ITV programs might be prepared by a teacher, a group of teachers, or a group of schools; generally they originate and are disseminated within a closed circuit system.

Educational television programs are designed for general educational enrichment and might encompass both instructional programs and general information broadcasts which are deemed to have educational value. ETV programs are often open circuit programs,[2] though they may also originate within closed circuit systems.

A. TELEVISION TRANSMISSION AND DISTRIBUTION SYSTEMS

There are essentially three ways of disseminating television programs. Two are transmitted over the air and one via coaxial cable. Of the two over-the-air systems, one is "open circuit," while the other is closed. These three systems are described below.

1. Over-the-Air Transmission: Open Circuit Systems (VHF and UHF)

Commercial and educational television stations broadcast over-the-air programs in open circuit systems.[3] The signals are transmitted in all directions and can generally be received off the air by domestic TV sets, which is why the system is referred to as open circuit. Transmission is regulated by the Federal Communications Commission (FCC), which specifies the number and bandwidth of channels and the frequency ranges permitted. A summary of these FCC regulations for commercial and educational VHF and UHF television stations is as follows:

Frequency	*Megahertz*	*Channel Bandwidth*	*No. of Channels*	*Channel Number*
VHF	54– 88	6 MHz	5	#2– #6
VHF	174–216	6 MHz	7	#7–#13
UHF	470–890	6 MHz	70	#14–#83

2. Over-the-Air Transmission: Closed Circuit Systems (Microwave and 2500 MHz ITFS)

a. Microwave Transmission

Microwave is a loose term defining a spectrum of frequencies in the range above 890 MHz (i.e., 890 megacycles). Microwave transmission is termed "closed" because regular domestic TV sets are not designed to pick up this type of signal and also because transmission is point to point and the receiving antenna must be in line of sight of the transmitter. This type of transmission is used for a number of purposes, such as the connection or linking of two or more transmitters (VHF, UHF, or 2500 MHz) at separate locations or the sending of programs from a studio to a remote transmitter which might be miles away (i.e., a studio-to-transmitter link, or STL).

b. 2500 MHz ITFS

Since 1963, microwave transmission has also been used for instructional television. At that time, the FCC allocated a series of channels in the super high frequency range (microwave) to be used for educational purposes only. This range is between 2500 and 2690 megahertz (MHz) and the educational or instructional

[2]Open circuit programs refer to those which are transmitted over the air on frequencies which can be received off the air by ordinary domestic TV sets. The phrase "open circuit television" is not frequently used, although its opposite—closed circuit television—does appear frequently in its abbreviated form, CCTV.
[3]In the future, transmission of television (or radio) via satellite might play an important role in educational television especially for those areas far removed from major metropolitan centers. Airplanes might also be used to transmit educational television signals.

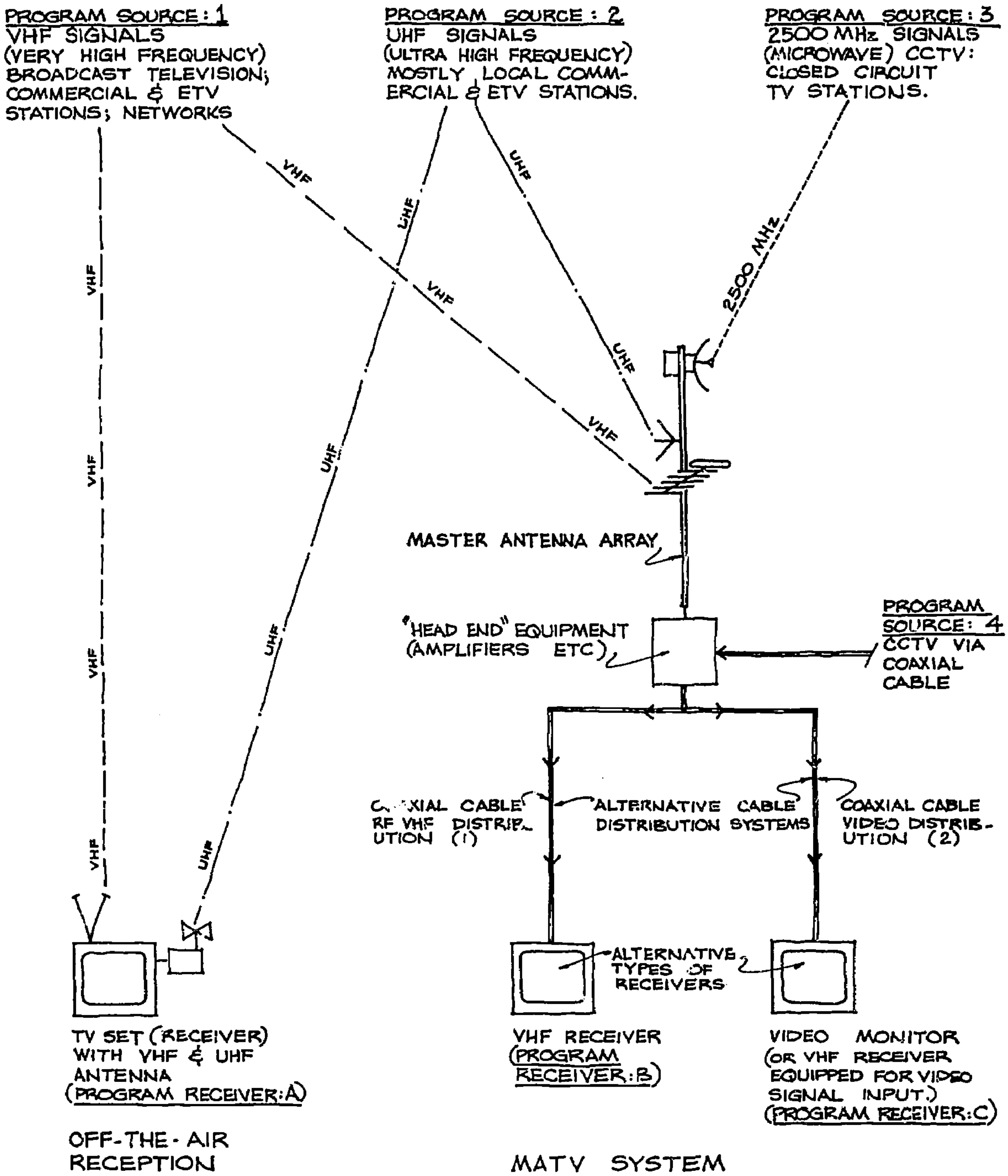

FIGURE IV-1: ALTERNATIVE WAYS OF RECEIVING VARIOUS TYPES OF TV SIGNALS

television system which has thereby resulted has come to be known as the 2500 Megahertz Instructional Television Fixed Service, or 2500 MHz ITFS.[4]

This system provides 31 channels, each of which is 6 megahertz wide, leaving 4 megahertz at the end of the available spectrum. These four megahertz, which are too narrow for a TV channel, are being used in one experimental system (the Stanford University Project) for audio "talkback," thus providing the rare opportunity in a television system for two-way communication.

A simplified diagram of a 2500 MHz ITFS system is shown in Figure IV-2. This diagram illustrates how line-of-sight transmission relates to the curvature of the earth and to intervening geographic or man-made objects. It is possible to overcome the problem of line-of-sight obstructions by careful placement of repeater stations or relay transmitters. These would pick up the microwave signals from the transmitter and then redirect them to those schools which would otherwise be out of range, either because of an obstruction or distance. The approximate area which can be covered by one transmitter is limited to a radius of 20 miles. The FCC stipulates that the transmitter cannot be mobile (hence the title ITV Fixed Service), that transmission shall be low-power (about 10 watts) and limited to a maximum of four channels per transmitter.[5]

It is possible to adapt this system from a district-wide to a state-wide educational television network. The economies effected by transmitting state-wide from one source would probably enable programs to be repeated several times throughout the school week, thereby alleviating problems of scheduling.

Delaware was apparently the first state in the country to institute such a system. Using both microwave relay and cable transmission, one source serves 190 schools (110,000 students) throughout the state with three channels of ITV. Fifty-five programs, varying in length between 6 and 35 minutes, are broadcast daily between 7:30 a.m. and 4:15 p.m. Some of these programs are repeated as much as 15 times in one week so that they can be effectively worked into schedules in all participating schools.

3. Antennae to Receive Over-the-Air Transmission

In television, the simplest form of antenna is the familiar "rabbit ears," which receives VHF broadcast signals.

Appropriate outside roof antennae are necessary for schools to get good reception of the various signals. Generally, a school would install a master antenna television system (MATV),[6] designed to receive the various signals, convert or modulate them as necessary, amplify and then distribute them to the various television receivers in the school. Distribution within the school would be via an internal coaxial cable system with outlets (taps) at all reception points (see Fig. IV-4).

4. Transmission via Coaxial Cable: Closed Circuit Systems

Coaxial cable television links occur between buildings or groups of buildings when they are within the same closed circuit television network and not so far apart that a microwave link might prove more economical. Reception is more reliable when signals are sent via cable since the cable is not subject to varying atmospheric conditions. It is also possible to send television pictures by telephone wire using a slow scan method. This is the technique used in the Sylvania "Blackboard-by-wire" system described in Section D2a, Chapter II.

The cost of inter-building RF cable has been discussed in Section F5x, Chapter II. The cable can be buried below ground or suspended between poles leased from the telephone company.

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[4]A hertz is a unit of measurement equal to one cycle per second. SI units (International System of Units) are being adopted officially in most countries of the world but only unofficially in North America. These units aim to standardize measurements and to eliminate language barriers; thus, the English language "one cycle per second" is equivalent to one hertz, which is recognized universally.

[5]For more information about ITFS, see the Division of Educational Technology. *Instructional Television Fixed Service (2500 megahertz): What It is . . . How to Plan* (Washington, D.C.: National Education Association, 1967).

[6]MATV is a term which is generally used to describe a television receiving and distribution system for large building complexes such as apartment houses or hotels.

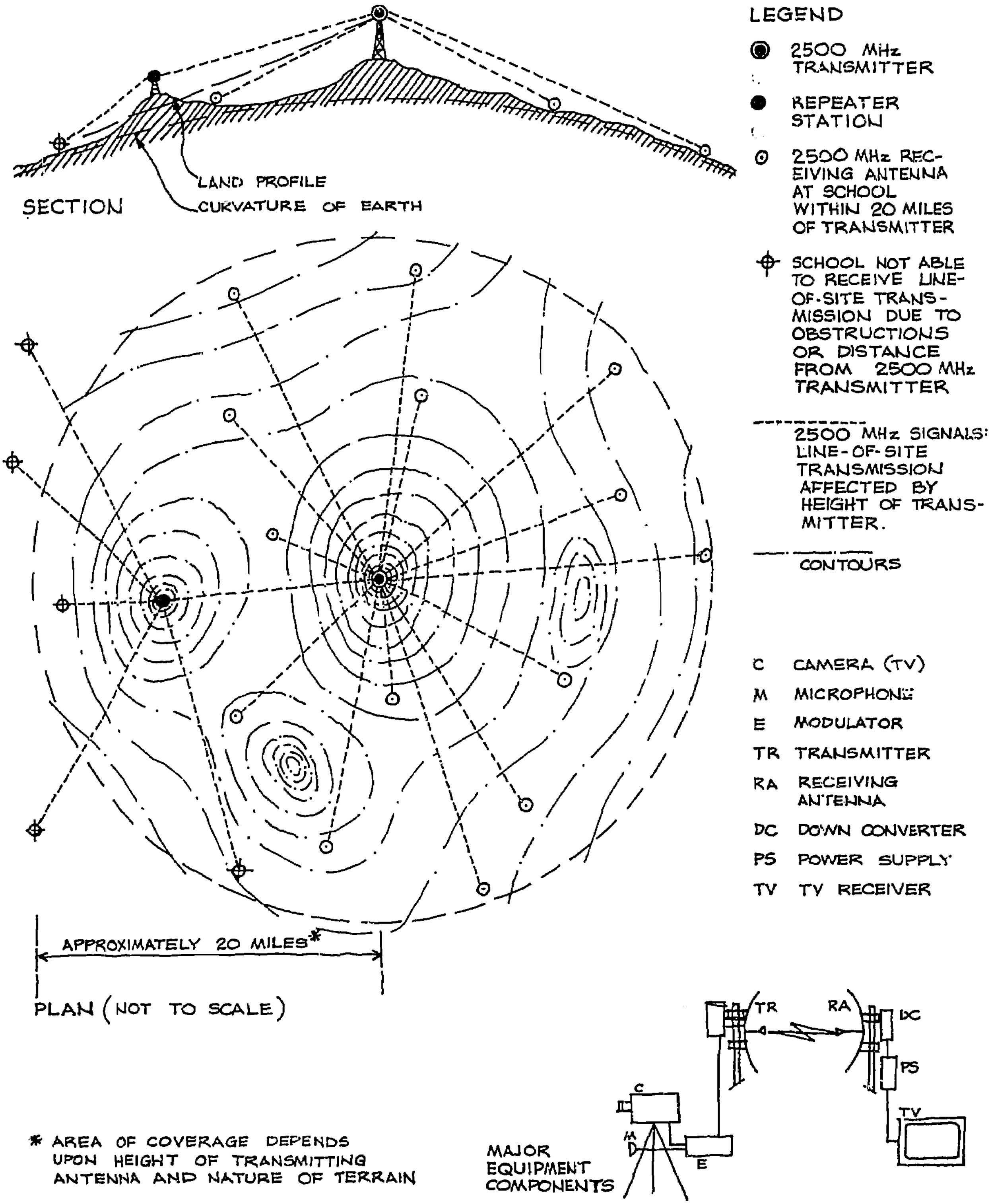


FIGURE IV-2: DIAGRAM OF 2500 MHz ITFS

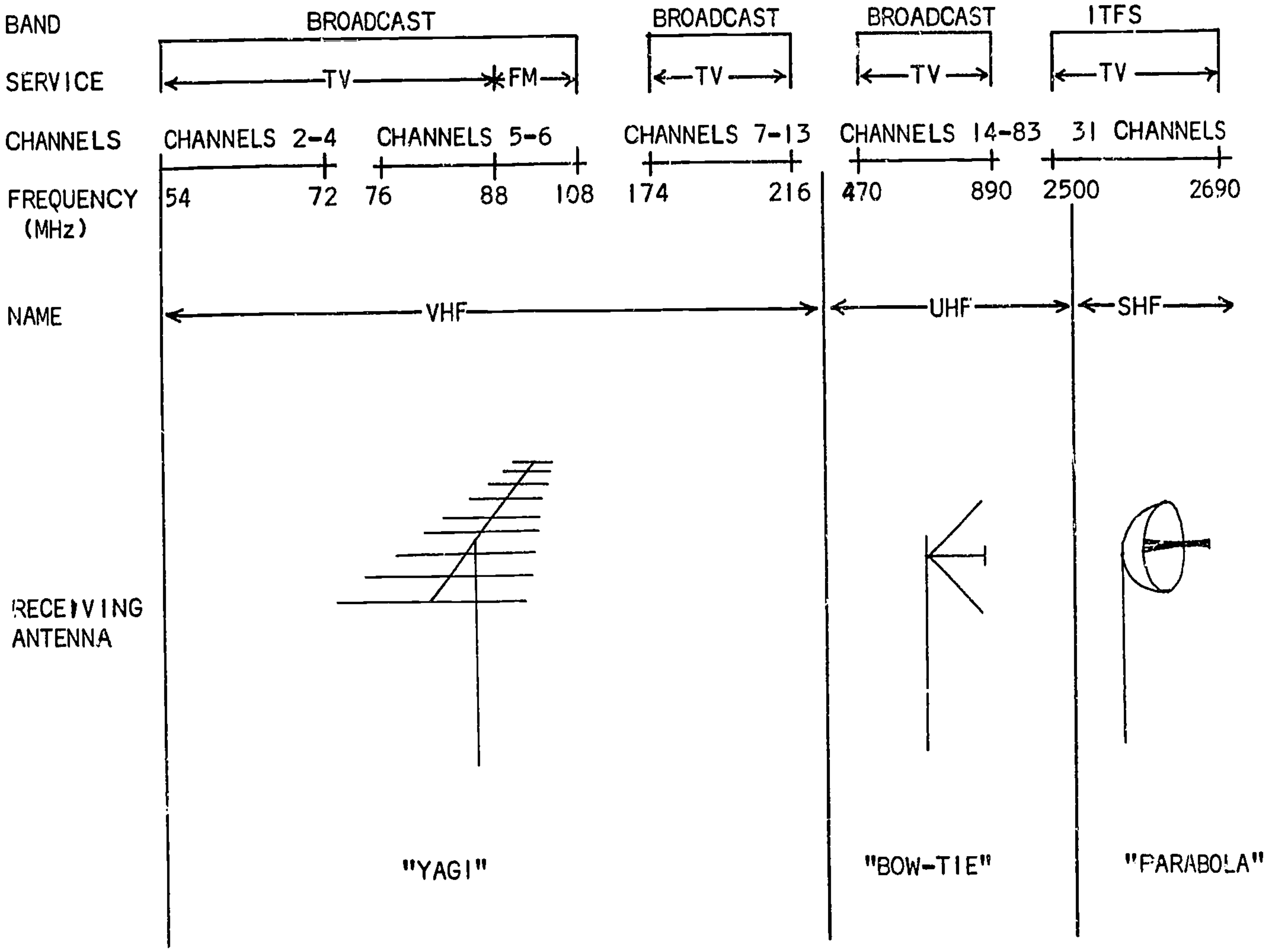


FIGURE IV-3: CHANNELS AND ANTENNAE FOR TELEVISION

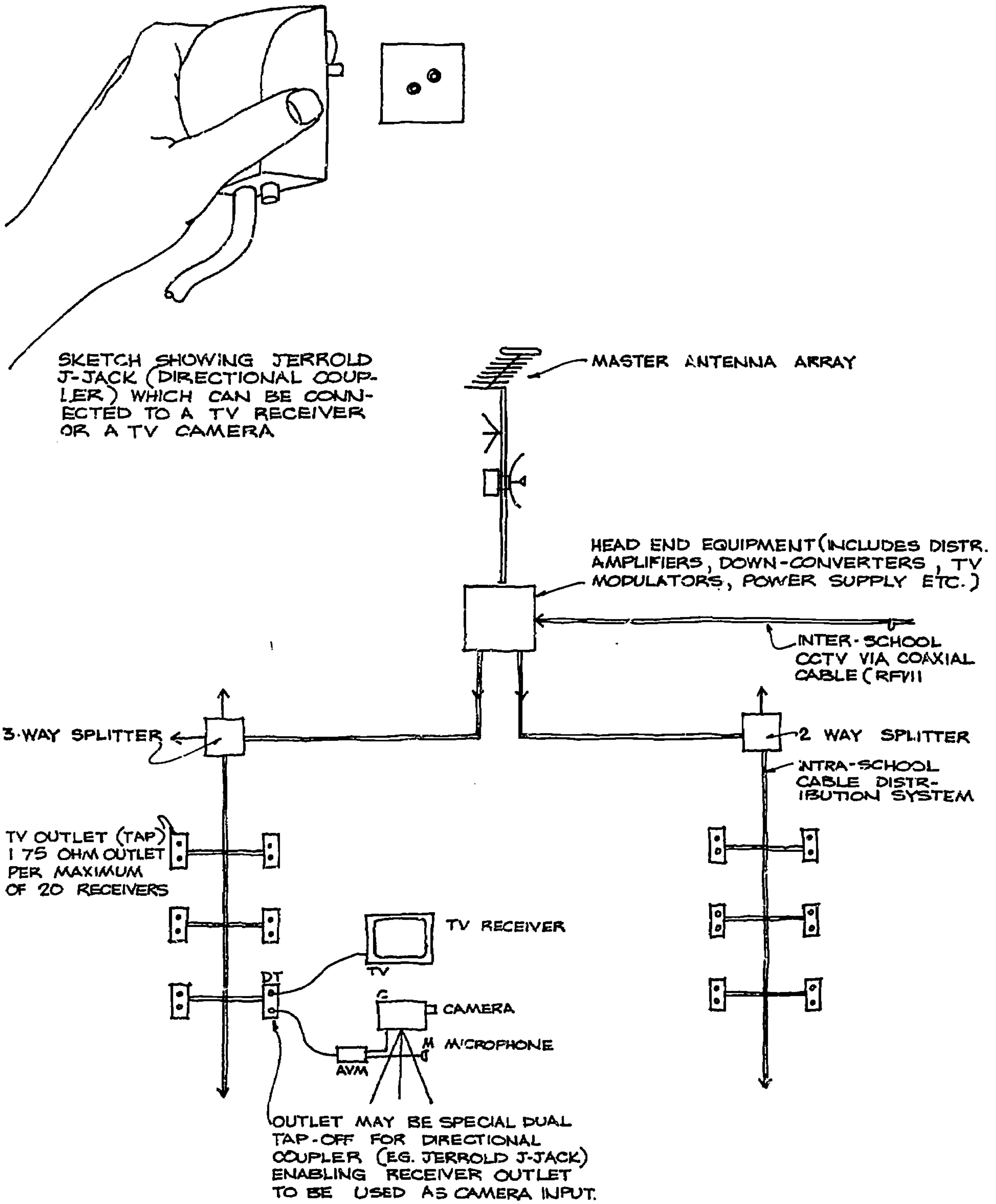


FIGURE IV-4: SIMPLIFIED DIAGRAM OF AN MATV SYSTEM

If the school served has a master antenna system, the cable would feed into the "head-end" equipment (amplifiers, etc.) from where distribution of all intra-building television programs would originate. Otherwise it is linked directly to the various TV receivers throughout the school.

The same coaxial cable system used to distribute TV programs originating outside the school can be used to distribute those originating within the school itself—either in classrooms or labs set up for this purpose, in a TV studio, or at other points in the cable system. Through the use of special devices known variously as directional couplers, dual tap-offs, and J-jacks, signals from any of these points can be channeled back to the head-end and then distributed through the school via the cable system. Mobile TV camera units could be used to originate programs from any of these points.

B. PRODUCTION EQUIPMENT

At the present time small studios are available. These studios are equipped with cameras, monitors, work surfaces, controls, and switching mechanisms which can integrate film or microscope chains and video tape recordings into the TV lesson material.

RCA's unit is called the TELEROAMER; the Westinghouse unit is called WAVE. Both of them can be equipped to suit a particular situation with the possibility of adding "modules" of equipment at a later stage (refer to Data Sheet DD).

The equipment required in a TV studio and related control room is generally more elaborate as shown in the diagrams in Figure IV-5. The equipment generally includes the following:

1. In the Studio

a camera chain: 2 television cameras connected to the video switcher in the control room.

a microphone: connected to the audio control in the control room.

the stage, props, and lighting.

2. In the Control Room

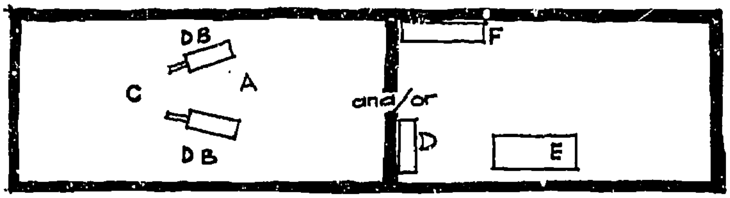
Video components
- monitors
- switchers
- synchronizing equipment
- distribution amplifiers
- power supply

Audio components
- amplifiers
- control equipment

Program sources and recorders
- film chain
- videotape units

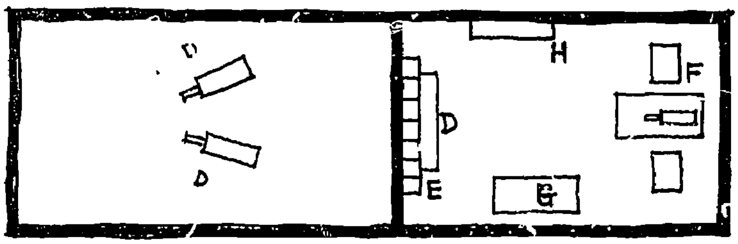
3. Film Chain

A film chain includes one or more film projectors (film, filmstrip, opaque, and slide), optically arranged in relation to a TV camera pickup source. The camera transmits the information from the projectors into the video system (Data Sheet CC).



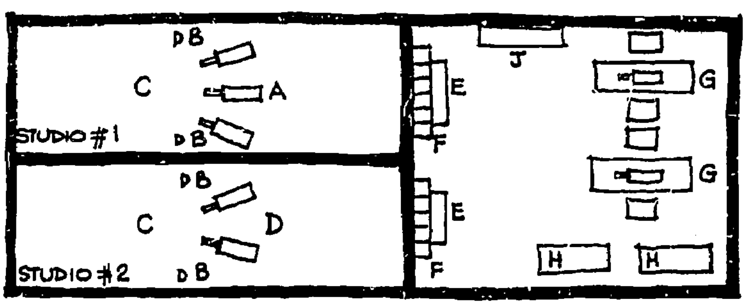
SMALL STUDIO OR ORIGINATION POINT

A Two TV Cameras
B Microphones
C Overhead Lighting
D Audio & Video Switchers
E VTR and Film-chain Dissemination Potential
F Misc. Equipment such as amplifiers etc.



MEDIUM STUDIO CONTROL RM.

A TV (Vidicon) Cameras
B Microphones
C Overhead Lighting
D Audiovideo Switcher
E Monitors
F Film-chain (Film & Slide Projectors, Camera, Multiplexer)
G Helical Scan VTR (Videotape recorder: type accepted by FCC)
H Misc. Equipment (Distribution Amplifiers, synch. equip., power supply etc.)



LARGE DUAL STUDIO CONTROL RM.

A TV (Image Orthicon) Cameras)
B Microphones
C Overhead Lighting
D TV (Vidicon) Cameras)
E Audiovideo Switchers
F Monitors
G Film Chain (see above)
H Tape Recorders
J Misc. Equipment (See above)

FIGURE IV-5: TYPICAL TV ORIGINATION EQUIPMENT

4. Videotape Units

A videotape recorder is an electro-mechanical device which makes possible electronic recording and immediate playback of images and sound on magnetic tape. Portable videotape recorders currently on the market cost between $1,000 and $9,000 plus costs for associated cameras, lenses, microphones, and monitors. Tapes are usually ½ in. and 1 in. with playing times varying from 30–60 minutes. Average cost of tapes is $30–50 per hour. Broadcast or professional units cost between $20,000 and $70,000 and use 2 in. tape which averages $95 per hour.

The type of television studio equipment which a school intends to install should be carefully selected by a special consultant. Equipment compatibility is of great importance, especially in the purchase of videotape recorders (VTR).

There are basically two types of videotape recorders—a "helical scan" and a "quadruplex." The latter, which are much more costly, are usually installed in broadcast or large closed circuit installations. Helical scan recorders made by one manufacturer often produce tape recordings that cannot be played back on another manufacturer's equipment. Besides compatibility, other considerations to be taken into account are availability of parts and service.

C. PRODUCTION SPACE REQUIREMENTS

The design of television production facilities is very specialized and too complex to be covered in any significant detail in this survey. Several planning guides already exist; the reader is referred to those listed in Appendix II.

A summary of rule-of-thumb guides is given as follows in order to illustrate the range of requirements:

Studio

Area	1000 sq ft per each two cameras (minimum).
Height	12 ft to bottom of lights (minimum); i.e., 14 ft over-all (minimum).
Proportion	3:2 – 2:1
Temperature	69° ± 2%
Location	Away from areas of high ambient noise; close to utilities and services; easily accessible to outside door for large objects to be moved in and out; adjacent to preparation and storage rooms and usually to control room.
Other Requirements:	Windowless; at least two unbroken walls; acoustically separated from adjacent storage and preparation areas and control room.

Production Storage Room

Area	5% studio area X number of cameras

Maintenance Room

Area	Space for 4 ft by 10 ft long bench

Preparation Room

Area	Place to prepare visuals and other materials to support televised lesson. (Could use studio during nonproduction periods.)

Control Room(s)

Location	The control room may be located at some distance from the studio itself if the two are connected electronically by video monitors. The window which is usually located between the two spaces is often in the way of the equipment and is quite unnecessary in most cases where monitors are provided. The audio controls are usually located in the same room as the video controls, although they may be in separate locations in large installations.

D. SERVICE REQUIREMENTS FOR TV PRODUCTION FACILITIES

Air Conditioning

Multi-zone; separate from building air conditioning; minimal noise from equipment.

5.7 tons/20kw of power consumed (typical small school studio requires 7–10 tons total).

Low noise so as not to interfere with audio recording.

Power

115/208 volts; 4-wire service; in a small operation, 6–8 20-ampere circuits minimum.

No power transformers within 250 ft of video or audio tape production or storage areas.

Manufacturer's requirements for equipment plus 25 percent for miscellaneous and expansion.

Maintenance area should be equipped with plug-in strip or outlet boxes every 2 ft on bench with 30 amp separate circuits.

To ensure the elimination of ground loops the common grounding bus should be provided interconnecting all areas requiring power.

Electrostatic shielding for power circuits and transformers.

Special voltage regulation requirements.

Lighting

No fluorescent lights; 200 fc in studio area (quartz-iodine or incandescent).

Lighting should be zoned, dimmable.

12 ft above studio floor and 45° angle.

Special ceiling supports in studio.

Master control area should have 65–75 fc at working surface.

E. METHODS OF DISPLAYING TV PROGRAMS

There are basically three ways of displaying TV programs, each of which may be coupled with any of the program sources already mentioned. The three TV program display methods are:

Individual viewing at a study carrel on a small TV receiver (or monitor).

Display to a classroom or lecture-hall group on one or more TV receivers (or monitors).

Projection onto a large screen for group viewing.

The monitor in the individual study carrel has typically a 9 in. picture tube. The most commonly used group-viewing monitors have 23 in. and 25 in. picture tubes. A general rule of thumb states that the size of the monitor in inches is equal to the *approximate* number of viewers that can be accommodated.

In a typical classroom desk layout, up to 30 students may view one monitor. Image brightness and contrast are usually high enough to permit viewing without reducing room light levels. The monitor(s) may be permanently mounted to the wall, floor, or ceiling in "yoke mounts" or they may be set upon a shelf or mounted onto a mobile unit (see Data Sheet AA).

Whether it is preferable to use a single TV projector and projection screen or numerous monitors for large-group viewing is the subject of some debate. In order to provide the same viewing area as a 9 by 12 ft projected TV picture, more than 50 23 in. TV receivers or monitors would be required. However, the quality of the projected image does not always compare with the image on a TV monitor. The single projector produces a large image on the screen; but the lack of image brightness and contrast, especially with the less expensive projectors, requires the room to be darkened to a 5–10 fc level. The projector, however, may be

rented when needed, thereby reducing costs considerably. On the other hand, the provision of many large screen monitors is costly, and their use may involve considerable room wiring.

Television projectors can be supplied to receive and project both off-the-air broadcasts as well as closed circuit television inputs which may emanate from a TV camera, videotape recorder, or TV film chain.

Most television projectors can be supplied to provide television pictures which range from 4½ by 6 ft up to 9 by 12 ft in size. TV projection is in many ways similar to film projection, and the considerations regarding ambient light levels at the screen area as well as the selection of a proper screen should be thoroughly considered. For additional information on screen selection see page 40.

Both front and rear screen projection can be used with TV projectors. As a general rule, the following statements apply to the choice of screens:

1. For Front TV Projection:

Reduce the ambient light level to less than one fc at the screen.

Avoid the use of a matte white screen.

Use a glass-beaded screen for head-on viewing when the audience is seated beyond the maximum limit of 20° from the projection axis.

When in doubt, use a lenticular screen, which must be tension mounted in order to function properly.

2. For Rear TV Projection:

Translucent rear-projection screens, like glass-beaded screens, are directional and should be viewed within 25° from the projection axis. Beyond this point, the viewer experiences a rapid fall-off in picture brightness. For best results with rear projection, the projector side of the translucent screen must be dark.

The TV projector itself comes in a single package ("unitized") or in dual-units. It can be mounted on a mobile cart or ceiling mounted. The latter type of mounting is most suitable for dual-unit projector construction with the optical head portion mounted at the ceiling and the electronics portion (called the control unit) connected to it by cable.

F. APPROXIMATE COSTS

The following figures illustrate approximate costs of television components. They are derived from the book *Instructional Television Fixed Service (2500 megahertz): What It is . . . How to Plan,* published by the Division of Educational Technology of the National Education Association in Washington, D.C. in 1967.

ITEM	COSTS IN DOLLARS		
	Budget Costs/Unit		Costs May Vary Between:
	Standard or Black & White	Color	
Classroom outlet[7]	80		
23" TV receiver with stand	150	350	
Large screen TV Projector	2,000		
Videotape recorder VTR			
Helical scan	8,500		1,000–9,000
Quadruplex	25,000	70,000	20,000–70,000
Vidicon camera	8,500		1,000–8,500
Vidicon camera chain	25,000		
Image Orthicon camera	20,000		15,000–20,000
Image Orthicon camera chain		75,000	70,000–75,000
Film chain (add to camera chain)		55,000	50,000–55,000
Studio equipment installation	10,000		
Studio miscellaneous (scenery, lighting, air conditioning)	5,000		4,000–5,000
Lighting for studios/sq ft			0.50–0.75
Air conditioning for studios/sq ft			1.00
Transmitter: single channel (ITFS) including antenna and transmission line	15,000		
Receiving antenna and related items	1,500		
Average cable charges per month per mile			40–50

[7]Based on two distribution systems—one for closed circuit and the other for open circuit television.

FIGURE IV-6: COST ESTIMATES

A. 10 SCHOOLS (150 CLASSROOMS—3,750 STUDENTS)

	One Channel	Two Channel	Three Channel	Four Channel
Survey	$ 500	$ 500	$ 500	$ 500
Studio equipment	45,000	45,000	60,000	60,000
Transmitting equipment	15,000	27,000	39,000	51,000
Receiving antenna, down-converter, etc. (9 @ $1,500 each)	13,500	13,500	13,500	13,500
Distribution system (150 outlets @ $80 each)	12,000	12,000	12,000	12,000
TV receivers and stands (150 @ $150 each)	22,500	22,500	22,500	22,500
Subtotal	108,500	120,500	147,500	159,500
Maintenance (10 years @ 5% of above cost per year)	54,250	60,250	73,750	79,750
Total Cost (10 Years)	$162,750	$180,750	$221,250	$239,250
Cost/year	$ 16,275	$ 18,075	$ 22,125	$ 23,925
Cost/pupil/year	$ 4.34	$ 4.82	$ 5.90	$ 6.38

The above figures are for black and white only. The cost of a complete ITFS color system will be appreciably more than the figures quoted above for studio equipment, transmission, and receivers.

FIGURE IV-6A: AVERAGE INVESTMENTS REQUIRED FOR A 2500 MHz ITFS SYSTEM

B. 20 SCHOOLS (300 CLASSROOMS–7,500 STUDENTS)

	One Channel	*Two Channel*	*Three Channel*	*Four Channel*
Survey	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Studio	45,000	45,000	60,000	60,000[a]
Transmitting equipment	15,000	27,000	39,000	51,000
Receiving antenna, down-converter, etc. (19 @ $1,500 each)	28,500	28,500	28,500	28,500
Distribution system (300 outlets @ $80 each)	24,000	24,000	24,000	24,000
TV receivers and stands (300 @ $125)[b]	37,500	37,500	37,500	37,500
Subtotal	151,000	163,000	190,000	202,000
Maintenance (10 years at 5% of above cost per year)	75,500	81,500	95,000	101,000
Total Cost (10 years)	$226,500	$244,500	$285,000	$303,000
Cost per year	$ 22,650	$ 24,450	$ 28,500	$ 30,300
Cost/pupil/year	$ 3.02	$ 3.26	$ 3.80	$ 4.04

The above figures are for black and white only.

[a]If three or four channels are operated, it is assumed that additional program origination equipment would be a necessity (one additional tape recorder or film system for each channel), approximately $10,000 to $15,000 for each additional channel. The maximum figure is used here.

[b]In larger quantities, the per unit cost of receivers and stands is less. Therefore, the $125 figure is used instead of the $150 quoted in the preceding table.

FIGURE IV-6B: AVERAGE INVESTMENTS REQUIRED FOR A 2500 MHz ITFS SYSTEM (300 Classrooms)

Chapter V

COMPUTER ASSISTED INSTRUCTION

When the computer is used as the individual student's guide through a programmed course of instruction, this system is called Computer-Assisted Instruction (CAI). It is also referred to as Computer Aided Instruction and Computer Assisted Learning.[1]

In one sense an educational computer system is one that utilizes standard techniques of data processing to lead a student through a curriculum. In an alternative use of the data processing techniques, it is a system that provides classroom management by assisting instructors in the logistics of individualized curriculum.

A system can provide both, either, or parts of either as seen fit by the originators of a system.

A computer system will always reflect the human input, and while providing interaction with phenomenal speed can only interact with the degree of complexity with which it is programmed. Several systems are currently available, referred to as Computer Assisted Instruction (CAI), Computer Based Instruction (CBI), and Computer Assisted Learning. The field is still too unstandardized to generalize with specific nomenclature, as will be discussed in Section V D, under System Options. However, in this survey the term "CAI" will generally be used to describe all computer based educational systems.

Software is the nonphysical components of the system, such as the computer language and the instructional programs.

The instructional program is the planned sequence of presentation of curriculum material. A computer system is able to process stored information by reacting to a specific instruction for each procedural step. A series of instructions that together form a meaningful procedure is a program. The student is led through the curriculum in an orderly way, as a teacher would do, with the computer systems dispersing information, then asking questions about it, and going ahead or explaining and repeating, depending on the answers to the questions. The curriculum author generally has to work through a programmer conversant with the computer language. This procedure presents certain difficulties to teachers wishing to be involved in the development of software. For this reason, computers are beginning to be programmed to interpret instructions given in a language very similar to the authors' natural language. An example of this is IBM Coursewriter language.

The curriculum author may be a teacher, a professional author, an educational researcher, or a service bureau. School systems may retain their own personnel to develop CAI courses, but the economics of pro-

[1]Note that some authors refer to Computer Assisted Instruction as CBI (Computer-Based Instruction).

gram development are such that most school systems cannot afford it. However, until a convincing body of the software does exist, educators will be very slow to accept CAI to any significant degree.

An early development in CAI was the response of the textbook industry, which was farsighted enough to understand the implications of software development. They thought that if existing textbooks were considered adequate, the conversion of published written text into computer programs would be a simple process. This is not so! The textbook of today requires the backup of a teacher who is able to lead the student through the text, answer questions, and provide the guidance that will lead to the greatest advance. To build this response and guidance ability into the computer is one of the major problems faced by curriculum authors.

One such textbook publisher—Harcourt, Brace, and World—has recently associated with RCA to prepare programs and materials for CAI. Such mergers between large publishing houses and the computer manufacturing industry is a pattern which will give great impetus to the acceptance and use of CAI in the next decade. Until the publishing houses entered the field, the computer industry was faced with the classic "chicken or egg problem" of wondering whether to invest in the preparation of expensive software before the concept had even gained acceptance.

The cost of development of high quality effective computer programs is difficult to predict. It has been estimated that for tuition of medium complexity, an average of 100 hours of author time is involved in development of one hour of student console time. But for complex tutorial programs, development time might be 8 or 10 times more.

The simplest type of CAI program to develop is referred to as "Drill and Practice." Drill and Practice Systems are designed to supplement the regular curriculum thus relieving the teacher of the drilling aspect of instruction. The computer program instructs each individual student by offering exercises of differing degrees of difficulty.

The next level of complexity above Drill and Practice is a "Tutorial System." With Tutorial Systems, the program takes over the responsibility for developing skill in the use of a given concept and approximates the relationship between a student and a tutor. Skill subjects such as reading, mathematics, and elementary foreign languages are suitable. A large part of traditional present day instruction is at this level.

The "Dialogue System," sometimes called a Dialogue Tutorial or Inquiry System, is the most complex level of programming characterized by increased student control over the selection and frequency of the messages which make up the conversation with the computer. Little in the way of predetermined teaching pattern would be programmed into such a system. The system is still undeveloped, but according to some educators it appears to hold the most promise for CAI. It would establish a basis for genuine challenge, response, and discussion with each student.

An important part of computer software is the operating system. The operating system is a group of computer programs which, in essence, control the running of the computer and control the computer programs which actually give the instructions. Differences among operating systems make the interchange of CAI programs among users difficult and sometimes impossible.

A discussion of computer software would not be complete without some comments about the management of CAI systems. This task requires specialized knowledge beyond the scope of school faculty and administration. To fill the need for management, the software service industry has developed. Companies offer their services not only in preparing but also in operating and managing computer programs for specific purposes. In the educational field the General Learning Corporation, Westinghouse Learning Corporation, and the American Institute of Research are active.

Software companies are usually able to write and tailor their programs to the hardware that is most suitable and therefore able to exploit any special attributes that one piece of hardware may have. The industry is presently more experimental than commercial with federally assisted funding.

A. THE IMPLICATIONS OF EDUCATION COMPUTER SYSTEMS

When CAI comes into use it will probably not be on a school-wide basis but on a small project basis–i.e., one or two specific and confined areas of a school may be set up for CAI, probably in conjunction with only one or two disciplines such as math or language skills. The terminals could either be connected to a remote computer shared by several school systems and managed by a software service company or a university center; or they might be connected to a local school computer which might also be used for administrative purposes, especially in a large school system. In the latter case, programs could be purchased off the shelf so that there would not be any need to accommodate programmers or curriculum authors on the school premises.

There are many crucial decisions which must be made at the design stage by the appropriate authorities regarding the possible use of computers and CAI, even if this use is not for several years. If installation costs were not continually rising, it would still be a great deal more expensive to remodel schools to make provisions to accommodate future installations. However, provision of unlimited flexibility for possible future changes is unrealistic, and some parameters will need to be set.

The strategy of the design team must be that the building systems will easily accommodate a remodeling program when electronic teaching aids arrive in any quantity.

The demands on the building systems will be at a maximum on the academic floors rather than at the central data processing areas, as these areas can be treated as special areas not requiring complete flexibility. On an academic floor, the building systems must have the capability of providing any building service to any 5 ft by 5 ft module. In this discussion the requirements for a student carrel which might occur in any modular area are for the following building services:

a. Normal building electrical power,
b. Communications cables for TV, computer assisted instruction, dial access programs (both audio and video),
c. Environmental comfort (e.g., sufficient air conditioning to satisfy the additional demand imposed by the electronic equipment),
Also, the ability to provide these services with reasonable cost at any time.

Each academic floor would require:

a. An electrical power room,
b. A communications systems cabling room,
c. A system of distributing power and communications cables in the floor.

The system of cable distribution is affected by the anticipated location of student terminals or carrels, which educators anticipate will be free standing or arranged in clusters in otherwise open space. This then eliminates the use of ceiling space for conventional overhead wiring, dropping down in walls or partitions to the user. In fact, the criteria for flexibility demands the elimination of all wiring in partitions. A system of distribution in the floor or below the floor is mandatory.

One of the most economical methods of servicing an outlet in an open floor area is the "poke through" method (commonly used by speculative office builders). Wiring is run in the ceiling space below the user's floor, which is core drilled where the outlet is required, and the conduit or cable is pulled through the hole. Various manufacturers produce fittings to provide a neat finished termination. This does, however, have a disadvantage in that to provide service to an outlet on one floor, two floors are disturbed. The inconvenience is overcome by using a distribution system enclosed within the floor slab. Included in the available systems are under-floor duct, trench duct, cellular flooring, modular arrangements of embedded conduit, and outlet boxes, a structural system providing raceways for cabling.

To provide a floor system capable of distributing all possible cables and wiring to any modular area is economically impractical. The large cables required for the IBM 1500 Instructional Systems, as an example,

are 1-1/8" o.d. and, while few in number, would require an abnormally large floor raceway or cell. These cables should, therefore, be routed in the ceiling space of the floor below and "poked-up" through core-drilled holes to a student carrel cluster above. Such a decision then limits the location of these carrels due to high density of HVAC ductwork in the ceiling in certain areas. A study of proposed duct layouts implies that any large grouping of student carrels may well be limited to the center part of an academic floor.

However, this restriction would not necessarily apply to electronic aids requiring smaller service cables such as coaxial cables for ETV.

Other than space for cabling, the use of electronic teaching aids also implies an additional demand on both the electrical power and air-conditioning systems. One layout, with 50 carrels on an academic floor, imposes an additional demand of 2 watts a square foot on the power system, with corresponding increased demand on the air-conditioning system to maintain environmental comfort. It is these demands on the building systems that require an initial design of greater capability than the conventional school of today.

B. PROCESSING REQUIREMENTS

"Hardware" describes the physical components of a system.

1. The System

Educational computer systems are adaptations of existing information technology and data processing techniques. As in any data processing center the system consists of a combination of units; input, storage (or memory), processing (arithmetic and control), and output. These units are common to most computing centers, and in general are not different from those used by a bank or commercial accounting office.

Several manufacturers are engaged in the development of CAI equipment having major differences between their systems. However, even very similar systems will sometimes utilize different terminology for the same functional items.

The essential major components are the data processing equipment (referred to in the text as "computer" for convenience), and the student terminals through which the student interacts with the computer. Other pieces of equipment—usually communications links—are sometimes interposed between the central computer and the terminals.

For instance, in the RCA Instructional 70 System when the computer is located at a great distance from the terminals, a "line concentrator"[2] collects the information from the terminals via low-speed telegraph lines and transmits the information to the computer through data sets and one high-speed telephone transmission line (see Figure V–1). The data sets and the telephone transmission lines are part of the subsystem leased to the user by the telephone company.

2. The Computer

A digital computer is made up of the following basic units:

Input Unit: transfers information from external media to the storage unit. Input devices are also called peripherals.

Memory or Storage Unit: stores information which is to be processed, together with the instructions for the type of processing to be executed. Secondary, buffer, or temporary storage units are sometimes used and may expand the memory capabilities of the computer.

Output Unit: transfers information from the memory unit to external media such as printed forms, punched cards, magnetic writing on tapes. Often, more than one output unit is used to provide greater flexibility. Output devices are also sometimes called peripherals.

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[2]The line concentrator serves as a communications link. Its function is to direct and control messages between the central processor and remote student terminals. It is primarily a multiplexing device in that it collects lines from many terminals, transferring the information into one line which connects with the computer.

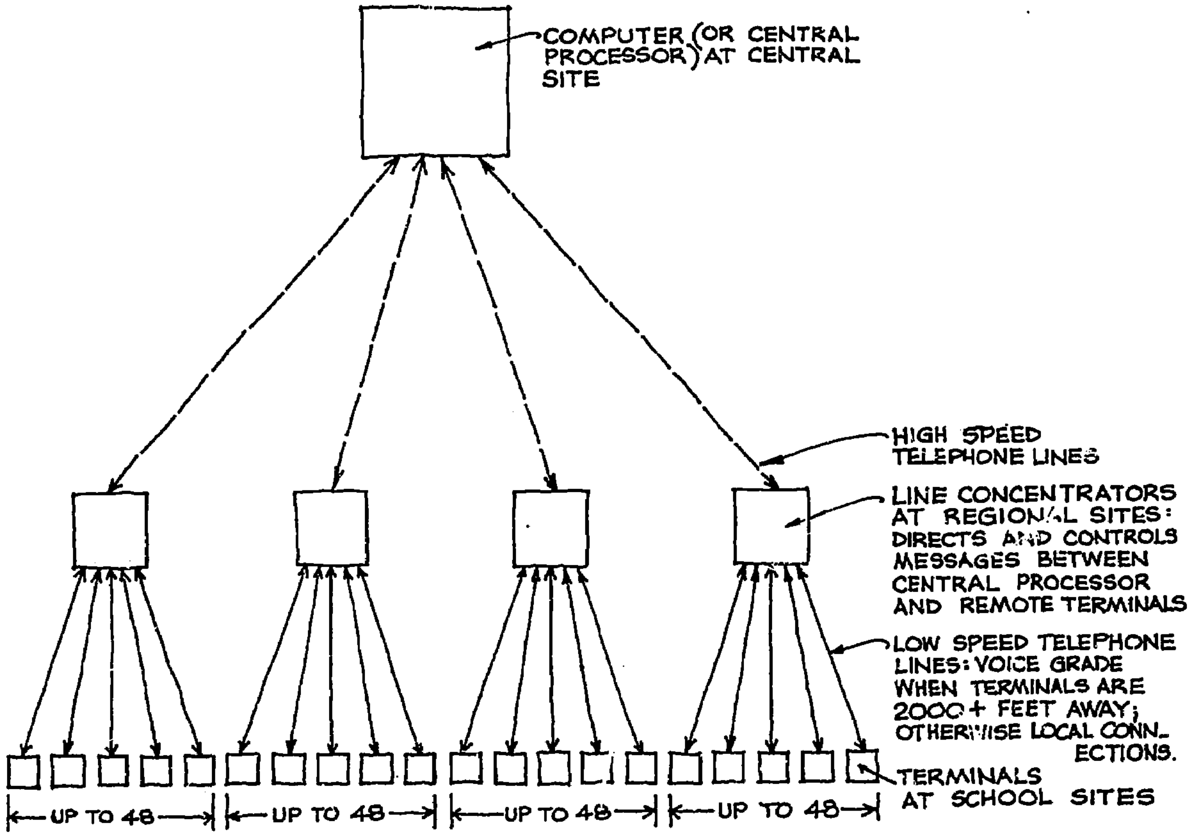


FIGURE V-1: RELATIONSHIP OF LINE CONCENTRATOR TO OTHER COMPONENTS OF RCA INSTRUCTIONAL 70 SYSTEM

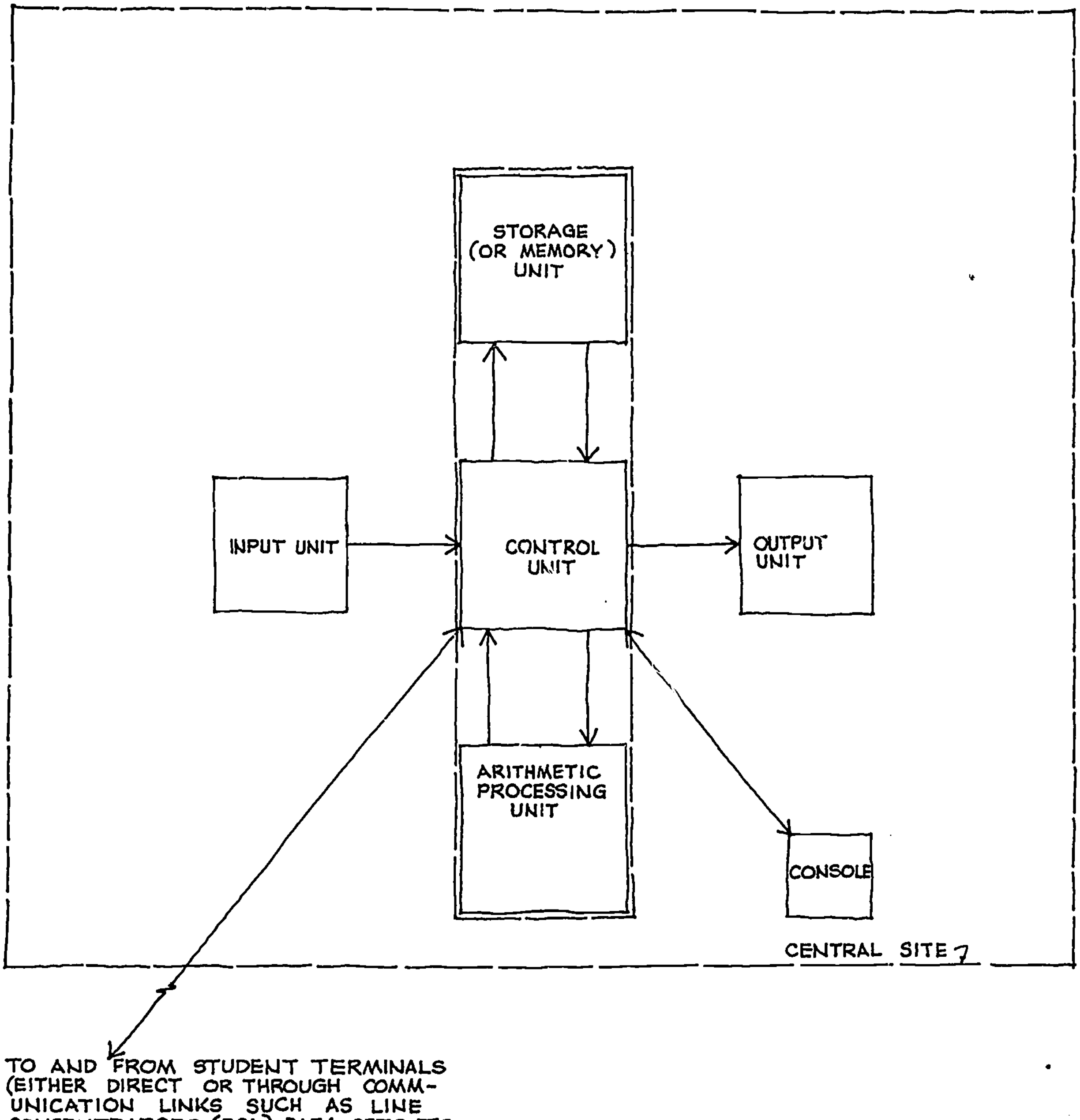


FIGURE V-2: RELATIONSHIP OF UNITS IN A TYPICAL DIGITAL COMPUTER

Arithmetic Processing or Computing Unit: arithmetic and logical operations such as add, subtract, compare, etc. are performed through this unit. The data to be operated on is transferred from the memory unit, and the results of the operation are then transferred back to it.

Control Unit: integrates the total system by monitoring the operations of each unit.

Console Unit: provides direct access to the central processing unit by an operator.

A diagram showing the relationship of these units is shown in Figure V–2. The computer equipment is located at the "central site" which may be in the same building as the terminals or at another location—even as far away as 3000 miles. When it is in the same building, connections to the terminals are made by cable. When it is located elsewhere, telephone, telegraph, or other long distance transmission lines are used, and other equipment is required as communication links (see Fig. V–1).

C. Terminal Requirements

The "terminal" is the equipment at each student station in a CAI system. The terminal may refer to a device such as a teletypewriter or it might refer to the individual study space housing several devices.

The terminal permits communication between the computer and the student by means of various display and response devices. A display device is any piece of equipment which permits the computer to display questions, instructions, illustrations, etc. It might be a cathode ray tube (or CRT)[3] screen (which is similar to a television screen), or it might be a rear projection slide viewer[4] or a simple typewriter device which prints out the instructions on the paper. Figure V–3 illustrates two of these devices. The latter would also be termed a response device since it permits the student to respond to the computer program questions. Other response devices include the electronic light pen which the student may use as a pointer on the CRT screen. The area of the screen that is touched will be registered on the computer, which will then assess whether or not it is the correct response.

Display and response devices at terminals are sometimes called input/output devices. (The latter term more generally refers to equipment in the computer room which feeds information into and out of the computer.) If a terminal has very few of these devices, it is termed "lean" by some authors; if it has many devices, it is termed "rich." The devices can be used in many combinations, some of which are illustrated by means of the matrix in Figure V–4.

The most commonly used display and response device at present is the teletypewriter which some experts criticize as being too slow and too noisy. They are also critical of the CRT device because it tends to have poor resolution, making it difficult to read for extended time periods. A great deal of development in terminal devices is currently under way, and in the future it may be economically and technically feasible to communicate with the computer by graphic means or to utilize "non-impact printers" which are quiet, fast, and easy to read but too costly at this time. Some development work is also going on relating to touch-sensitive and pressure-sensitive surfaces.

Briefly stated, the criteria for selection of terminal devices are as follows:

Suitability with regard to educational value,
Cost,
Reliability of performance,
Maintainability, and
Flexibility in terms of subject matter and teaching method.

[3]When terminal equipment includes a CRT screen in combination with a keyboard, it is sometimes referred to as a Video Terminal.
[4]The rear projection slide viewer is referred to as an Image Projector by manufacturers.

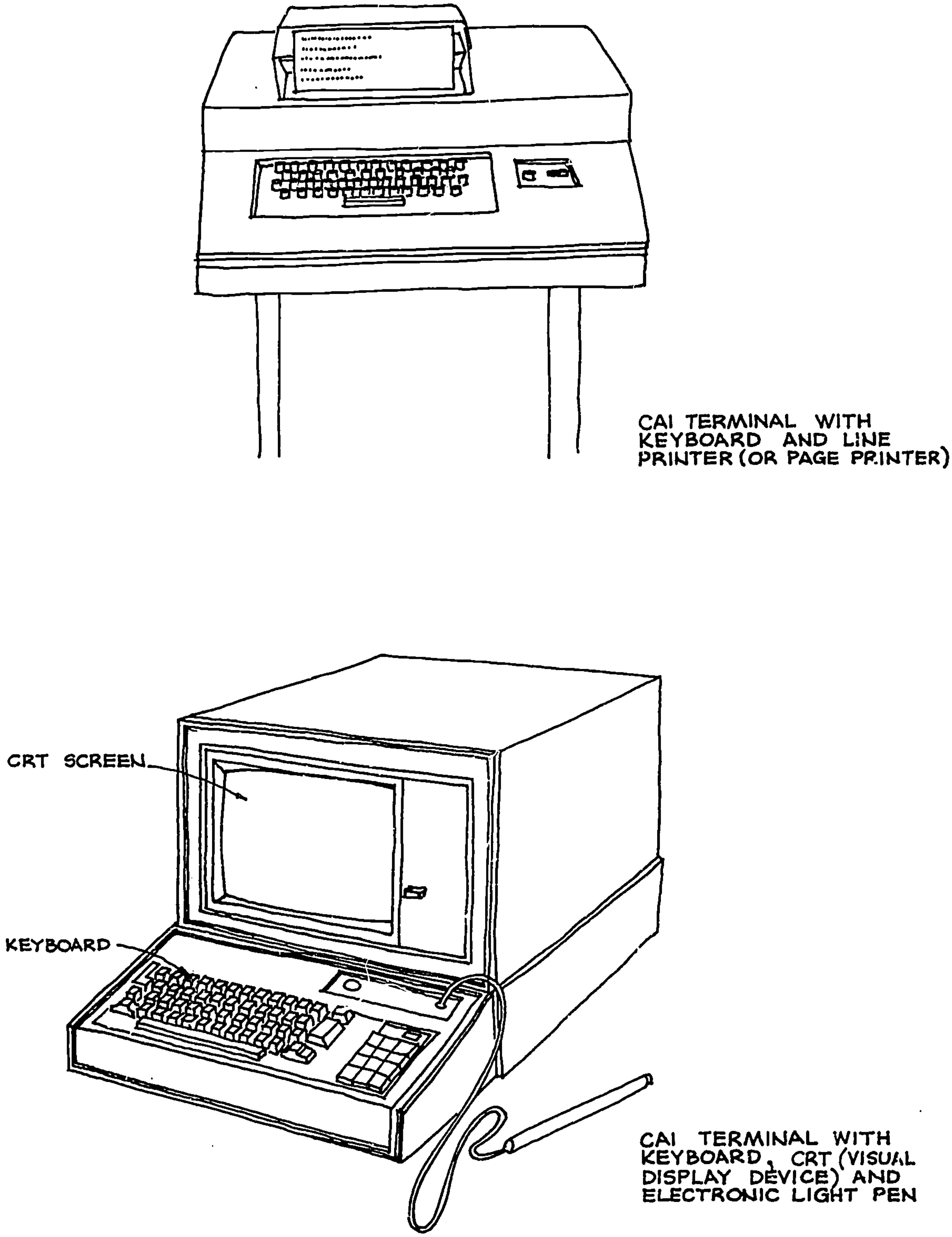


FIGURE V-3: DISPLAY AND RESPONSE DEVICES AT CAI TERMINALS

D. SYSTEM OPTIONS

1. General Review of System Options

In considering system options, it must first be understood that the programming of computers to interact with students on line is not a proprietary invention of one manufacturer. It is an inherent capability of timesharing computer systems. The complexity and amount of hardware used on each system is a function of the sophistication of the programmed instruction. It would appear then that the buyer would have reasonable choice in selecting a system for a particular school. This, however, is not the case at present due to the lack of actual written programs. There is at present only limited standardization in the options that are available, which relate to hardware more than software. Most systems have their own computer language (e.g., IBM uses Fortran and Author-Input, RCA uses "Instruction Systems Language," GE uses Basic and Fortran). While the use of one language limits the use of that program to the specific hardware it was designed for, it can be translated into another language, although that process is very costly. Most of the time it is easier to write the program from the beginning in the desired language.

Another basic premise to be understood before discussing CAI system options is that the equipment can, to varying degrees, be used for other school functions such as vocational guidance and assistance with school management. Such use would be in the fields of staff payroll and assignments, and in classroom management by providing the instructor with the logistical means for individualized instruction.

The location of the central equipment depends to some extent on the number of terminals in use and the complexity of the curriculum program.

As an example, a school with 1000 terminals and tutorial programs of medium complexity would probably require its own computer system. A school with only 100 terminals could be serviced by computer system that is shared by several schools. In all systems where the processing equipment is remote, there is a local satellite computer, control unit, or line concentrator. The limitation in cable length is about 1000 feet from the satellite computer or control unit to the student terminal. This may require that a school have more than one control unit, if terminals are spaced far apart.

2. REVIEW OF EDUCATIONAL COMPUTER SYSTEMS CURRENTLY OFFERED BY HARDWARE MANUFACTURERS

Central hardware in most CAI systems will be located in machine areas away from academic areas. The discussion in this section is therefore concentrated on the educational aspects of each system and the hardware seen by the student and teacher.

a. IBM 1500 Instructional System. The IBM 1500 instructional system provides tutorial instruction to the student using a terminal composed of a 1510 Instructional Display and a 1512 Image Projector (see Fig. V-5). The terminal can consist of a CRT and any combination of the following:

light pen (for student response),
keyboard (for student response),
earphones (for audio input),
image projector (for presentation of curriculum material).

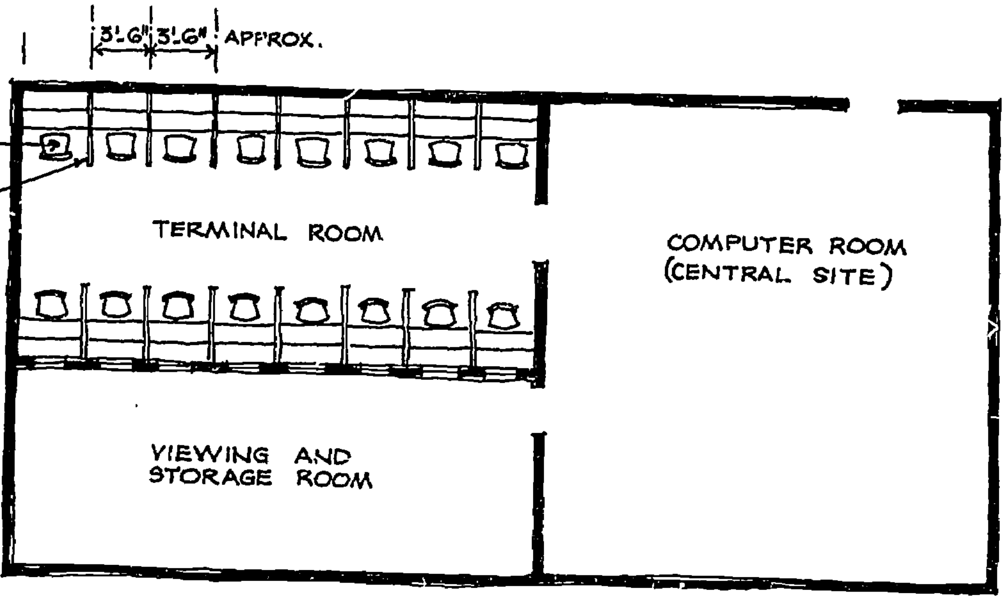
A simple installation might consist only of a CRT and keyboard which could have the capability of drill and practice and some limited tutorial and inquiry modes of instruction. The light pen provides faster student response to multiple choice questions. In clusters of terminals the keyboard may be too noisy. The image projector is useful in providing a static illustration of the subject while tuition is provided on the CRT. Audio instructions are received through earphones.

In common with other computer based systems, the IBM 1500 Instructional System stores the students' responses and on command can print out a multitude of reports on individual or group performance. Such rep ts quickly clarify the learning response to particular instructional programs and also tabulate individual and group progress.

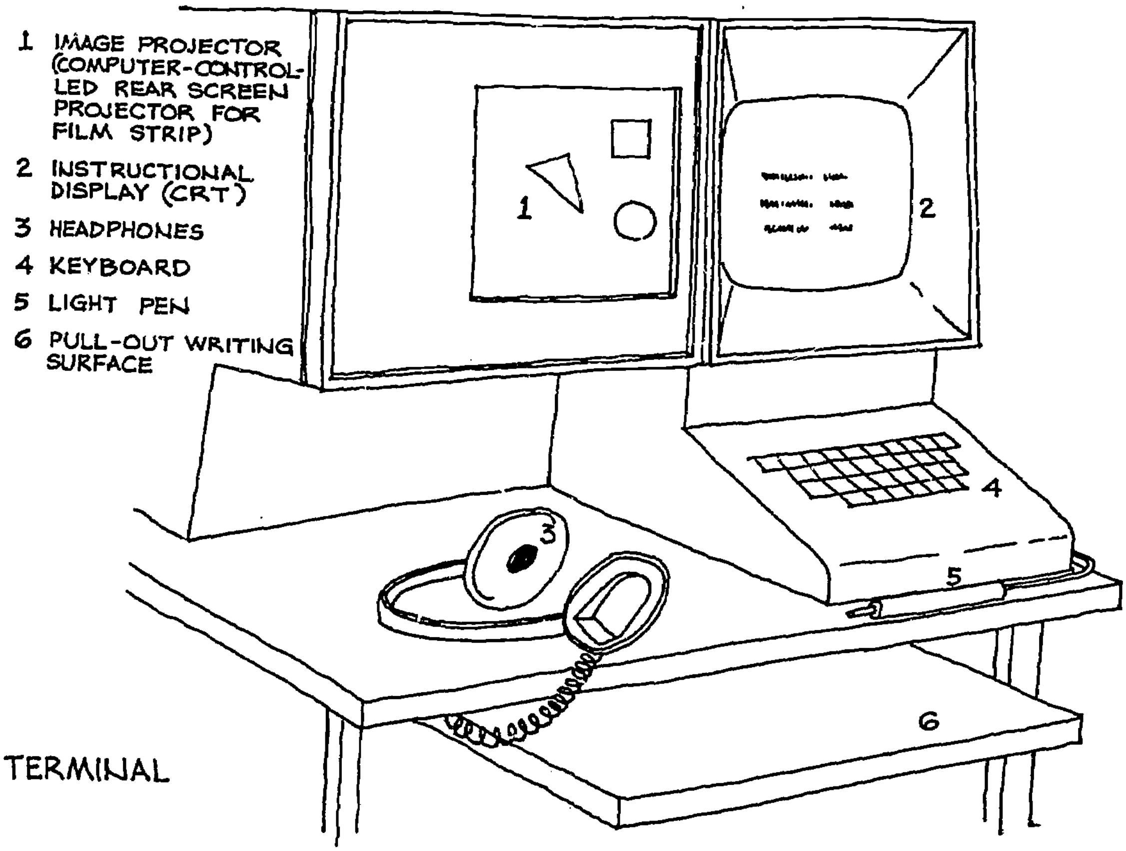
TERMINAL TYPE*							
	MANUFACTURERS						
DISPLAY AND RESPONSE DEVICES	A	B	C	D	E	F	G
KEYBOARD (teletypewriter etc)	X	X	X	X	X	X	
PAGE PRINTER	X					X	
SCREEN (CATHODE RAY TUBE)		X	X	X	X		X
ELECTRONIC LIGHT PEN			X	X			X
IMAGE PROJECTOR (rear screen, slides etc)				X			
OTHER GRAPHIC DISPLAY (sketch, facsimile repro. etc)							
TAPE PLAYBACK				X	X		X
EARPHONES				X	X		X
SPEAKER							
TEACHER CALL						X	X

*Note that different manufacturers offer different combinations of equipment, and the user is limited to those items offered by the specific manufacturer selected. For instance, the Image Projector is presently offered only by IBM. It is a mistake to assume that any functional need determined by the educator can at this time be serviced by equipment supplied by all manufacturers.

FIGURE V-4:SOME OF THE MANY DIFFERENT COMBINATIONS OF DISPLAY AND RESPONSE DEVICES AT STUDENT TERMINALS IN CAI SYSTEMS



PLAN (NO SCALE)



TERMINAL

FIGURE V-5: CAI FACILITY AT BRENTWOOD SCHOOL, PALO ALTO, CALIFORNIA

OPTIONS	COMPONENT	SPACE REQUIREMENTS			SERVICE REQUIREMENTS				COST FACTORS[2]			
		Number of Locat.	Area Req'd (sq ft)		Power Req'd (KVA)		Air Cond. Req'd (Tons)		Initial Const. ($/sq ft)		Remodel ($/sq ft)	
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
A: A central computer at one school and satellite computers at each of four schools	Central Computer	1	1500	2500	50	100	15	30	5	10	20	30
	Satellite Computer	4	300	500	5	10	2	5	5	10	20	30
	Control or Communication Unit[1]	110	50	100	1	5	1	2	5	10	20	30
B: Five separate computers at each of five schools	Each school Computer Room	5	400	1000	6	20	1.5	12	5	10	20	30
	Control or Communication Unit[1]	110	50	100	1	5	1	2	5	10	20	30
	Student Station	4500	10	25	0.5	1	0.2	0.3	5	10	20	30

1. The number of control or communication units needed is a function of the number of student station terminal addresses required and probably will be significantly reduced in the future.

2. Cost factor assumptions are based upon both the cost for including facilities in the original construction and for remodeling after the structure is finished. Cost factors include structural, electrical, and air-conditioning costs and represent average facility costs for typical data processing systems.

FIGURE V-6: SUMMARY OF SIGNIFICANT INSTALLATION FACTORS FOR CAI

This system of instruction is by far the most sophisticated so far developed, and is still not out of the trial stage. It is strongly influenced by Suppes' experiments which indicate particular importance of spoken messages for young children.

b. The RCA Educational 70 System. The RCA Educational 70 System provides drill and practice using a student terminal as either a teletypewriter or a video terminal (i.e., keyboard and CRT). The teletypewriter allows interaction between student and computer by receiving messages from the computer that are typed out on a roll of paper.

At the end of the drill, review, or test, the date and the number and percent of the problems correct and wrong and timed out are printed out for the student and simultaneously recorded with other information on magnetic tape. The student then is able to keep the printout for self-study, and the information stored on magnetic tape can, on command, print out reports of interest to teachers and administrators. The reports include:

—a Daily Status Report providing class and individual information from the previous day's processing;
—a Student Map Report intended to aid investigators of learning theory.

c. General Electric Company. General Electric markets a Time Sharing Computer System for general applications by scientists and engineers which can be programmed for tuition.

The system options at present involve the terminal. The basic installation is a Bell Telephone Model 33 ASR teletypewriter (similar to that used by RCA for drill and practice). Video terminals, GE Datanet-760 Keyboard/Display, are available and presumably could replace the teletypewriter. These video terminals are similar to those used by IBM, RCA, NCR, and Burroughs. When not in use as an instructional tool, the terminals can be used for management and administrative duties.

Hardware in any one school would include a Datanet 760 Display Controller which can service up to 32 keyboard video display terminals and four teletype printers. Terminals must be located within 1000 feet of the controller.

d. Philco Ford. The Philco Ford System presently in operation is less sophisticated than the IBM 1500 Instructional Series, but more so than the RCA Drill and Practice System. Instruction is given in video (CRT), and the student response is made through a keyboard to multiple choice questions. The use of light pens and audio instruction should follow as a logical growth of this system.

An interesting detail of the Philco Ford system is the use of the large remote library of stored data which is transmitted to the satellite computers only as requested. As classes change, the central computer system is commanded to transmit the next lessons to the local processing unit, which allows the latter to have only limited storage. Student-computer interaction is then reduced to the local level. This allows the use of smaller processing units in any one school and should be useful in adapting existing schools for CAI.

One option of this system is the adaptation of "standard" TV receivers at the video terminal capable of receiving ETV and ITV programs.

e. Scientific Data System. SDS manufactures computers and terminals that can be assembled into a system of time sharing as has been done by General Electric. Time sharing systems are operational and appear to function satisfactorily.

f. The National Cash Register Company (NCR). NCR manufactures computer equipment and terminals that could be readily adapted to CAI. The NCR 795 Data Display system provides remote access to stored information in a similar method to that used in the GE Time Sharing Plan. The local Data Display controller, however, can service only 12 data display screens.

E. SPACE REQUIREMENTS

A discussion of space requirements divides readily into two sections--the one dealing with the requirements of the CAI installation itself, and the other with the effects that the introduction of CAI or other electronic teaching systems might have on the way in which space is eventually utilized.

The following paragraphs describe the approximate area and location of spaces currently required for computer installations. The range of area requirements is shown in Figure V-6. Area requirements have, on the one hand, been diminishing over the years as smaller and smaller components have come into being;[5] and on the other hand, as the volume of data being handled has continued to increase, the space requirements have also tended to increase. The net result of these two opposite trends has been that the physical plant for computer installations has not varied significantly for the past 15 years or so.

The following list enumerates the different types of spaces required. These include:

(a) Space for student stations (terminals);
(b) Machine area for on-site equipment;
(c) Maintenance service area;
(d) Storage areas for paper, magnetic tape, cards, etc.;
(d) Administrative and utility areas for technicians, operators, programmers, etc.

1. Space For Student Terminals

Space requirements for student terminals will be affected by the type of terminal selected, the number involved, and their disposition and grouping within the building.

Each terminal will occupy approximately 10–25 square feet of floor space. The smaller area will be required for "lean terminal" which might be nothing more in appearance than an electric typewriter on a stand—sometimes with a small "data set" alongside or below.

Figure V-7 illustrates one arrangement with 12 terminals in a conventional classroom space, all connected to one remote computer. The same terminal type can also be placed so that students face the walls eliminating some visual distractions. It should be noted that the noise generated by several teletypewriters in one room is considerable. Some manufacturers are attempting to reduce the noise level by insulating the inside of the keyboard cover. In that case, however, the heat generated by the machine may become a problem requiring attention.

Figure V-5 illustrates the type of terminal used at the Brentwood School in Palo Alto, California. These terminals occupy about 14 sq ft of floor space and are arranged in two rows of eight on opposite walls. The students face the wall and are protected from all visual distraction by means of side panels, 4 ft high by 4 ft deep. At this facility, students have been provided with swivel chairs. (This is apparently very distracting for the supervising teachers since the young children tend to swing about on these seats.)

The requirements for the design and layout of terminals depend a great deal on the educational philosophy of the administration and the recommendations of the education consultants. It is they who will decide how students are to study—whether in conventional groupings, at regular desks or tables, or at individual study carrels. They will decide whether the carrels are to be "home base" to each student or whether they are to be special areas equipped with special teaching machines; how many of each are to be provided and how and where they will be grouped. All these general educational decisions, together with the specific decisions about the size, manner, and mode of CAI installation will affect space requirements. For instance, the CAI terminals may be combined with the conventional audiovisual carrels,[6] or may be separate, specialized study areas.

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[5]The first modern computers used vacuum tubes which were replaced by transistors. These, in turn, are being replaced by smaller "integrated circuits."

[6]The computer display device (CRT) can be adapted to serve as a regular television monitor when not being used for CAI. For many CAI systems it is now possible for the keyboard to serve as an ordinary electric typewriter when not being used for CAI.

The number of terminals is determined by the length of time per day that each student is involved with CAI. This, in turn, depends upon which subjects are to be taught with CAI, the level of interaction, and the programs available.

The number of student station terminals can be calculated as follows:

$$\frac{\text{\# students} \times \text{\# hrs per week each student is at a terminal}}{\text{\# hrs per week each terminal is available}} = \text{terminals required}$$

For instance, if a school of 5000 students operates for 6 hrs/day and 5 days/week resulting in 30 station hours available per week; and if each student requires an average of 5 hrs/week at the terminal, then the number of terminals required equals 833 (i.e., 5000 X 5/30). A change in the number of hours available per day from 6 to 8 would reduce the number of terminals required to 625 (i.e., 5000 X 5/40). The number of terminals provided should be larger (by about 25 percent) than the number determined by this formula. This will prevent queuing problems and also allow for repairs, maintenance, etc.

Terminals can be arranged in many different groupings, ranging from a single terminal in a conventional classroom, to clusters of carrels in flexible teaching spaces (see Fig. V-8), to special terminal rooms. According to some experts, utilization is greatest when special terminal rooms are provided. However, this may encourage the notion of the computer as something apart rather than as just another teaching tool and may be a disadvantage to the CAI process. If special terminal rooms are provided, some adjacent waiting space may be necessary. Also, garment and book storage should be provided. It may be that the best arrangement of computer terminals would be to group them in a special terminal room convenient to a cluster of classrooms (see Figs. V-9, V-10).

2. Machine Area for On-Site Equipment

There are several options available with a CAI system, as discussed elsewhere. One essential difference is the location of the computer in relation to the student terminals. Space requirements for these different options are listed in Figure V-6.

The area where the central computer is housed is called the "central site." If this is a remote location, "regional sites" may be required. These are usually located on the same site as the student terminals.

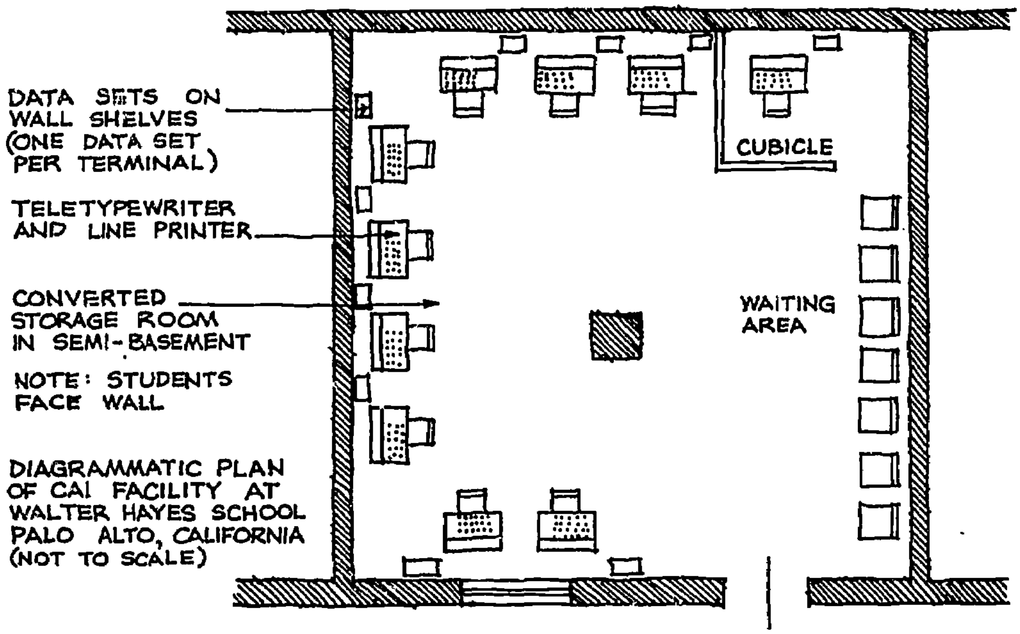
a. The Regional Site. In the case of a remotely located central computer, the regional site would house the communication link and control unit between the computer and the terminals. The area required is much smaller than that for the central site, ranging from 120 sq ft to 350 sq ft depending upon the complexity of the system. If terminals are connected to the computer by telephone lines, the communication link is housed at each terminal and requires little additional space.

b. The Central Site. Besides the computer the peripheral input/output devices such as card readers, printers, etc., space should be provided within the main computer room for daily storage of disk, film, and audio tape cartridges to be used. Space may also be required for other storage cabinets, card files, work tables, desks, and table-mounted equipment. Proper servicing requires adequate service clearance around each unit of the system.

Different systems will have differing space requirements. According to manufacturer's recommendations, the minimal central site machine area varies from 800 sq ft to 1500 sq ft.

For personnel comfort, some acoustic treatment of surfaces is required in machine areas because blower fans in the units and card punches, etc. are sources of noise.

Computer rooms generally have raised floors to facilitate cabling and cooling of equipment which is discussed in another part of this section. The architect must recognize that the raised floor entails a ramp at all points of entry to bridge the differences in floor elevations (approximately 12 inches).



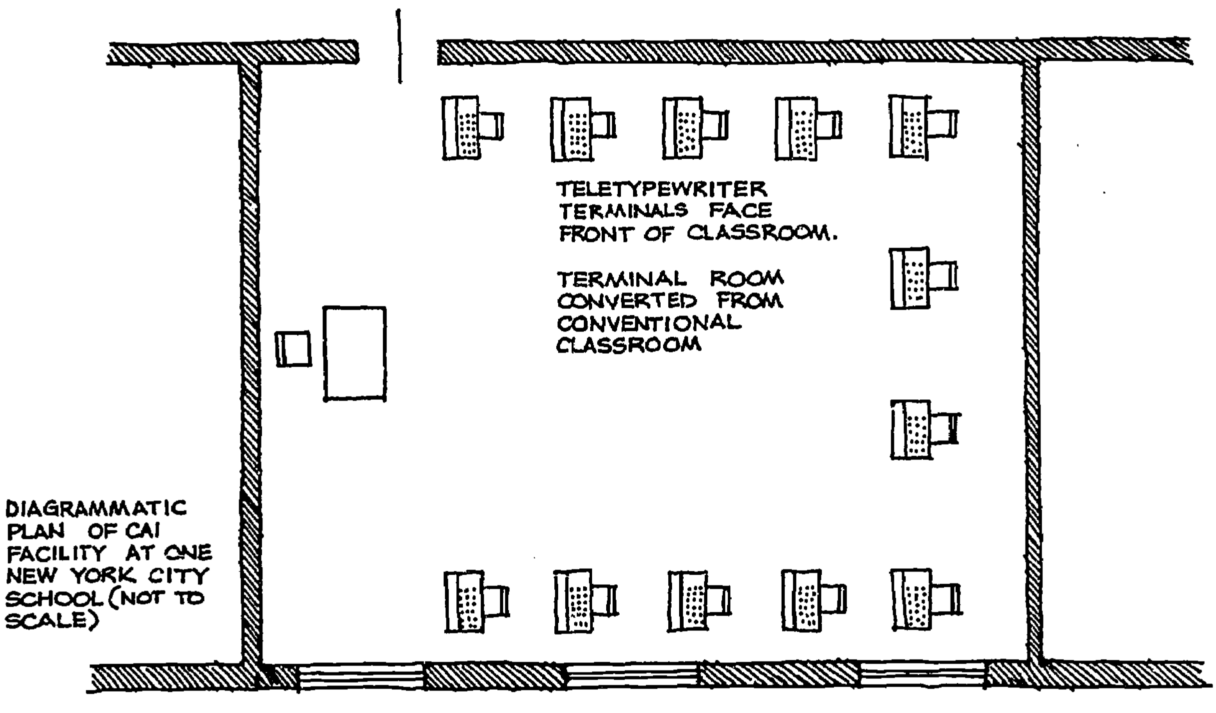


FIGURE V-7: TWO EXISTING CAI FACILITIES

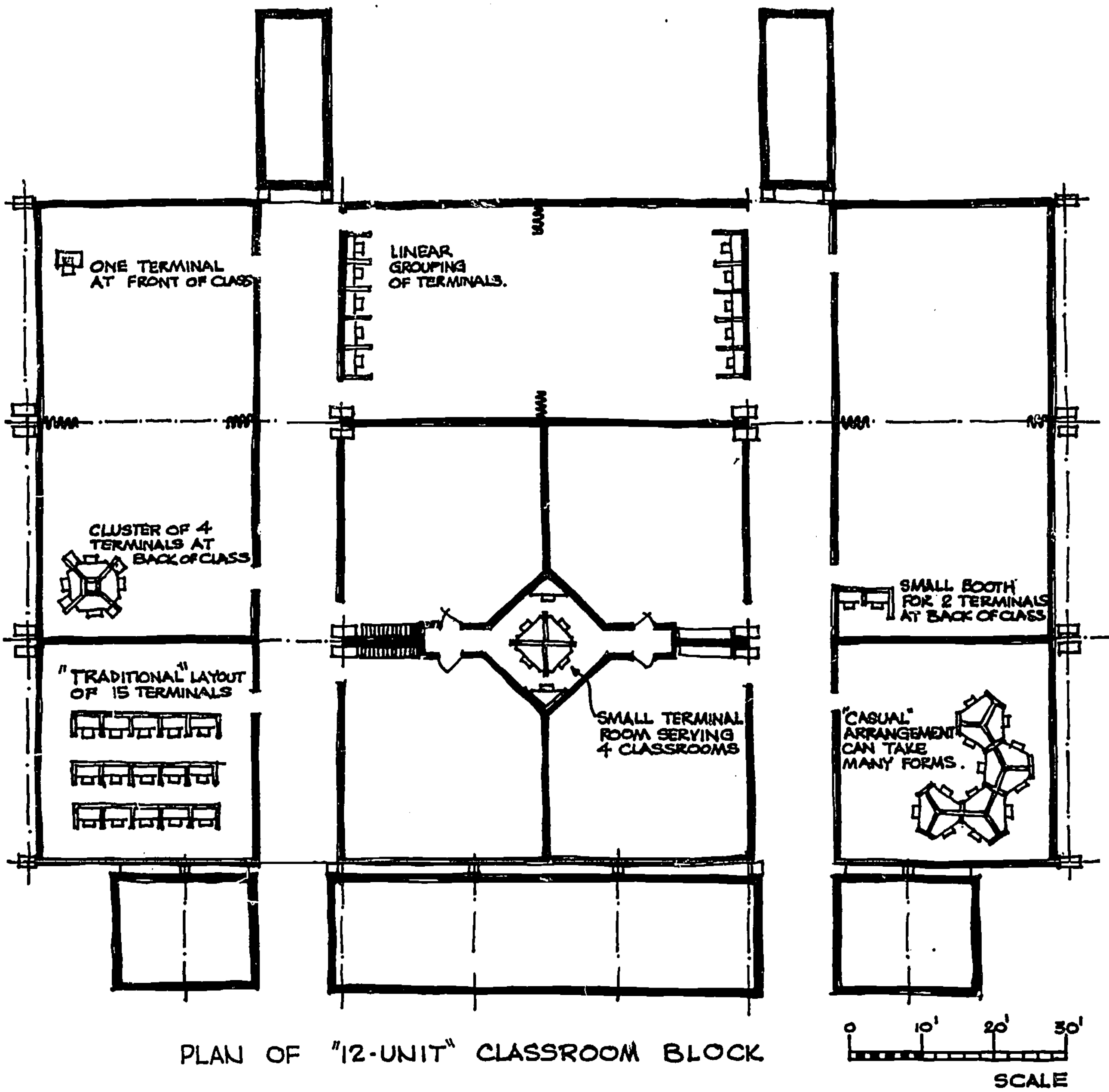
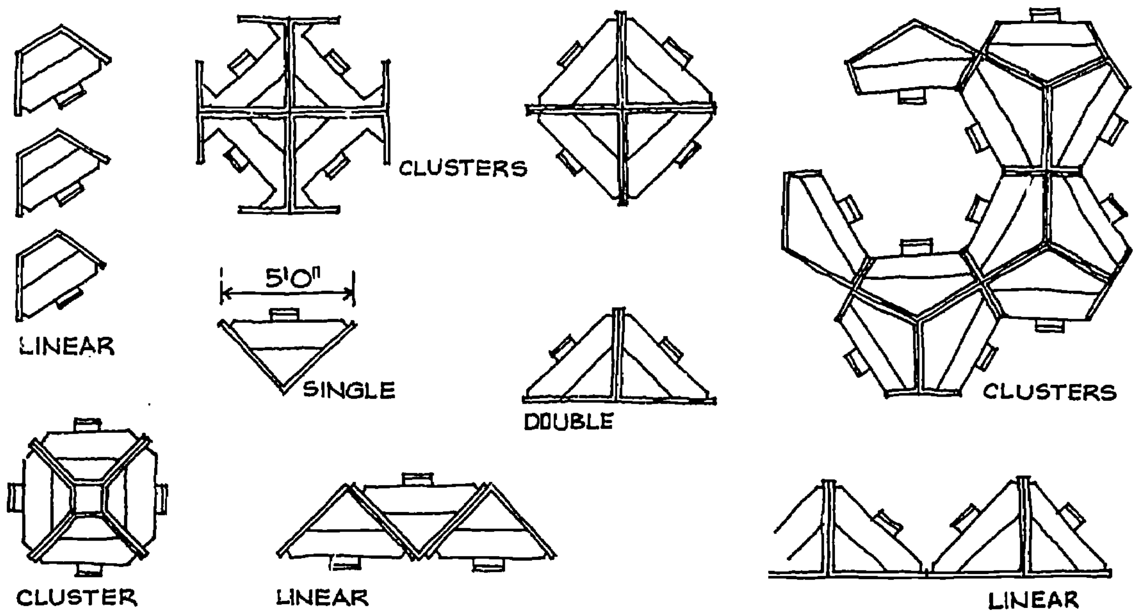
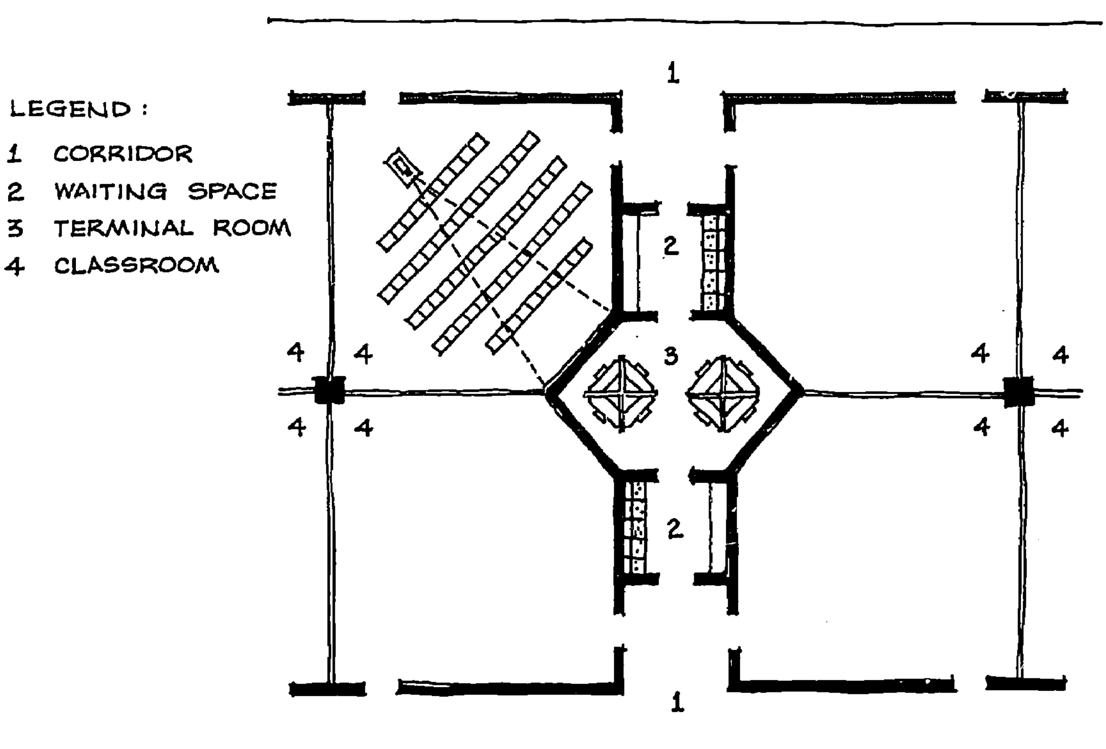


FIGURE V-8: 50 CAI TERMINALS IN VARIOUS POSSIBLE GROUPINGS



VARIOUS DESIGNS & GROUPINGS OF INDIVIDUAL STUDY CARRELS



PLAN SHOWING POSSIBLE RELATIONSHIP BETWEEN TERMINAL ROOM AND CLASSROOM CLUSTERS (NOT TO SCALE)

FIGURE V-9: WAYS OF GROUPING CAI TERMINALS

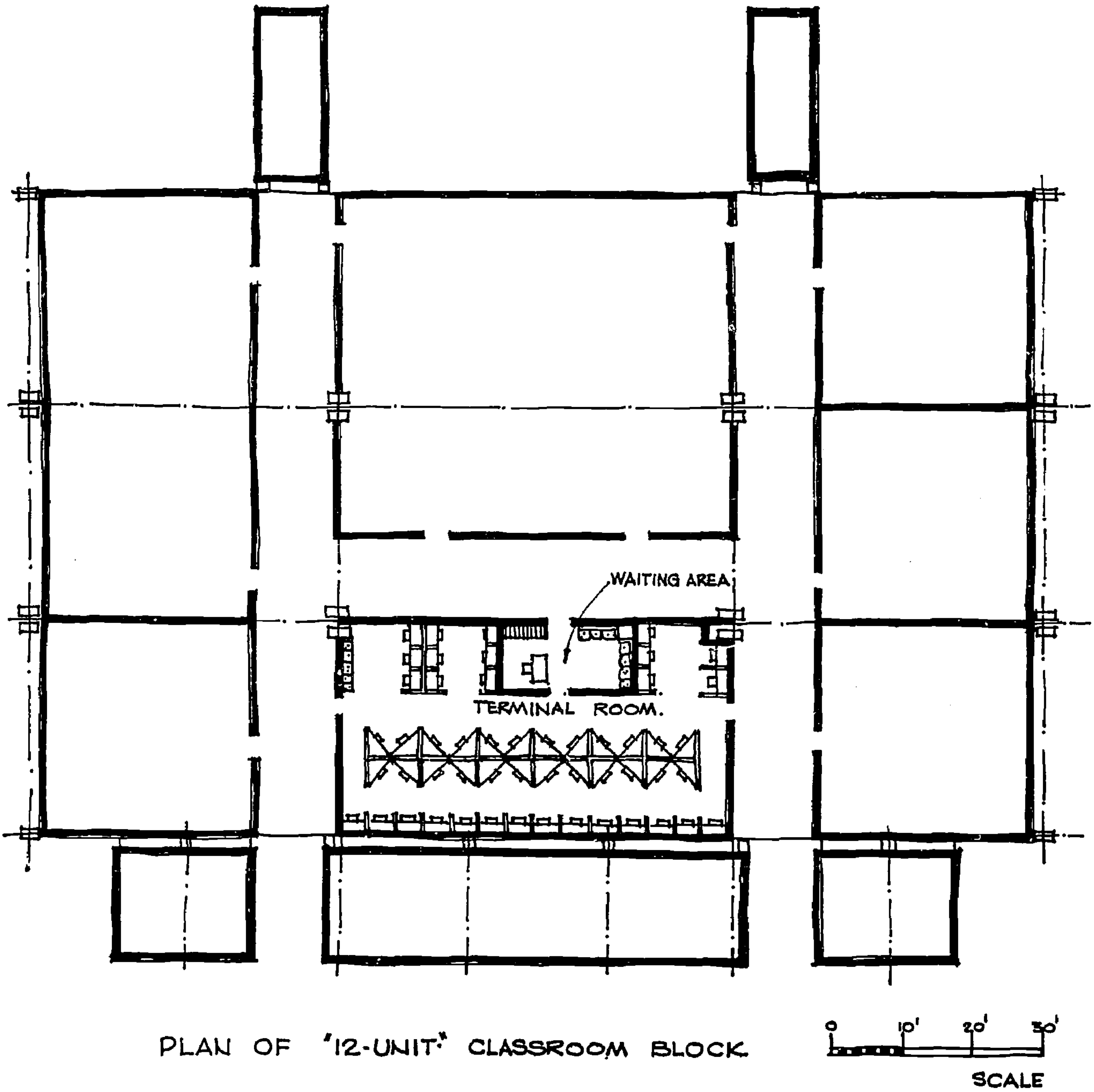


FIGURE V-10: ONE TERMINAL ROOM PER 12-UNIT CLASSROOM BLOCK

Lighting in machine rooms should provide a general level of illumination of 100 fc, with fluorescent fixtures having alternate lamps switched separately so that lower levels may be achieved. The lower level of illumination may be required if there are keyboard/display units with CRT's.

The specific location of the central or regional site within the school will depend upon several variables which are included in the following considerations.

—If the computer is to be used for administrative and maintenance purposes as well as for CAI, it should be conveniently near the personnel who will be using it for those functions.
—The location should have reasonable access to shipping and storage facilities.
—If outside personnel are to have access to the system, their entry and egress should not conflict with student traffic.
—A location near the source of power and air conditioning will usually result in a more economical installation.
—Since cable lengths between the various components of the system are usually limited, a central location for the machine area usually proves advantageous.
—The location of the machine area should be such that the area available can be increased if the system is enlarged. This is most easily achieved if the original machine area is surrounded by spaces such as offices which can easily be moved to other locations.

3. Maintenance Service Area

This area should be approximately 100-200 sq ft. It is used for the storage of spare parts, test equipment, and for the use of servicing personnel. It should be at the same floor level as the machine area or access ramps should be provided.

The machine and maintenance service area should be planned so that installation and servicing of the equipment do not constitute major problems. The size and capacity of elevators, size of doors, aisles, and window openings should be compared with equipment sizes as listed in the Data Sheets. Packaging thicknesses should also be taken into consideration.

4. Storage Areas

Sufficient space should be provided for storage of operating supplies such as paper, tape, and cards. Some storage may be housed in cabinets in the computer room itself. Other items which require storage include master document files, card files, disk, audio tape, and film cartridge files. Combustible material such as cards, audio tape, film, and paper forms should be kept in metal cabinets or other fireproof containers. Film manufacturers' recommendations should be observed for film storage.

Even if the above items are stored in cabinets inside the computer room itself, a separate storage room should be included for maintaining duplicates of master records and for security reasons.

5. Offices for Programmers and Other CAI Personnel

The number of people involved in a CAI facility will depend upon the systems options which are selected by a particular school. For instance, if software service companies are involved in the management of the instruction or if the central computer is located off premises, fewer staff will be required at the school CAI facility. Assuming that a school has its own computer and also its own CAI programming and management staff, then approximately 10 people would be required to administer and maintain the CAI facility at the school. Some of these may be teachers with other duties as well and some may be visiting staff. They would include people with skills in program content research, in programming, evaluation, and in hardware operation, all under one director who might be the media specialist.

On the basis of these assumptions, a net space of approximately 1200-1600 sq ft would suffice. The accommodation would include a conference space, offices, and toilets.

F. ENVIRONMENTAL REQUIREMENTS

The equipment at the student terminals is designed for use under normal classroom conditions. The computer, disk storage drives, etc. in the machine area require a dust-free and relatively stable thermal environment. Optimum operation occurs at about 75° F with approximately 50 percent relative humidity.

A wide range of temperature and humidity levels is acceptable. Different manufacturers recommend slightly different environmental limits for their respective systems. When the equipment is in operation, typical recommended ranges are as follows:

Temperature 60-90° F
Relative Humidity 20-80 percent
Maximum Wet Bulk 78° F

In the "power-off" condition, the temperature range may vary by an additional 20° F in either direction and the relative humidity by an additional 10 percent in either direction.

It is recommended that the the machine area be equipped with instruments to record temperature and humidity continuously. A visual or audible signal should be connected to the recording instruments to warn when the recommended environmental limits are being approached.

The same environmental conditions that exist in the machine area (computer room) should be maintained for the storage of supplies. If paper, cards, tape, etc. are stored under dissimilar conditions, they must be acclimated for about 24 hours before use.

Except as otherwise recommended by the manufacturers, the following limits should be maintained for storage of film and tape:

Audio tape: relative humidity 20–80 percent; temperature 60–90° F.
Film: relative humidity 25–60 percent; temperature below 80° F.

Air-conditioning loads for computer installations have stayed consistent over the past years for much the same reasons that space requirements have remained constant. That is to say, the net result of two opposite trends (for larger information systems with reduced requirements per unit of information processed) has been to leave almost unchanged the quantity of power and air conditioning required in typical installations. The range of these requirements is shown in Figure V–6.

The use of CAI equipment creates a demand on the air-conditioning system for cooling in excess of that normally required to maintain a comfortable environment in instructional areas. Approximate cooling loads for CAI components are shown in Figure V-6.

Referring to Figure V-8, showing a 12-classroom instructional area, the 50 CAI student stations impose a demand of 15 tons additional cooling on the HVC system. The volume of air required to satisfy this requirement will enlarge duct work, mixing boxes, and diffusers and may possibly require additional ceiling space which can only be obtained by increasing the floor-to-floor height.

Maintaining environmental control of computer equipment rooms can be effected by conventional methods using local units which take air out of the room and force it into the plenum created by the raised floor and the building floor slab. The air then circulates up through the data processing equipment before returning to the room.

Several companies manufacture air-conditioning units that are finished like the data processing equipment and visually blend into the machine room.

G. SERVICE REQUIREMENTS FOR CAI

It becomes apparent that the use of CAI and other electronic instructional media has implications on space and building systems that have not previously existed in the schoolhouse. These include additional electrical power and space for cabling between electronic system components as well as additional demands imposed on the air-conditioning and ventilation system. In the over-all planning of the academic floor area, it may be necessary to subordinate the space utilization to meet the limitations of the building system whether these limitations be inherent due to lack of built-in flexibility or due to criteria established by the design team based on economic analysis.

1. Cabling Requirements

Perhaps the most restrictive implication is that related to the cabling between student terminals and central or local control units.

It is, therefore, necessary to establish the quantitative aspect of the cabling–what type of cables, how big are they, can they be bent and pulled through conduit, what other characteristics and what considerations must be allowed for and included in the building criteria?

Generally, it is more likely that the computer would be located in a central utility area, and would function not only for instructional programs, but also for processing administrative programs such as scheduling, payroll, purchasing and maintenance. It is therefore to be anticipated that extensive cabling would be necessary between the central computer and student terminals on the academic floors, and possibly in other areas such as social-study spaces.

The cabling requirements of the more sophisticated CAI systems may impose limitations on the arrangement of student terminals and require the juxtaposition of terminal groups and control equipment area (see Fig. V-12). It has been suggested that local cabling problems at the student terminals can be overcome by locating a line connector or cable splitter at the heart of a cluster and then running the large cables within the cabinet work (see Fig. V-13). A further advantage of the cluster design approach is that the lighting in that area may be controlled to a level adjusted to suit the task.

2. Types of Wiring and Cabling

Comptuer system wiring and cabling can be separated into the following three classifications.

2. *Electrical Power Conductors*. Electrical power for computer, peripheral equipment, and student terminals will generally be at 120/208 volts three phase 4 wire 60 Hz. Wiring for computer equipment is usually provided up to a point close to the equipment served, terminating in a special receptacle. The computer equipment is provided with a cable that plugs into the receptacle. The necessity for large size conductors exists only at the central and/or satellite computers; the terminal equipment requires only 20 ampere/circuits of #12 AWG building wire.

b. *Low voltage multi-conductor or coaxial cables*. Information flows between system components through multi-conductor cables or coaxial cable. The multiconductor cables are similar to cables commonly used on public telephone systems, the dimensions of which, of course, depend upon the number of conductors. As an example, the diameter of the largest cable in the IBM 1500 Instructional System is 1-1/8 in o.d., with a bending radius of 4 in. All other cables have a bending radius less than 4 in.

Coaxial cable, used for video signal transmission, is commonly the thickness of a pencil. Multi-conductor cables are jacketed over-all with PVC or a similar plastic material and, in common with coaxial cables, require a measure of protection from mechanical injury. It is not mandatory to run these cables in conduit, though in some localities it is a requirement of the electrical code.

c. *Communication cables*. Communication cables between remote system components are generally single pair telephone lines commonly provided by the Bell Telephone System over Dataphones, and are leased by the user. Dataphones present an opportunity to tap into other central computer locations and possibly use other CAI programs which are not available at the local CAI installations.

3. General Methods of Wiring and Cabling

There are three requirements which govern the available methods of routing wire and cable between computer system components. They are: (1) Electrical codes do not permit power conductors to share the same conduit, trench duct, or floor cell with communication and signal cables; (2) They also require that the system be grounded at all points, which is usually accomplished through a system of continuous metallic raceways, grounded at the building main service (all raceways, including cellular flooring, used for electrical wiring must therefore have a U. L. label of approval for this usage); and (3) A common requirement for all wiring and cabling is that of protection against physical damage. Methods of routing wire or cable between computer system components are:

(1) floor trench, Figure V-14,
(2) raised floor, Figure V-14,
(3) cable ramp, Figure V-15,
(4) underfloor raceway, Figure V-15,
(5) cellular floor, Figure V-16,
(6) ceiling space,
(7) wall raceway

In each method, it is necessary to ensure that the cables are not subjected to mechanical damage, are not bent at a radius small enough to cause insulation breakdown, and are installed with sufficient flexibility for removal and relocation of system components. The decision as to which method should be used should be based on the adaptability of the building systems and the degree of flexibility required by the user.

4. Cabling for Typical Computer Systems

The extent of cabling required for different systems is shown in Figures V-17, V-18, and V-19 for a possible arrangement of a typical 12-unit classroom block with 50 student terminals.

5. Electrical Power Requirements

A typical computer system requires electrical power at a frequency of 60 Hz and at a voltage of 120 or 208 volts ± 10 percent. This is available in most buildings, as the voltage drop on a typical system will not exceed 4 percent. Frequency is controlled by the utility company and would normally be maintained within the required frequency band. However, in cases where the building power fluctuates in excess of plus or minus 10 percent, a separate transformer or motor alternator may be necessary.

Power to student stations may be supplied from the normal lighting and power system. Terminals and standard building loads should not be connected to the computer distribution system.

Quantitatively, a CAI system may impose demands that a conventional school cannot satisfy. Installation factors include the following electrical power requirements:

Student station	0.5 – 1.0 KW
Control or communication unit	1.0 – 5.0 KW
Central computer room	6.0 – 20 KW

Consider a typical academic area 90 ft by 140 ft as shown in Figure V-8 with 50 CAI student stations. It is quite probable that all stations would be utilized simultaneously, imposing an added maximum load of 50 KW or 4 watts per square foot of over-all floor area. This load is in addition to other power requirements on that floor for such activities as movie projection and electrical typewriters.

A floor with 50 student stations would also require a control unit (or satellite computer) with electrical power requirements of 5 KW. The over-all implication is that the electrical power distribution system must be designed with provisions for an additional demand on the air-conditioning system, and the credibility of such a demand must be carefully studied (see Environmental Requirements).

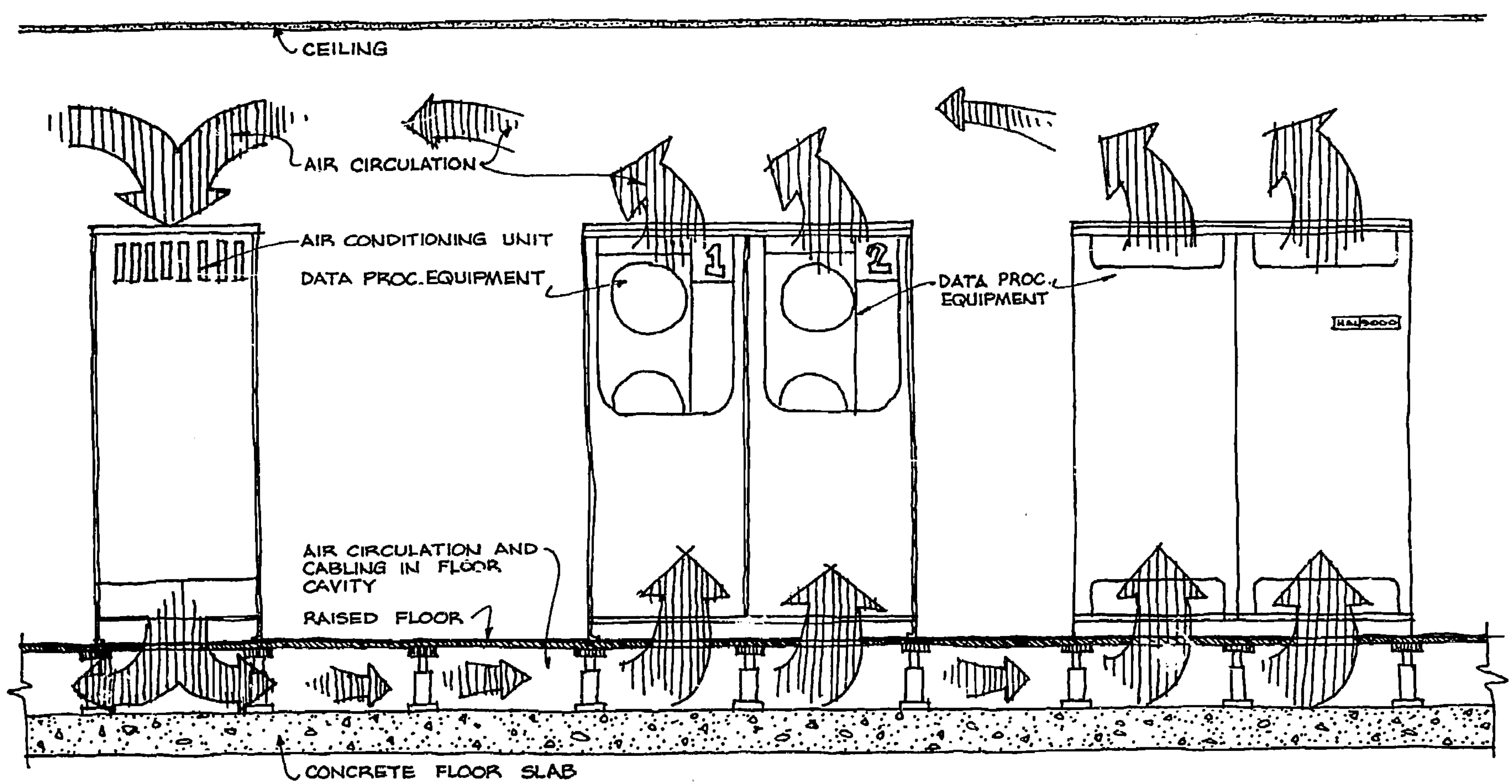


FIGURE V-11: USE OF RAISED FLOOR FOR COOLING DATA PROCESSING EQUIPMENT

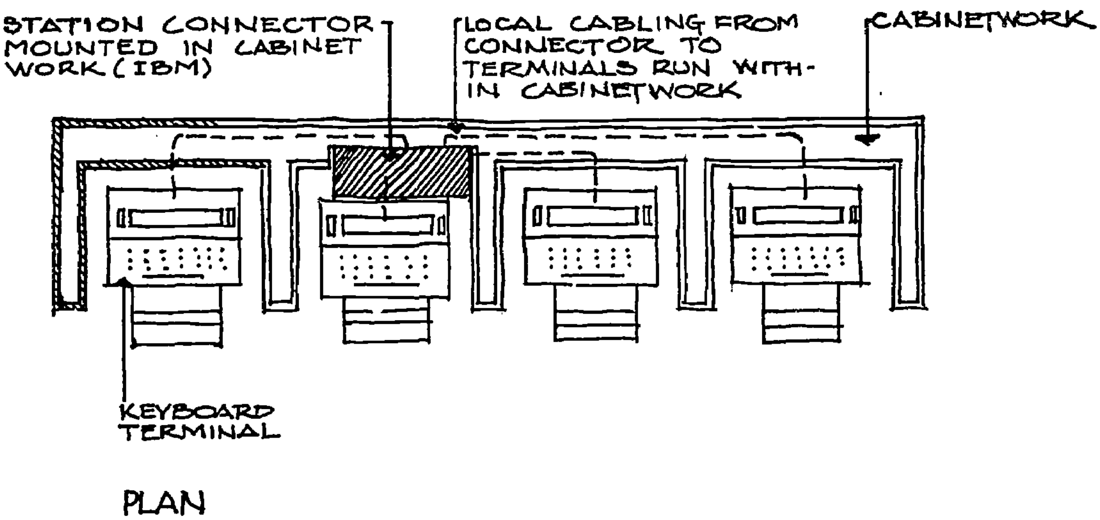


FIGURE V-12: LOCAL CABLING OF CAI TERMINAL

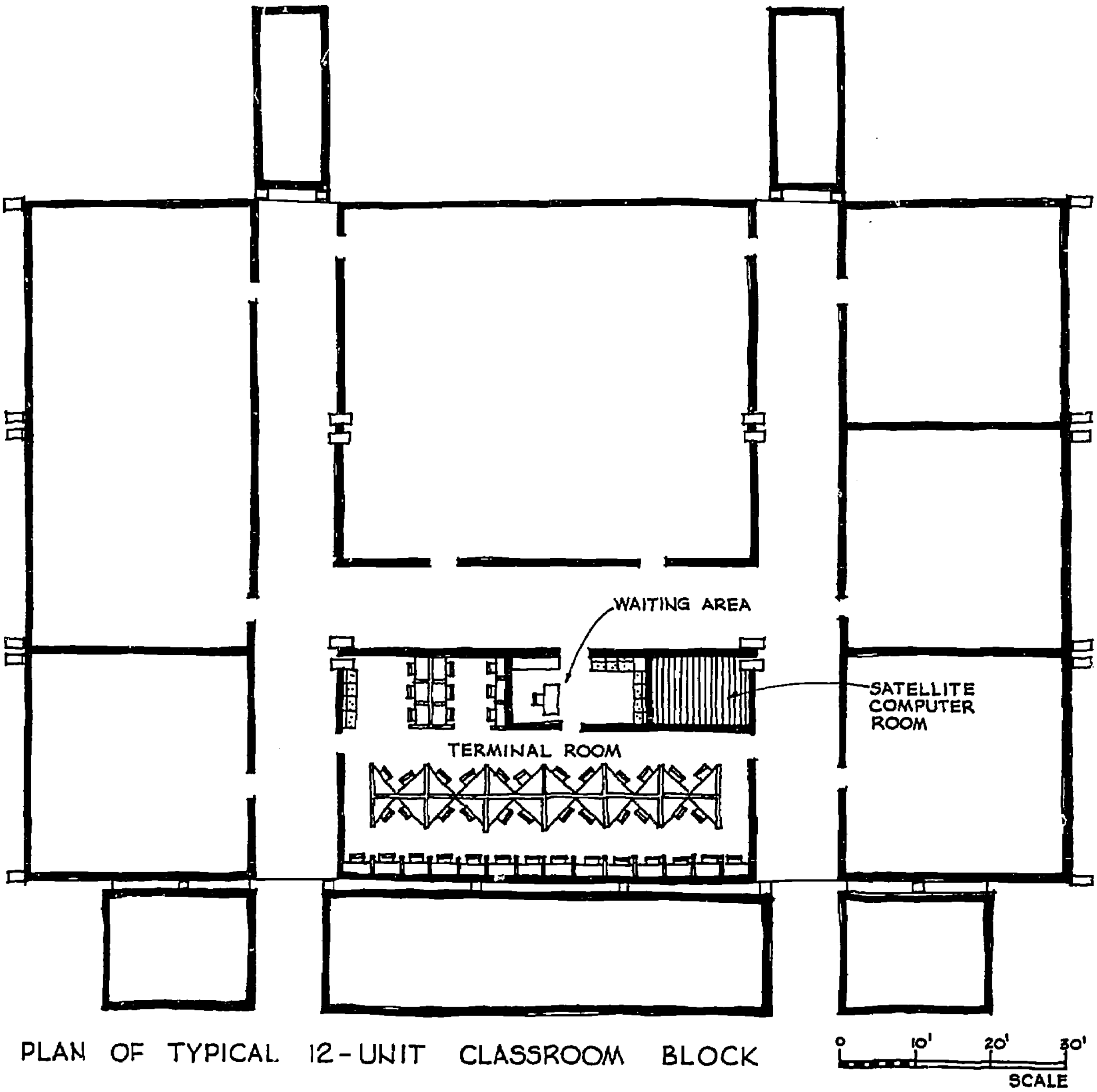
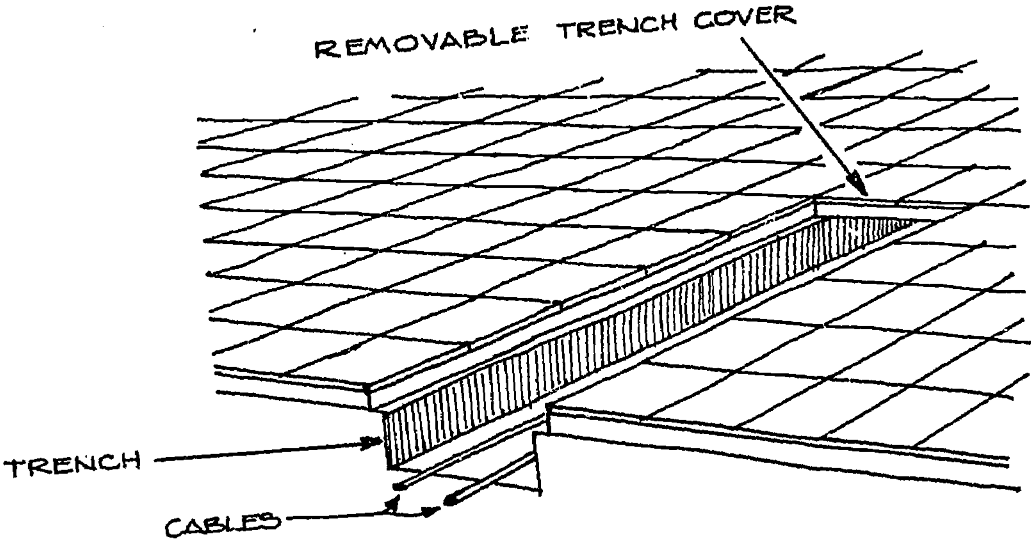
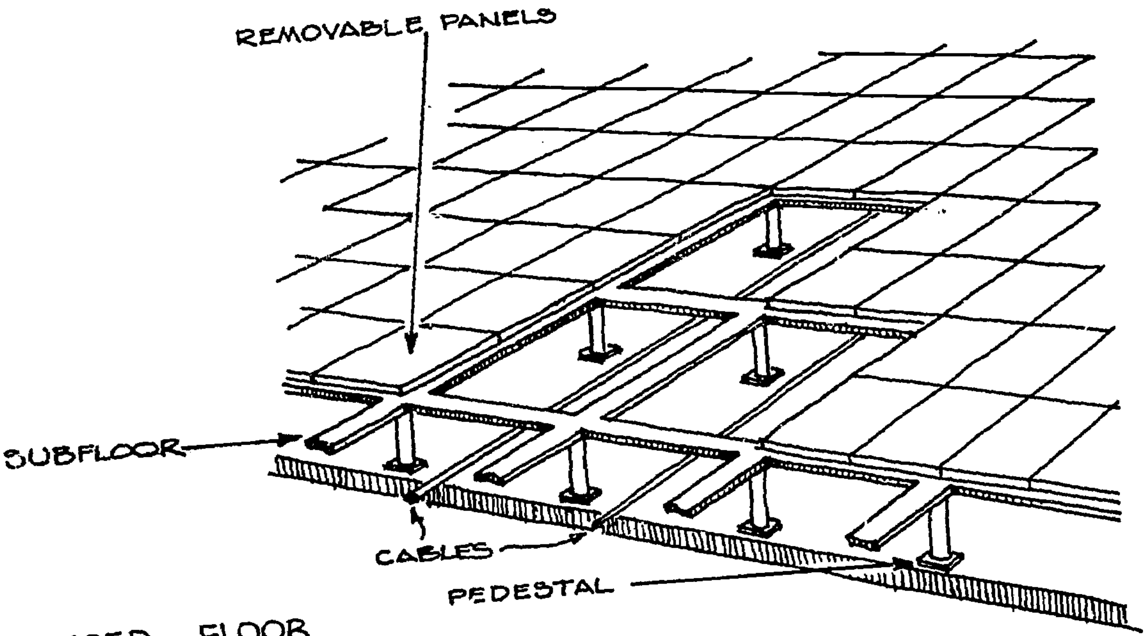


FIGURE V-13: SATELLITE COMPUTER ROOM ADJACENT TO TERMINAL ROOM TO FACILITATE INTERCONNECTION CABLING

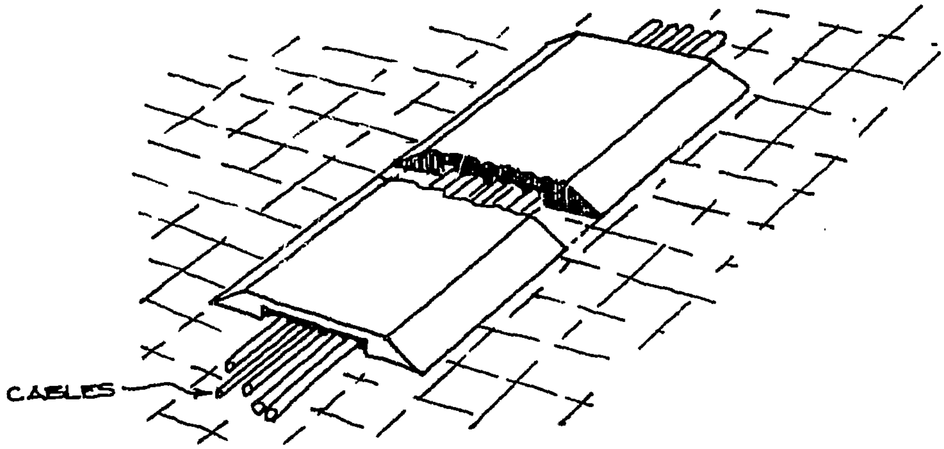


FLOOR TRENCH

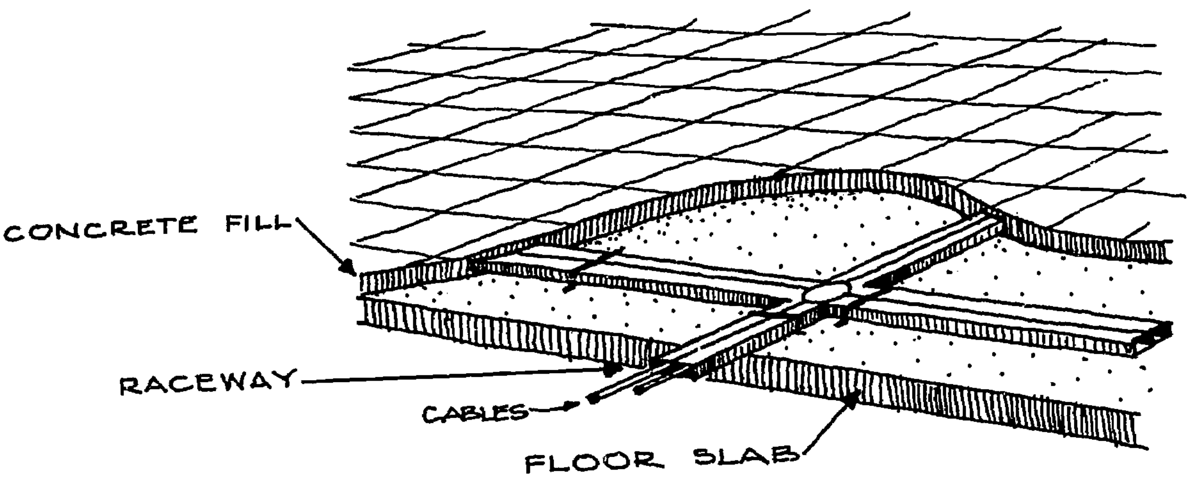


RAISED FLOOR

FIGURE V-14: METHODS OF ROUTING WIRING AND CABLING (1): FLOOR TRENCH AND RAISED FLOOR

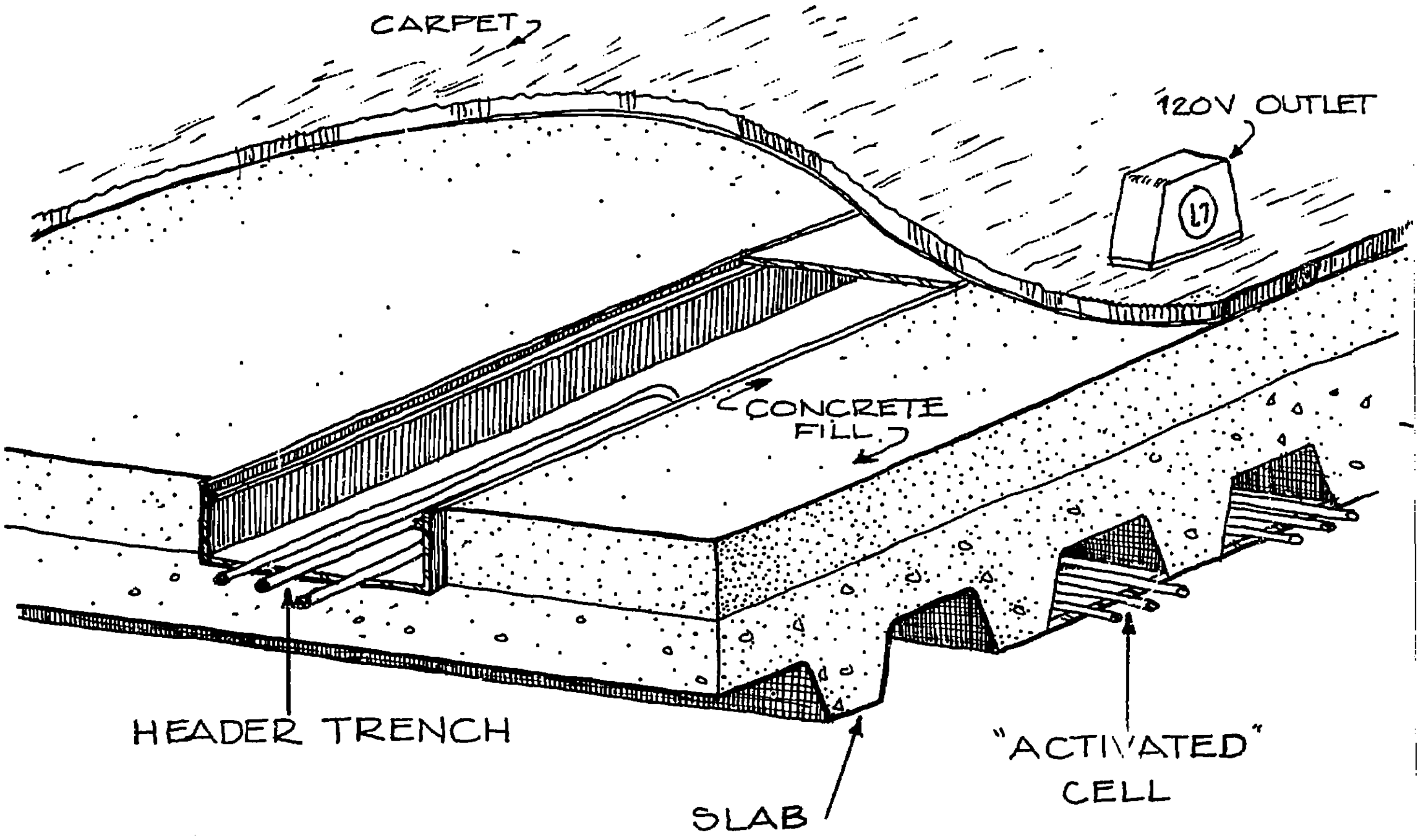


CABLE RAMP



UNDERFLOOR RACEWAY

FIGURE V-15: METHODS OF ROUTING WIRING AND CABLING (2): CABLE RAMP AND UNDERFLOOR RACEWAY



TYPICAL CELLULAR FLOOR

FIGURE V-16: METHODS OF ROUTING WIRING AND CABLING (3): CELLULAR FLOOR

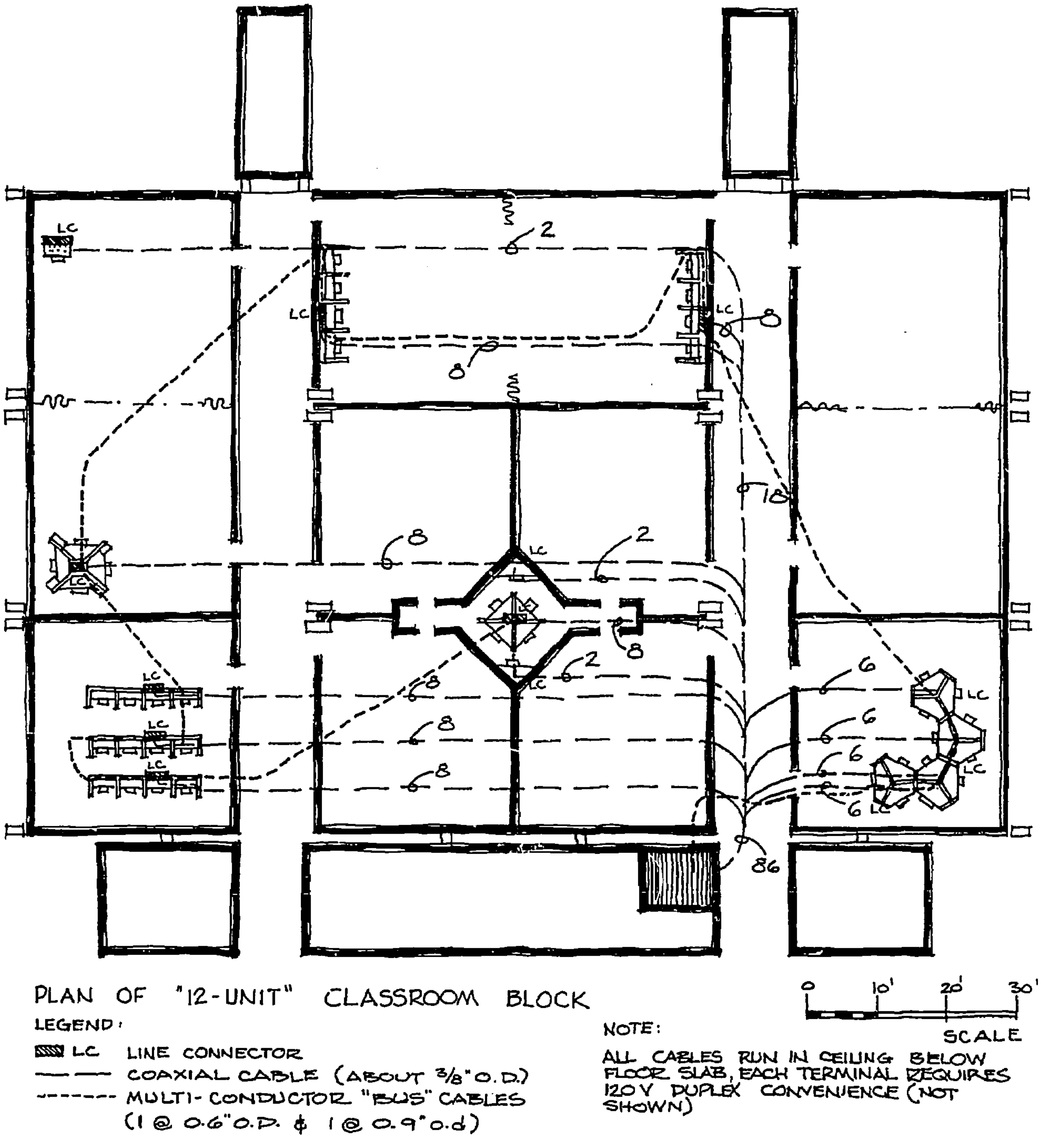
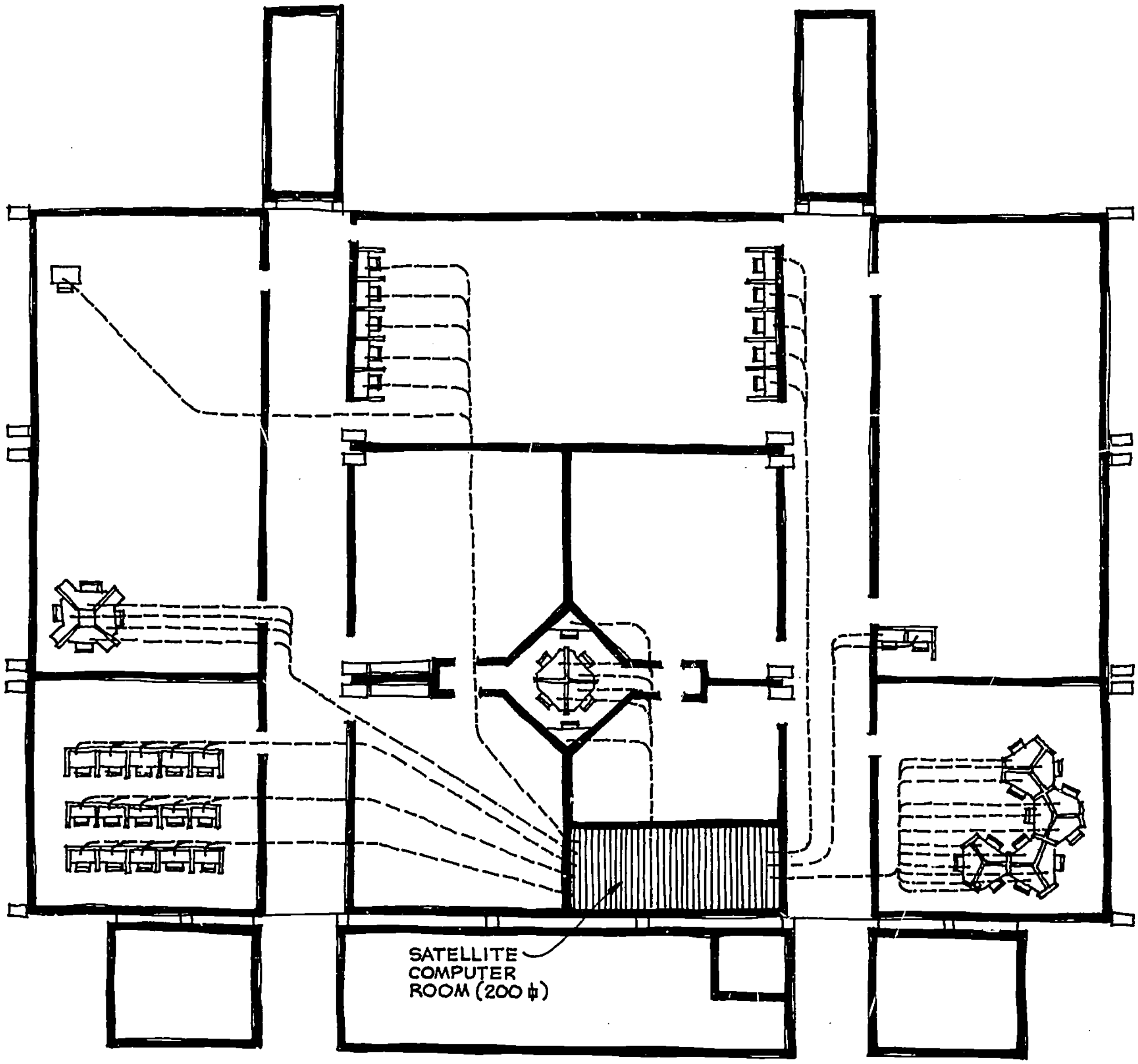


FIGURE V-17: CABLING FOR 50 IBM TERMINALS

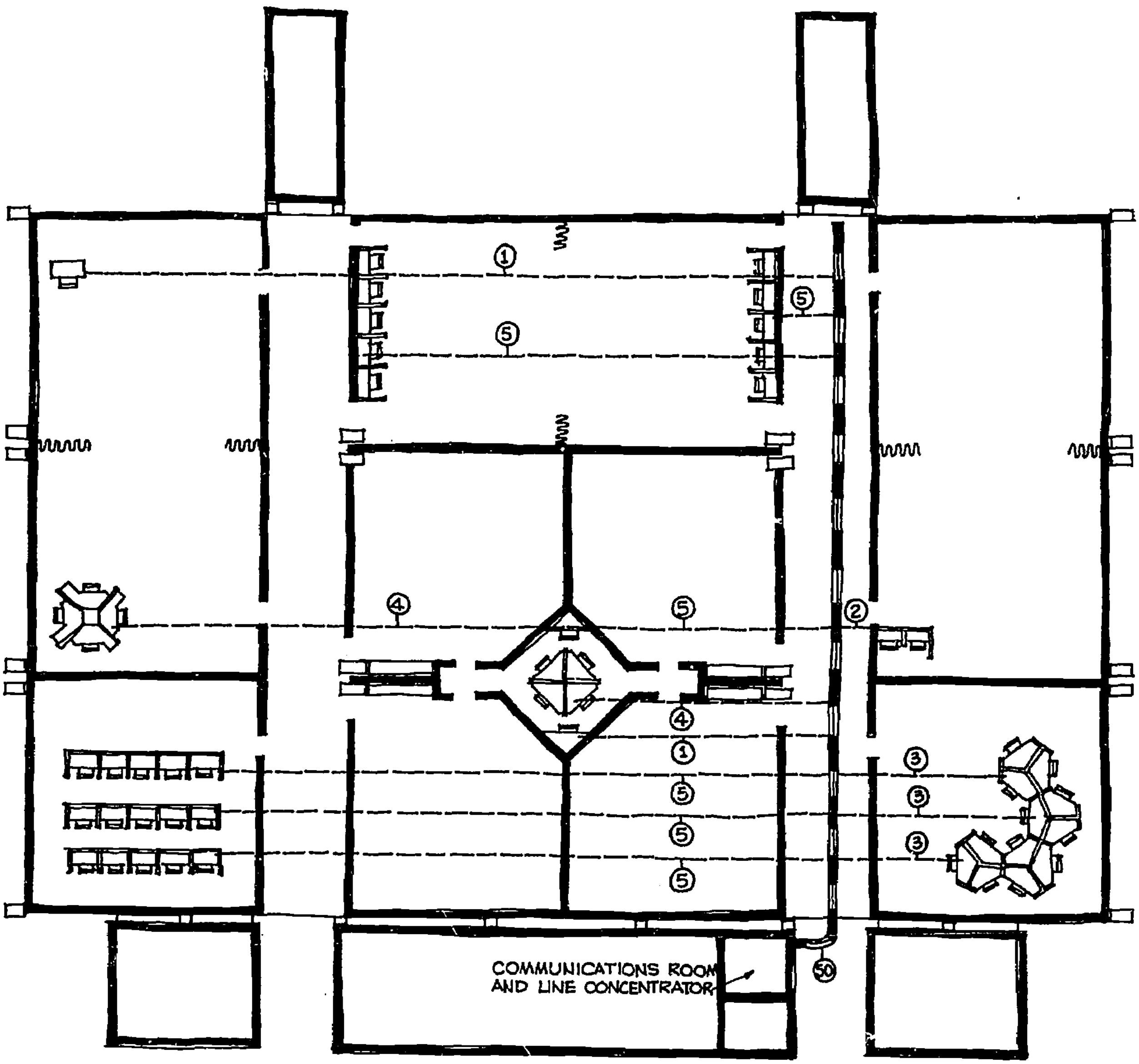


PLAN OF TYPICAL 12-UNIT CLASSROOM BLOCK

LEGEND:

------ CABLE TO EACH TERMINAL FROM SATELLITE COMPUTER ROOM – ONE MULTI-CONDUCTOR CABLE (5/8" O.D.) AND ONE COAXIAL CABLE (1/4" O.D.) TO EACH TERMINAL. DUE TO QUANTITY AND DENSITY, ALL CABLING WOULD BE RUN IN CEILING SPACE BELOW FLOOR.

FIGURE V-18: CABLING FOR 50 PHILCO-FORD TERMINALS (NOTE SATELLITE COMPUTER ROOM)



PLAN OF "12-UNIT" CLASSROOM BLOCK

0 10' 20' 30'
SCALE

LEGEND:

TRENCH DUCT (SEE PAGE 5/40)

(5) SINGLE PAIR TELEPHONE CABLES (3/8" O.D.) RUN IN CELLULAR FLOOR. (5) INDICATES 5 CABLES.

NOTE:
120 V RECEPTACLE REQUIRED FOR EACH TERMINAL.

FIGURE V-19: CABLING FOR 50 RCA "DRILL AND PRACTICE" TERMINALS

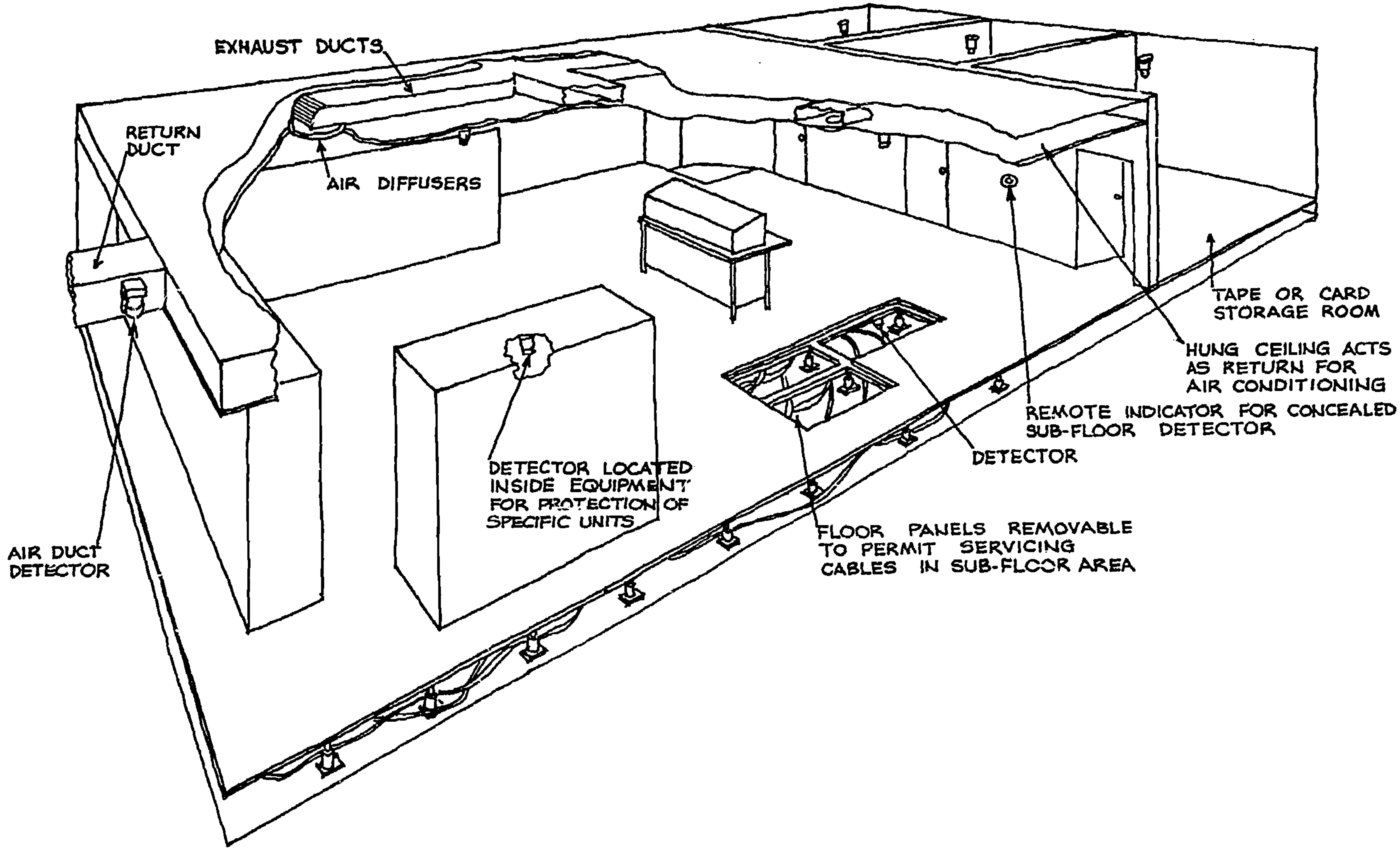


FIGURE V-20: TYPICAL PROTECTION FOR COMPUTER ROOMS

The possibility of 50 student stations on an academic floor of 12 classrooms may be economically impractical over the next 20 years. Educators may decide this number is too great for the possible student density. Electronic engineers expect technological breakthroughs which will reduce the energy consumption and heat dissipated from terminal equipment. Would all terminals be in use at one time or would there be a diversity factor? As one of the major obstructions to the early and widespread use of CAI is cost, it must be assumed that student stations would be utilized on a full-time basis.

Advice from the computer industry is that, while technological advances have over the past few years drastically reduced the space, power, and air-conditioning requirements, this has been accompanied by a significant increase in the amount of data processing capacity required by the user. It would seem that the projection of requirements in 10–20 years cannot produce a lesser quantitative requirement than that for 1968 equipment, if the history of computer engineering is to be used as a criteria. To the puzzled layman, this means that while the electrical energy requirements of a student station may decrease significantly in the next few years, the desirability, and therefore, number of stations used, will increase proportionately.

The need for a source of emergency power to operate computer equipment in the event of commercial power failure is problematical. Student terminals are connected to the standard building distribution system, and unless there would be sufficient standby power to allow the school to continue in operation, it would be futile to continue operating the computer equipment. However, as is most probable, the central computer will have functions other than CAI, and these administrative and maintenance tasks may require a standby power source to ensure an uninterruptable operation.

In this event, all electrical loads that are vital to the computer system operation must also be supplied by emergency power. These include machine and storage room lighting and air-conditioning units.

The central and satellite data processing and control units should have a "special" power feeder, terminating in a distribution panel in the machine room. This "special" power feeder should come directly off the building main switchboard bus and should not serve any other loads. In this way the computer equipment is not affected by line transients and voltage variations that would occur if it were not isolated from other building loads.

H. FIRE PROTECTION

It is recommended by computer manufacturers that carbon dioxide fire extinguishers should be readily available in the machine room. The fire extinguishers should be light enough for easy handling and should be displayed where they can be seen easily. An automatic fire and smoke detection system should also be installed in the machine room to give audible warning at the commencement of a fire. A recommended system uses ionization type smoke detectors in the underfloor plenum and on the ceiling near exhaust diffusers.

I. APPROXIMATE COSTS

One of the first concerns of the potential user is the cost of computer assisted instruction. Costs are difficult to determine since much more than the hardware costs are involved, and the inherent benefits are almost never taken into account. The following list enumerates some of the factors which should be taken into account when estimating the CAI costs:

—Equipment rental charges for computer and related equipment;
—Cost of programs and other software. It has been estimated that 50 percent of the cost at a computer installation is software development and maintenance. Hardware manufacturers many times supply part of an installation's software needs. The cost of this software is included in the hardware price;
—Cost per student terminal;
—Wiring and cabling costs;
—Transmission line charges, including data sets;

—Back-up costs of programmers and other personnel;
—Other maintenance and operation costs including increased loads for air conditioning, etc.

The total of these costs can be evaluated as a percentage of the school budget or as a dollar cost per student per hour. The latter cost does not reflect the possibility that much more may be accomplished in a CAI hour than with traditional teaching.

Costs per student per hour have been variously quoted or estimated as \$.80–\$1.00 or \$1.40 or \$2.00 or \$3.73.

The discrepancies between the various figures are probably due to the factors chosen for consideration. In any event, the costs are meaningful only when compared with those quoted for traditional teacher assisted instruction (TAI), which is estimated as \$0.27/student/hour as a national average at the elementary school level (almost twice as much in California), and as \$0.36/student hour at the elementary and high school level on a national average. No matter which figures are used, it is obvious that the cost of computer assisted instruction is currently several times more than the cost of traditional instruction.

The present equipment costs of a CAI installation can be illustrated by the rental charges paid by the New York school system for an RCA installation, where each of 15 schools has been provided with 12 terminals all connected to one remote computer. These charges are listed below. It should be noted that rental fees can be charged against functions other than CAI. The latter would not be in operation for longer than eight hours a day, leaving two other shifts of eight hours each during which the computer could be utilized for other purposes. For instance, one shift of each day could be used for routine school data processing for the 200,000 school population involved. The second unused shift could support either adult evening education or could be sold to a computer-time sales broker.

Taking these possibilities into account, the equipment costs attributable to CAI can be determined on the basis of the three following options:

Option A.	The computer is not put to any other use during the day; therefore, the total equipment cost is charged against CAI.
Option B.	The computer is used for one other shift during the day (e.g., data processing) but is not used during the other remaining shift; therefore 2/3 of the total equipment cost is charged against CAI.
Option C.	The computer is used for purposes other than CAI during two shifts (16 hours of the day); therefore only 1/3 of the total equipment cost is charged against CAI.

The cost implications of these three options are as follows:

	Option A	Option B	Option C
Equipment Rental/Month	62,500	62,500	62,500
Equipment Rental/Year	750,000	750,000	750,000
Equipment Rental Allocated to CAI/Month	62,500	41,667	20,833
Equipment Rental Allocated to CAI/Year	750,000	500,000	250,000
Equipment Rental/CAI Hour	625	417	208
Cost/Terminal/Year	3,750	2,500	1,250

Cost/Student/Year	125	83	42
Cost/Student Use	0.52	0.35	0.17

The figures relating to the cost/student are based on the assumption that 6,000 students will be serviced by the CAI facility, each of them for 10 minutes per day on the average. The number of terminals is assumed to be 200 and the number of hours of student use is assumed to be 5, leaving 3 hours of the CAI shift available for teachers' daily reports and the priming of the system for the following day's activities.

These costs cover only the rental of the terminals, four line concentrators (@$5,000/month each), and the central processor (@$20,000/month). If 16 hours/day of the computer's time were actually sold by the New York school system's CAI facility for school data processing or to a computer-time sales broker, the income from these sources could be credited against the cost of CAI. (Apparently the RCA Spectra 70 computer time is marketable for about $300/hour and routine school data processing on the computer has been successfully billed in the past at $4.50 per year per student.)

The figures given in this section should illustrate the extent of the costs which may be expected with a typical CAI facility. It should also be remembered that the cost of CAI is a continuing expense rather than a capital investment. In any event, it is apparent that the costs of CAI are considerable and the benefits to be derived from its use not yet fully confirmed. Most school systems would be hesitant to invest in CAI unless they could rely on federal or state assistance to finance a CAI installation. According to the President's Science Advisory Committee, however, "there is some evidence that some communities and school boards have been liberal in financing computers and computing in secondary schools" (not in remote or underprivileged areas, however). The Committee recommended that university centers should be encouraged to provide service to secondary schools at the same time that the Office of Education investigates the best ways of introducing the use of computers into secondary school education.

Chapter VI

STUDENT RESPONSE SYSTEMS

A. DISCUSSION

Student response systems have come into being primarily to overcome certain problems related to current teaching practices. One of these is the increasing size of classes and the resulting decrease in contact between individual students and the instructor. A second problem is the diminished opportunity for two-way communication, imposed by room-darkening during filmed lessons or by the difficulty of interrupting a film or television presentation at those times when student response may be desirable.

In the past, with traditional teaching methods and small classes, it was possible for an instructor to know whether or not he had managed to convey the lesson material effectively or if any particular student was having difficulty with the lessons. With large classes this feedback has become almost impossible except with devices such as those comprising student response systems.

Student response systems are designed to facilitate contact and immediate feedback from the students. The hardware consists essentially of an instructor's console which registers responses and small student responder units located at each student station (see Fig. VI-1).

The system can be used in conjunction with many presentation techniques, such as TV, film, or live lectures. It can also be used for many purposes, such as student testing, evaluation of the effectiveness of lesson material, and immediate detection of those students who are having problems and require special attention. In general practice, the instructor reads or projects a question and each student answers by pressing one of five buttons. The individual response and cumulative totals or percentage of each response are registered at the instructor's console.

Because of the range of purpose and techniques with which these systems can be used, they may be found in many different types of learning spaces. They are most commonly found in large-group lecture halls equipped for multi-media presentation, but they may also be integrated into auditoriums or typical classrooms or even into individual study carrels if these are equipped with the nececessary cables. It is also possible that the system could be entirely mobile, if it were acceptable for the connecting cables between student responder units and the instructor console to be temporarily exposed.

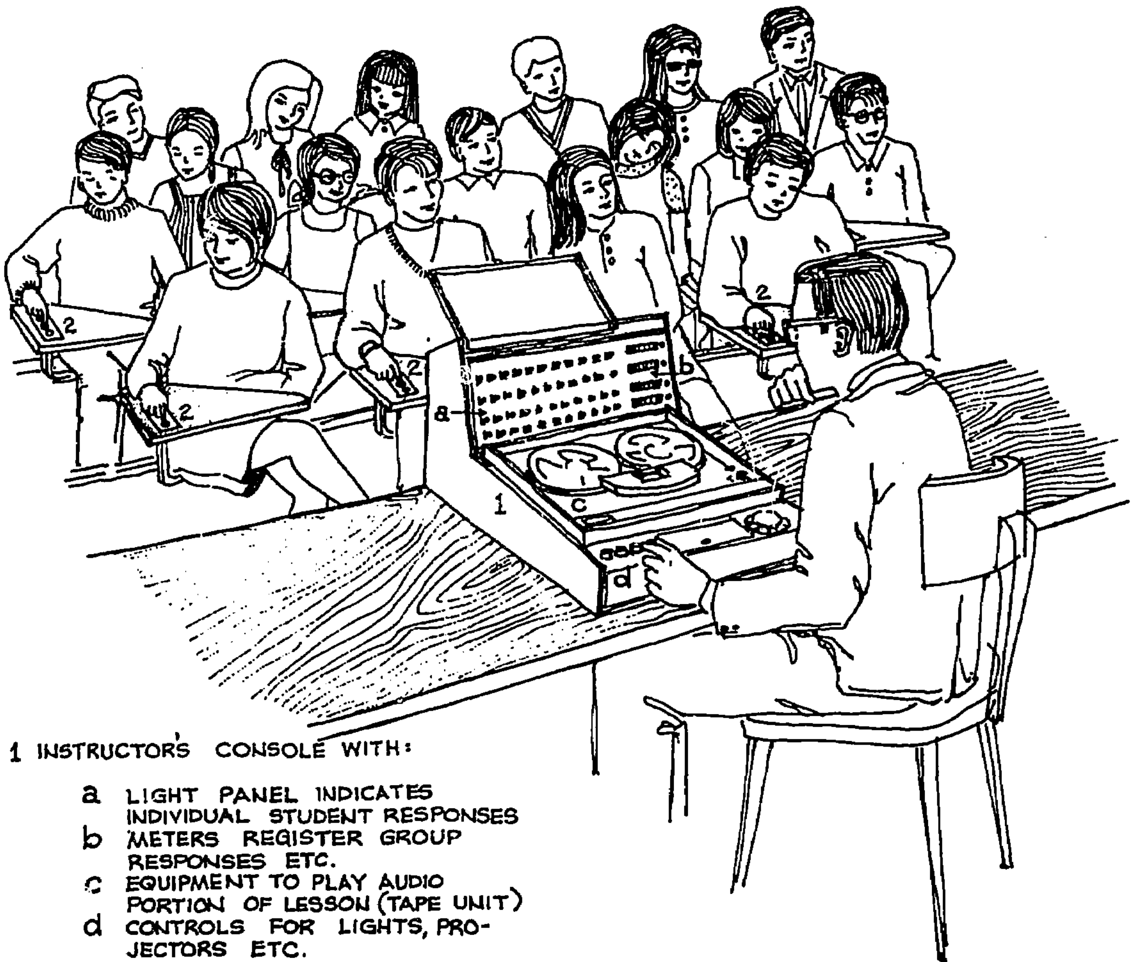


FIGURE VI-1. STUDENT RESPONSE SYSTEM

B. EQUIPMENT

1. Responder Unit

The responder units are devices which are usually small enough to be held in the hand. They are equipped with four or five push buttons, switches, or dials or other means of selecting a response from several choices. The units may be hand-held or desk mounted or fixed to the arm (or tablet arm) of the student's chair and may be either flush or surface mounted. The student responds by selecting one of the push buttons, and his response is displayed at the instructor's console.

2. Instructor's Console

Typically there are two or more meters at the instructor's console—one to register the number of students responding and another to register the number of corrrect responses. Besides the meters, there is also usually an array of indicator lights to represent each student station so that the instructor can see which particular students do not have the right answer.

Other features which can be integrated into the instructor's console include multi-media (film, filmstrips, slides) projector controls and audio tape recorders.

3. Other Optional Equipment

Many systems also include equipment which automatically records the student responses for later diagnosis, and one offers an interface with a remote time-sharing computer for automatic analysis of the responses.[1]

The following brief descriptions of specific systems indicate the variety of components which may be found under the generic term of student response systems.

C. SPECIFIC SYSTEMS

1. MATA (Multiple Answering Teaching Aid) Responder System made by Alda Instruments Ltd.

This system is fairly typical except that it comes in both a standard and a mobile model. The latter has the advantage of being usable in any learning space. The instructor's console which is on wheels has space below for storage of the student response units and on the side for the connector cables. When the system is in use, the cables are temporarily laid on the floor, and the desk-top responder units are handed out, one to each student.

The system comes in three sizes; for 20, 30, and 40 students. It operates on a normal 110 volt, 60 cycle electric outlet.

Student responder units are equipped with four color-coded, numbered, and lettered buttons, each of which is connected to a corresponding colored light at the instructor's console. The instructor can also activate a "right-answer" light at the student unit. This direct feedback in two directions serves as reinforcement in the learning process and is apparently very effective.

Another feature of MATA is a receptacle for a 25 ft remote control cord which enables the instructor to move away from the console while conducting the class.

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[1]General Electric Research and Development Center, Schenectady, New York.

2. Aetna Drivocator

This is a training system to teach students to drive an automobile. (Some other systems use a simulated car, e.g., Driver-Trainer manufactured by Raytheon. This has been described on page 47.)

The Aetna Drivocator is manufactured by the Raytheon Company. It consists of multi-media projection (filmstrip, projector, sound, motion picture projector, and projection screen) combined with a student response system. The student responds to questions posed on the prepared film media. His responses are recorded on the instructor's console for evaluation. The student response equipment is the same as that described below.

3. Raytheon (Edex) Response Learning System

There are three variations of the Raytheon System: a communicator system, a multi-media control system, and a large-group response system. General Electric and other manufacturers also make similar responder systems.

a) *The Communicator System* is a classroom response system. Student response units consist of 5 push buttons and are located at each student position. The instructor's console is a desk-top type device called a "Communicator console." It is equipped with a panel of indicator lights—each light represents a student station. Other optional features include meters to register group responses and devices to count individual scores.

b) *The Multi-Media Control System* integrates the Communicator System with automatically programmed audio and/or visual materials. (The Drivocator described above is a multi-media control system which limits the audiovisual materials presented to those simulating driving conditions.)

The control console for this system includes the regular Communicator System equipment and also includes a 2-track audiotape unit and controls for one or more filmstrips, slide, or 16mm sound motion picture projectors. The two tracks of the tape unit carry the audio portion of the program and the inaudible directions which control the multi-media presentation.

Rear screen projection, overhead projectors, and television can be integrated with the system though these are not standard components.

The manufacturer also "offers" the services of its staff for the preparation of program material and the planning of the installation.

c) *The Large Group Response System.* This system extends the number of students which can be served to almost 1,000 per auditorium with up to four auditoriums in close proximity. To serve this number of students, a "data acquisition and recording system" is integrated with the multi-media control system described above.

The data acquisition and the recording system replaces the light panel and records information such as attendance, individual responses, and scores onto tape (paper or magnetic). This information can then be fed into a computer.

The multi-media system is also extended for large groups so that it includes facilities for closed circuit TV as well as film projection.

APPENDIX I

GLOSSARY

This glossary is intended to inform the reader of the meaning of the most commonly used technical terms which may be found in the literature dealing with electronic teaching aids. The terms derive mainly from technologies relating to communications, television, computers, and education.

ACCESS TIME: Time required to obtain information from computer storage (read-time), or to put information away in storage (write-time).

ADDRESS: A number that identifies one of the memory locations in the memory section.

ANALOGUE COMPUTER: Device using voltages, forces, fluid volume, or other continuously variable physical quantities to represent numbers in calculations. Contrasted with digital computer.

ASSEMBLER: A computer program which operates on a symbolic input data to produce from such data machine instructions. Synonymous with assembly routine, assembly program, and related to compiler.

ATTENUATION: The difference (loss) between transmitted and received power during transmission through equipment, lines, or other communications media.

AUDIO: The sound portion and related equipment of any communications system. Depending upon the type of television system in use, audio may be transmitted either over the same signal carrier with the television impulses or may be a completely independent system.

AUDIO DUPLICATING SYSTEM: Equipment designed primarily for the duplication of audio tapes, or placing information from a number of tapes onto a single tape.

AUDIO-VIDEO MIXER (MODULATOR): An electronic component of an RF (radio frequency) transmission system that combines (or "modulates") the separate audio and video signals from microphone and camera respectively into a single high frequency signal for transmission to the receiving equipment where the signals are again separated and directed to the speaker and screen.

BANDWIDTH: (1) The frequency range of a specific signal being transmitted. Each United States broadcast television channel covers 6 megacycles for both audio and video.
(2) The difference, expressed in cycles per second (or hertz), between the highest and lowest frequencies of a band, or part of a channel. Determinant of amount and quality of information which can be passed per second.

BINARY DIGIT: Often abbreviated to bit. The smallest unit of information in a binary system of notation. It is the choice between two possible states, usually designated one and zero.

BRANCH: The selection of one or two or more possible paths in the flow of control based on some criterion. The instructions which mechanize this concept are sometimes called branch instructions; however, the terms transfer of control and jump are more widely used.

BROADBAND: A term applied to facilities or circuits whose bandwidth is in excess of that required for high quality voice communications.

BROADCAST: The "open circuit" transmission of either radio or television signals through the air at frequencies which can be received by appropriate equipment within range of the transmitter. All broadcasting is regulated by the Federal Communications Commission.

CABLE: Assembly of electrical conductors in a common protective sheath arranged to permit the conductors to be identified for use singly or in combinations.

CAI: Computer-assisted instruction, which see.

CAMERA CHAIN: One or more cameras with associated electronic devices as needed to transmit a television picture.

CAMERA (TV): In television, that device which by utilizing an optical system, a light-sensitive electronic tube, and an electronic scanning device converts a visual image into electrical impulses.

CARRIER: High frequency electrical signal suitable for modulation by an audio or other intelligence signal. The resultant modulated signal can then be transmitted over a communications facility.

CARRIER WAVE: The basic frequency or pulse repetition rate of a signal, bearing no intrinsic intelligence until it is modulated by another signal which does bear intelligence (e.g., audio signal). A carrier may be amplitude, phase, or frequency modulated.

CHANNEL: (1) A path for electrical transmission between two or more points. Also called a circuit, facility, line, link, or path.
(2) A range or "band" of frequencies assigned for the transmission of communication signals; in television it is the group of frequencies comprising the transmitted visual (video) and sound (audio) signals.

CLOSED CIRCUIT: A system of transmitting TV signals to receiving equipment directly linked to the originating equipment by coaxial cable, microwave relay, or telephone lines.

CLOSED LOOP: Pertaining to a system with feedback type of control, such that the output is used to modify the input.

COAXIAL CABLE (CONCENTRIC LINE): (1) A transmission line formed by two coaxial conductors, each insulated from the other by some suitable dielectric material such as air or polyethylene, polyfoam, teflon, etc.
(2) A specific cable designed to carry one or more channels of telephone and television signals simultaneously.

COMMUNITY ANTENNA SYSTEM (CATV): A master antenna array and the signal distribution system, i.e., the amplifers, coaxial cable, connecting devices, etc., necessary to effect signal presentation at TV receiver for a community (e.g., housing subdivision).

COMPUTER: A device capable of accepting information applying prescribed processes to the information, and supplying the results of these processes. It usually consists of input and output devices, storage, arithmetic, and logical units, and a control unit.

COMPUTER ASSISTED INSTRUCTION (CAI): When the computer is used as the individual student's guide through a programmed course of instruction, this system is called Computer Assisted Instruction or CAI. It is also sometimes referred to as Computer Aided Instruction.

COMPUTER BASED INSTRUCTION: Computer Based Instruction or CBI describes a system which uses the computer as the center of a communications system linking all the aids of technology. The computer, in other words, is used as a means of control over many media rather than as the main medium of instruction, which is the case with CAI.

CONTROL CONSOLE: An assembly of equipment which contains the switches, meters, monitors, and controls required for operating and adjusting the various components of a system.

COST EFFECTIVENESS: The product of an analysis of materials, equipment, and procedures among many variables wherein a decision is made to adopt a program when it can be proven that a reasonable dollar return will accrue from each dollar invested.

CYBERNETICS: The field of technology involved in the comparative study of the control and intracommunication of information handling machines and nervous systems of animals and man in order to understand and improve communication.

DATA-PHONE: (1) A trade mark of the A.T. & T. Company to identify the data sets manufactured and supplied by the Bell System for use in the transmission of data over the regular telephone network. It is also a service mark of the Bell System which identifies the transmission of data over the regular telephone network (DATA-PHONE Service).
(2) A generic term to describe a family of devices available to facilitate data communication.

DATA PROCESSING: (1) The preparation of source media which contain data or basic elements of information, and the handling of such data according to precise rules of procedure to accomplish such operations as classifying, sorting, calculating, summarizing, and recording.
(2) The production of records and reports. Synonymous with data handling.

DEAD TIME: Any definite delay deliberately placed between two related actions in order to avoid overlap. that might cause confusion or to permit a particular different event such as a control decision, switching event, or similar action to take place.

DECIBEL: A measure of the gain or loss of sound energy, intensity, or loudness; each three decibel gain in sound measurement doubles the intensity of loudness.

DEMODULATION: The process of removing the video and audio signals from their respective carrier waves.

DEMODULATOR: (1) A device which receives tones from a transmission circuit and converts them to electrical pulses, or bits, which may be accepted by a business machine.
(2) A device which detects the modulating signals, thus removes the carrier signal, and reconstitutes the intelligence. Clarified by modulation code and contrasted with modulator.

DIAL ACCESS: A system involving two or more receivers (students) who are able to select and receive any one of two or more stored programs (audio and/or visual) from a source which is at a location different from that of the receivers, the transmission from the source to the receiver being wholly or in part electronic.

DIGITAL COMPUTER: A computer which processes information represented by combinations of discrete or discontinuous data (e.g., by the presence or absence of an electrical pulse at a certain point in time). (Compare with an analogue computer for continuous data.) More specifically, it is a device for performing sequences of arithmetic and logical operations. A stored program digital computer is capable of performing sequences of internally stored instructions, as opposed to calculators, such as card programmed calculators, on which the sequence is impressed manually. Related to data processing machine.

DIRECTIONAL ANTENNA: An antenna radiating or receiving radio waves more effectively in some directions than in others.

EDUCATIONAL SPECIFICATIONS: A description of an identifiable category of educational information which includes information needed, basic source, rationale, and time schedule for collection.

EDUCATIONAL TECHNOLOGY: The systematic integration of human engineering, technological innovations, principles of learning, and structure of the subject matter discipline to achieve desired educational objectives. Processes leading to the production of validated and reliable learning systems which can be replicated.

EQUIPMENT COMPATIBILITY: The characteristic of computers by which one computer may accept and process data prepared by another computer without conversion or code modification.

ETV: Educational Television

FACSIMILE: Transmission of pictures, maps, diagrams, etc. The image is scanned at the transmitter, reconstructed at the receiving station, and duplicated on some form of paper. Same as facsimile transmission.

FEEDBACK: The part of a closed loop system which automatically brings back information about the condition under control.

FILM CHAIN: One or more film projectors, plus optics and a TV camera, used to pick up and transmit images.

FOOTCANDLE: A unit measure of quantity of direct illumination falling on a surface, measured from the surface toward the source.

FOOTLAMBERT: A unit measure of reflected emitted light "seen" by the viewer at the surface being illuminated.

FREQUENCY: Number of cycles per second (or hertz).

GAIN: The ratio between the output signal and the input signal of a device.

GENERAL PURPOSE COMPUTER: A computer designed to solve a large variety of problems; e.g., a stored program computer which may be adapted to any of a very large class of applications.

GIGO: Garbage in/garbage out. An expression used to signify that the quality of the output and its accuracy are only as good as the quality of the input.

HARD COPY: A printed copy of machine output; e.g., printed reports, listings, documents, and summaries.

HARDWARE: (1) Technological equipment for the storage, retrieval, and/or presentation of information, (e.g., computer and dial access) and providing interface between students and software.
(2) The physical equipment or devices forming a computer and peripheral equipment. See software.

HEAD: A device which reads, records, or erases information in a storage medium, usually a small electromagnet used to read, write, or erase information on a magnetic drum or tape.

HEAD END: (Of MATV System) Main TV Amplification System with associated TV antennas, converters, and/or modulators.

HEADSET: A device whereby an individual or individuals can listen to an audio source. When a microphone is added, intercommunication between headsets can be achieved.

HERTZ: One cycle per second is equivalent to one hertz. Hertz is a more recent term which has replaced cycles per second in many parts of the world.

HEURISTIC ROUTINE: A routine by which the computer attacks a problem not by a direct algorithmic procedure, but by a trial and error approach frequently involving the act of learning. Synonymous with heuristic program.

HIGH-SPEED PRINTER: A printer which operates at a speed more compatible with the speed of computation and data processing so that it may operate on-line. At the present time a printer operating at a speed of 250 lines per minute, 100 characters per line is considered high-speed. Synonymous with HSP.

HIGH-SPEED READER: A reading device capable of being connected to a computer so as to operate on-line without seriously holding up the computer. A card reader reading more than 250 cards per minute would be called a high-speed reader. A reader which reads punched paper tape at a rate greater than 50 characters per second could also be called a high-speed reader. Synonymous with HSR.

HOLOGRAM: A 3-D picture made with two laser beams. When a laser beam is passed through the developed plate, the original scene seems to hover some distance from the plate in startling realism.

IMAGE ORTHICON: The type of television camera pickup tube commonly used in live broadcasting cameras and in the most highly sophisticated closed circuit installations having professionally trained staffs. Can televise even under low lighting conditions. More expensive than Vidicon.

IMPULSE: The making and breaking of a circuit by pulsing contacts to operate remote devices.

INDIVIDUALIZED INSTRUCTION: Individualized instruction consists of planning and conducting with each student a program of studies that is tailored to his learning needs and his characteristics as a learner.

INFORMATION RETRIEVAL: The recovering of desired information or data from a collection of documents or other records.

INFORMATION RETRIEVAL SYSTEM: A system for locating and selecting, on demand, certain documents or other records relevant to a given information requirement from a file of such material. Examples of information retrieval systems are classification, indexing, and machine searching systems.

INFORMATION SYSTEM: The network of all communication methods within an organization. Information may be derived from many sources other than a data processing unit, such as by telephone, by contact with other people, or by studying an operation.

INFORMATION THEORY: The mathematical theory concerned with information rate, channels, channel width, noise, and other factors affecting informaton transmission. Initially developed for electrical communications, it is now applied to business systems and other phenomena which deal with information units and flow of information in networks.

INPUT-OUTPUT: A general term for the equipment used to communicate with a computer and the data involved in the communication. Synonymous with I/O.

INPUT-OUTPUT DEVICES: Includes the following equipment: card reader, card punch, paper tape reader, paper tape punch, printer, multiple tape lister, magnetic tapes, magnetic reader/sorter, keyboard, perforated tape reader/punch, plotters, data communications controllers, etc.

INSTRUCTIONAL PROGRAM: The instructional program can be described as the planned sequence of presentation of curriculum material.

INTEGRATED CIRCUIT: So named because all the elements of the circuit are inseparably associated. Between 100 and 500 integrated circuits can be manufactured simultaneously on a silicon wafer that is about one inch in diameter and less than 1/100 inches thick. Use of integrated circuit reduces the size of computers significantly.

ITV: Instructional Television.

KEYBOARD: Electric typewriter or teletypewriter that enables the user to communicate with the computer. Located at terminals or console. An input or response device, sometimes used in conjunction with a CRT display.

KEYPUNCH: (1) A special device to record information in cards or tape by punching holes in the cards or tape to represent letters, digits, and special characters.
(2) To operate a device for punching holes in cards or tape.

KILOCYCLE: 1000 cycles (1 kc), a cycle being used as a unit of measurement of frequency. AM radio is broadcast in the kilocycle range. (1 kc is approximately two octaves above middle C on piano.) See kilohertz.

KILOHERTZ: 1 kilocycle per second is equivalent to 1 kilohertz. See hertz.

KINESCOPE RECORDING: A film recording made by a motion picture camera specially designed to photograph a television program directly off the front of a television tube. Sound is recorded simultaneously.

LANGUAGE: A system for representing and communicating information or data between people or between people and machines or between machines.

LASER: Light Amplification by Stimulated Emission of Radiation. Coherent (in phase) light, collimated (one direction).

LDX: Long Distance Xerography. A name used by the Xerox Corporation to identify its high speed facsimile system. The system uses Xerox terminal equipment and a wide band data communication channel.

LIBRARY: (1) A collection of information available to a computer, usually on magnetic tapes.
(2) A file of magnetic tapes.

LIGHT-PEN: A photo-sensitive device used for communication with a computer via a cathode ray tube.

LINEAR PROGRAMMING: A technique of mathematics and operations research for solving certain kinds of problems involving many variables where a best value or set of best values is to be found. This technique is not to be confused with computer programming, although problems using the technique may be programmed on a computer.

LINE SCANNING FREQUENCY: The number of lines of an image scanned each second; under present U.S. standards it is 15,750 cycles per second, which corresponds to a 525-line picture.

LOGIC: (1) The science dealing with the criteria or formal principles of reasoning and thought.
(2) The systematic scheme which defines the interactions of signals in the design of an automatic data processing system.
(3) The basic principles and application of truth tables and interconnection between logical elements required for arithmetic computation in an automatic data processing system. Related to symbolic logic.

LOOP: (1) A self-contained series of instructions in which the last instruction can modify and repeat itself until a terminal condition is reached. Synonymous with cycle.
(2) A communications circuit between two private subscribers or between a subscriber and local switching center.

MACHINE ORIENTED LANGUAGE: (1) A language designed for interpretation and use by a machine with little translation.
(2) A system for expressing information which is intelligible to a specific machine; e.g., a computer or class of computers.

MAGNETIC CORE STORAGE: A storage device in which binary data is represented by the direction of magnetization in each unit of an array of magnetic material, usually in the shape of toroidal rings, but also in other forms such as wraps on bobbins. Synonymous with core storage.

MAGNETIC TAPE: A tape or ribbon of any material impregnated or coated with magnetic material on which information may be placed in the form of magnetically polarized spots.

MAGNETIC TAPE READER: A device capable of sensing information recorded on a magnetic tape in the form of a series of magnetized spots.

MAGNETIC TAPE UNIT: The mechanism, normally used with a computer, which handles magnetic tape and usually consists of a tape transport, reading, or sensing and writing, or recording heads, and associated electrical and electronic equipment. Most units may provide for tape to be wound and stored on reels; however, some units provide for the tape to be stored loosely in closed bins.

MASTER ANTENNA TELEVISION: (MATV) Television receiving and distribution system for large building complexes such as apartment houses, hotels, schools, etc. Includes an array of antennas designed to pick up various TV signals (UHF, VHF) which are then passed through one "head end" and distributed throughout the building via coaxial cable.

MASTER DISTRIBUTION SYSTEM: Amplifiers, transformers, and tap-off connections for transmission to receivers or monitors located within a building or between buildings, includes external antenna signal reception and local program origination.

MASTER TV CONTROL: The area or point from which all signals are controlled and adjusted prior to distribution.

MATHEMATICAL MODEL: The general characterization of a process, object, or concept, in terms of mathematics, which enables the relatively simple manipulation of variables to be accomplished in order to determine how the process, object, or concept would behave in different situations.

MEDIUM: The physical substance upon which data is recorded; e.g., magnetic tape, punch cards, and paper.

MEGACYCLE: (mc) One million cycles; when used as a unit of frequency, it is equal to one million cycles per second or one million hertz.

MEGAHERTZ (MHz): 1,000,000 hertz. Used as a unit of measurement of frequency. 1,000 kilohertz is equal to one megahertz.

MICROWAVE: All electromagnetic waves in the radio frequency spectrum above 890 megahertz.

MICROWAVE RELAYS: Systems used for transmission of video and audio signals by highly directional radio beams at frequencies between 2,000 and 15,000 mc.; distances up to 50 miles may be covered by a single link consisting of a transmitter and receiver; longer distances may be covered by multiple links receiving and transmitting the original signal.

MODULATION: The process of impressing audio or video impulses on the carrier wave for transmission through the air.

MODULATOR: A device which varies a repetitive phenomenon in accordance with some predetermined scheme usually introduced as a signal.

MODULE: (1) An interchangeable plug-in electronic item containing components.
(2) An incremental block of storage or other building block for expanding the computer capacity.

MONITOR: (1) To supervise and verify the correct operation of a program during its execution, usually by means of a diagnostic routine used from time to time to answer questions about the program.
(2) A special type of high quality television receiver used specifically in VIDEO transmission, rather than RF.
(3) The term "monitor" is also used informally to designate any receiver being used by the cameraman or program director to check the picture being transmitted.

MULTIPLEX: The process of transferring data from several storage devices operating at relatively low transfer rates to one storage device operating at a high transfer rate in such a manner that the high-speed device is not obliged to wait for the low-speed devices.

MULTIPLEXER: (1) Any device or circuit used for mixing signals.
(2) A specialized optical device that makes it possible to use a single television camera in conjunction with one or more motion picture, filmstrip, and/or slide projectors in a film chain.

MULTIPLEXING: (1) The transmission of a number of different messages simultaneously over a single circuit.
(2) Utilizing a single device for several similar purposes or using several devices for the same purpose; e.g., a duplexed communications channel carrying two messages simultaneously.

NETWORK: (TV) A group of television stations connected by radio relays or coaxial cable so that all stations may simultaneously broadcast a program.

NOISE: (1) Random electrical impulses introduced in a circuit by equipment components, man interference, or natural disturbances, i.e., lightning, sun spots, etc.
(2) The meaningless extra bits or words which must be ignored or removed from the data at the time the data is used.

OFF-LINE EQUIPMENT: The peripheral equipment or devices not in direct communication with the central processing unit of a computer. Synonymous with auxiliary equipment.

OFF-THE-SHELF MATERIALS: Prepared learning materials available commercially from publishers and producers of educational products.

ON-LINE EQUIPMENT: Peripheral equipment or devices in a system in which the operation of such equipment is under control of the central processing unit, and in which information reflecting current activity is introduced into the data processing system as soon as it occurs.

OPEN LOOP: Pertaining to a control system in which there is no self-correcting action for misses of the desired operational condition, as there is in a closed loop system.

OPERATING SYSTEM: An integrated collection of service routines for supervising the sequencing of programs by a computer. Operating systems may perform debugging, input-output, accounting, compilation, and storage assignment tasks. Synonymous with monitor system and executive system.

OPERATIONS RESEARCH: The use of analytic methods adopted from mathematics for solving operational problems. The objective is to provide management with a more logical basis for making sound predictions and decisions. Among the common scientific techniques used in operations research are the following: linear programming, probability theory, informational theory, game theory, monte carlo method, and queuing theory. Synonymous with O.R.

PAPER TAPE: A strip of paper capable of storing or recording information. Storage may be in the form of punched holes, partially punched holes, carbonization or chemical change of impregnated material, or by imprinting. Some paper tapes, such as punched paper tapes, are capable of being read by the input device of a computer or a transmitting device by sensing the pattern of holes which represent coded information.

PERIPHERAL EQUIPMENT: The auxiliary machines which may be placed under the control of the central computer. Examples of this are card readers, card punches, magnetic tape feeds, and high-speed printers. Peripheral equipment may be used on-line or off-line depending upon computer design, job requirements, and economics.

PERMANENT STORAGE: A method or device used to retain intermediate or final results outside of the machine, usually in the form of punched cards or magnetic tape.

PROBABILITY THEORY: A measure of likelihood of occurrence of a chance event, used to predict behavior of a group not of a single item in the group.

PROBLEM ORIENTED LANGUAGE: (1) A language designed for convenience of program specification in a general problem area rather than for easy conversion to machine instruction code. The components of such a language may bear little resemblance to machine instructions.
(2) A machine independent language where one needs only to state the problem, not the how of solution. Related to program generators and contrasted with procedure oriented language.

PROCEDURE ORIENTED LANGUAGE: A machine independent language which describes how the process of solving the problem is to carried out; e.g., FORTRAN. Contrasted with problem oriented language.

PROCESSOR: (1) A generic term which includes assembler, compiler, and generator.
(2) A shorter term for automatic data processor or arithmetic unit.

PROGRAM: (1) The complete plan for the solution of a problem, more specifically the complete sequence of machine instructions and routines necessary to solve a problem.
(2) To plan the procedures for solving a problem.
(3) An instructional unit; a series of instructional units.
(4) A definable activity of an educational agency; a cluster of related activities.

PROGRAM AMPLIFIER: The equipment used to amplify the level of the signal emanating from the audio or video playback device. A program amplifier is sometimes an integral part of an audio or video tape transport, in which case it may not be identified as a separate unit.

PROGRAMMER: One who prepares the sequence of instructions to solve a problem.

PROGRAM GENERATOR: A program which permits a computer to write other programs automatically.

PROGRAM LANGUAGE: A language which is used by programmers to write computer routines.

PROGRAMMED INSTRUCTION: Programmed instruction can be described as an instructional course which presents the instructions, questions, answers, and other information to the individual student in a carefully planned sequence or program, allowing the student to progress according to his individual capabilities.

PROJECTION TELEVISION: A combination of lenses and mirrors which projects an enlarged television picture on a screen.

PUNCH CARD: A heavy stiff paper of constant size and shape, suitable for punching in a pattern that has meaning, and for being handled mechanically. The punched holes are sensed electrically by wire brushes, mechanically by metal fingers, or photoelectrically by photocells.

PUNCH TAPE: A tape, usually paper, upon which data may be stored in the form of punched holes. Synonymous with perforated tape.

RADIO FREQUENCY: A frequency used for transmission of audio and video signals in the radio spectrum. The present practical limits of radio frequency are roughly 10 KHz to 100,000 MHz.

RADIO WAVE: An electromagnetic wave produced by rapid reversals of current flow in a conductor known as the antenna, or aerial; such a wave travels through space at the speed of light, 186,000 miles a second.

RANDOM ACCESS: (1) Pertaining to the process of obtaining information from or placing information into storage where the time required for such access is independent of the location of the information most recently obtained or placed in storage.
(2) Pertaining to a device in which random access, as defined in definition 1, can be achieved without effective penalty in time.

REAL TIME: The performance of a computation during the actual time that the related process transpires in order that the results may be used to guide the process.

REAL TIME PROCESSING: The processing of information or data in a sufficiently rapid manner so that the results of the processing are available in time to influence the process being monitored or controlled.

RECEIVER: (TV) A television set, designed for tuned (RF) channel reception of sound and picture.

REGISTER: A hardware device used to store a certain number of bits or characters. A register is usually constructed of elements such as transistors or tubes and usually contains approximately one word of information. Common programming usage demands that a register have the ability to operate upon information and not merely store information; hardware usage does not make the distinction.

RELAY STATION: A station used to receive picture and sound signals from a master station and to transmit them to a second relay station or to a television station transmitter.

REMOTE PICKUPS: Events televised away from the studio by a mobile unit or by permanently installed equipment at the remote location.

REPEATER: A device for receiving, amplifying, and retransmitting a signal or wave.

REPEATER STATION: An intermediate point in a transmission system where line signals are received, amplified or reshaped, and retransmitted.

RESOLUTION: The blending of TV picture elements and lines; it may also be used to refer to the amount of detail present that can be resolved into a complete picture; a numerical value to express resolution may be determined by examination of a transmitted test pattern.

RESPONSE TIME: The amount of time elapsed between generation of an inquiry at a data communications terminal and receipt of a response at that same terminal.

REVERBERATION: Persistence of sound in an enclosed space, due to reflection from the walls.

REWRITE: The process in a storage device of restoring the information in the device to its state prior to reading.

RUN: The performance of one program on a computer during which manual manipulations by the computer operator are minimal.

SCANNING: The process of deflecting the electron beam in a camera or picture tube so that it moves at high speed from left to right in a sequence of rows or lines from top to bottom, thus changing light and shadows of a scene into electrical impulses to form the image on the receiver tubes.

SCREEN: (Electronic) The surface in an electrostatic cathode ray storage tube where electrostatic charges are stored, and by means of which information is displayed or stored temporarily.

SERVOMECHANISM: A device to monitor an operation as it proceeds and to make necessary adjustments to keep the operation under control. A furnace thermostat is an example of a servomechanism.

SIGNAL: Information transposed into electrical impulses; two basic signals involved in television transmission—the picture or video signal and the sound or audio signal; each signal contains electrical impulses representing elements transmitted.

SIMULATION: (1) The representation of physical systems and phenomena by computers, models, or other equipment.
(2) In computer programming, the technique of setting up a routine for one computer to make it operate as nearly as possible like some other computer.

SOFTWARE: (1) The nonphysical components of a system.
(2) The totality of programs and routines used to extend the capabilities of computers, such as compilers, assemblers, generators, routines, and subroutines. Contrasted with hardware.

SOLID STATE COMPONENTS: The electronic components that convey or control electrons within solid materials; e.g., transistors, germanium diodes, and magnetic cores. Vacuum and gas tubes are not included.

STATION: One of the input or output points on a communications system.

STORE: (1) To transfer an element of information to a device from which the unaltered information can be obtained at a later time.
(2) To retain data in a device from which it can be obtained at a later time.

STUDENT RECORDER: Tape recorder used directly by the student. Recorder may be located remotely or at the student station.

STUDENT RESPONSE MODE: The ways in which students may communicate with the equipment, as via microphone, push-button, dial, etc.

STUDENT STATION: Input-output equipment designed for student use interacting with a computer. Same as terminal.

STUDIO CONTROL ROOM: The room or location where the monitoring equipment is placed for the direction and control of a television program.

SWITCHER: A control which permits the selection of one image from any of several TV cameras.

SWITCHER-FADER: A control that permits each of two or more TV cameras to be selectively fed into the distribution system. The "fader" permits gradual transition from one camera to another.

SYSTEM: An assembly of procedures, processes, methods, routines, or techniques united by some form of regulated interaction to form an organized whole.

SYSTEMS ANALYSIS: The examination of an activity, procedure, method, technique, or a business to determine what must be accomplished and how the necessary operations may best be acomplished.

TAPE TRANSPORT: (1) The equipment used to play back information on audio tape and/or in conjunction with other equipment, to record information on audio tape. These transports are normally located at a remote location but need not be.
(2) The mechanism which moves magnetic or paper tape past sensing and recording heads. Synonymous with tape drive or tape unit.

TEACHING MACHINE: Electronic device that utilizes a set of programmed materials for individual study. Material is presented to the individual through picture, written word, or audio medium. The student's response will then determine the next step. Most teaching machines are small, portable devices which can be housed temporarily in a study carrel or on a desk.

TELEVISION BROADCAST SIGNAL: A combination of two radio frequency carriers spaced by 4.5 MHz, the lower one being amplitude-modulated by a standard composite picture signal, the upper one being frequency-modulated by the accompanying audio signal.

TELEVISION CHANNEL: The term "television channel" means a band of frequencies 6 megahertz wide in the television broadcast band and designated either by number or by the extreme lower and upper frequencies.

TELEVISION RECEIVER: A receiver for converting incoming electric signals into television pictures and customarily associated sound.

TELEVISION TRANSMITTER: The radio-frequency and modulating equipment transmitting modulated radio-frequency power representing a complete television signal (including audio, video, and synchronizing signals).

TIME-SHARING: A method of operation in which a computer facility is shared by several users for different purposes at (apparently) the same time. Although the computer actually services each user in sequence, the high speed of the computer makes it appear that the users are all handled simultaneously.

TRANSCEIVER: A device which is capable of transmitting and receiving.

TRANSMISSION LINE: A material structure forming a continuous path from one place to another for directing the transmission of electromagnetic energy along this path.

TRANSMISSION SPEED: The number of information elements sent per unit time, usually expressed as bits, characters, word groups, or records per second or per minute.

TRANSMISSION SYSTEM: In communication practice, an assembly of elements capable of functioning together to transmit signal waves.

TRANSMITTER: A device to convert sound to electrical energy.

UHF: Ultra-high frequency, normally about 300–3000 megahertz.

ULTRASONICS: The field of science devoted to frequencies of sound above the human audio range; i.e., above 20 kilohertz.

UNIDIRECTIONAL ANTENNA: An antenna having a single well-defined direction of maximum radiation intensity.

UNIPLEXER: Projection of film directly into the TV camera.

VHF: Very high frequency, normally between 30 and 300 megahertz.

VIDEO: Of or concerning sight; specifically, those electrical currents representing the elements of a television picture.

VIDEO SIGNAL: The frequencies generated by the scanning of a scene or image plus the sync and blanking pulses involved.

VIDEO SWITCHING EQUIPMENT: The equipment used to channel the appropriate video program to the student making the request.

VIDEO SYSTEM PROCESSOR: The equipment facilitating video program control.

VIDEO TAPE DRIVE: The equipment used to play back information on video tape and/or in conjunction with other equipment, to record information on video tape.

VIDEO TRANSMISSION: The picture signal applied directly to the viewing tube without use of an RF carrier. As circuit conversion and reconversion stages are unnecessary, there is no deterioration–resulting in a higher quality image.

VIDICON: The camera pick-up tube in the vidicon camera, used in most closed circuit systems as well as filmed programs in broadcasting.

VIEWFINDER: A small monitor built into the TV camera enabling the cameraman to see exactly what his camera is "seeing."

VOICE GRADE CHANNEL: A channel suitable for transmission of speech, digital or analogue data, or facsimile, generally with a frequency range of about 300 to 3000 hertz.

WIDE AREA TELEPHONE SERVICE (WATS): A service provided by telephone companies which permits a customer by use of an access line to make calls to telephones in a specific zone on a dial basis for a flat monthly charge.

WORKING STORAGE: A portion of the internal storage reserved for the data upon which operations are being performed. Synonymous with temporary storage and contrasted with program storage.

XEROGRAPHIC PRINTER: A device for printing an optical image on paper in which dark and light areas of the original are represented by electrostatically charged and uncharged areas on the paper. The paper is dusted with particles of finely powdered dry ink and the particles adhere only to the electrically charged areas. The paper with ink particles is then heated, causing the ink to melt and become permanently fixed to the paper.

XEROGRAPHY: A dry copying process involving the photo electric discharge of an electrostatically charged plate. The copy is made by tumbling a resinous powder over the plate, the remaining electrostatic charge is discharged, and the resin is transferred to paper or an offset printing master.

Appendix II

MAJOR MANUFACTURERS OF ELECTRONIC TEACHING EQUIPMENT

CLOSED CIRCUIT TELEVISION

Ampex Corporation
401 Broadway
Redwood City, Calif. 94063

Blonder-Tongue Laboratories, Inc.
9 Alling St.
Newark, New Jersey 07102

Conrac Division,
Giannini Controls Corp.
19217 E. Foothill Blvd.
Glendora, Calif. 91740

Diamond Power Specialty Corp.
Box 415
Lancaster, Ohio 43130

Fairchild Camera & Instrument Corp.
221 Fairchild Ave.
Plainview, N.Y. 11803

General Electric
Electronics Park
Syracuse, N.Y. 13201

General Precision Labs.
Pleasantville, N.Y. 10570

Packard-Bell Electronics
649 Lawrance Dr.
Newbury Park, Calif. 91320

Panaconic
23-05 44th Rd.
Long Island City, N.Y. 11101

Raytheon
475 S. Dean St.
Englewood, N.J. 07631

Radio Corporation of America
Front and Cooper St.
Camden, N.J. 08102

Sarkes-Tarzian, Inc.
East Hillside Dr.
Bloomington, Ind. 47401

Shibaden Corporation of America
58-25 Brooklyn-Queens Expressway
Woodside, N.Y. 11377

Sony Corporation of America
47-47 Van Dam St.
Long Island City, N.Y. 11101

Micro-Link Systems/Varian Assoc.
19 Wartburg Ave.
Copiague, N.Y. 11726

Sylvania Electric Products, Inc.
Commercial Electronics Division
P.O. Box 238
Bedford, Mass. 01730

COMPUTER AIDED INSTRUCTION

International Business Machines Corp.
Data Processing Division
112 E. Post Road
White Plains, N.Y. 10601

Radio Corporation of America
Palo Alto, Calif.

Philco-Ford
Willow Grove, Pa. 19090

Westinghouse
Pittsburgh, Pa.

Burroughs (Under Development)
Detroit, Mich.

Honeywell
Electronic Data Processing Div.
60 Walnut St.
Wellesley Hills, Mass. 02181

DIAL ACCESS SYSTEMS

Ampex Corp.
401 Broadway
Redwood City, Calif. 94063

A. V. Electronics, Inc.
78 Main St.
Northhampton, Mass. 01060

Chester Electronics Labs, Inc.
Winthrop Rd.
Chester, Conn. 06412

North Electric Co.
Electronetics Div.
Galion, Ohio 44833

Omni-Lab, Inc.
Box 91
Couderay, Wisc. 54828

Raytheon Learning Systems Co.
Michigan City, Ind. 46360

RCA Instructional Electronics
Bldg. 15-5
Camden, N.J. 08102

Rheem-Califone Corp.
5922 Bowcroft St.
Los Angeles, Calif. 90016

Robert C. Merchant
Carmel Valley, Calif. 93924

Tele-Norm Corp.
32-31 57th St.
Woodside, N.Y. 11377

DRIVER-TRAINER EQUIPMENT

General Precision Labs
Pleasantville, N.Y. 10570

Raytheon Learning Systems Co.
Michigan City, Inc.

Link Educational Systems Div.
Binghamton, N.Y. 13902

INTERCOMMUNICATION AND SOUND SYSTEMS

Dukane Corp.
103 North 11th St.
St. Charles, Ill. 60174

Webster Electric Co.
1900 Clark St.
Racine, Wisc. 53403

LANGUAGE LABORATORY

a. Standard Language Labs

Acoustron Corp.
2418 Bartlett St.
Houston, Tex. 77006

American Seating Corp.
901 Broadway Ave. N.W.
Grand Rapids, Mich. 49502

Chester Electronic Labs, Inc.
Winthrop Rd.
Chester, Conn. 06412

Dictaphone Corp.
730 Third Ave.
New York, N.Y. 10017

Dukane Corp.
103 North 11th St.
St. Charles, Ill. 60174

Raytheon Learning Systems Co.
Michigan City, Ind. 46360

Radio Corporation of America
Bldg. 15-5
Camden, N.J. 08102

Rheem-Califone Corp.
5922 Bowcroft St.
Los Angeles, Calif. 90016

Robert C. Merchant Co.
Carmel Valley, Calif. 93924

b. Portable/Mobile Language Laboratories

American Seating Corp.
901 Broadway Ave. N.W.
Grand Rapids, Mich. 49502

Raytheon Learning Systems Co.
Michigan City, Ind. 46360

c. Listening Centers

Acoustron Corp.
2418 Bartlett St.
Houston, Tex. 77006

Acoustifone Corp.
20149 Sunburst St.
Chatsworth, Calif. 91311

PM&E Electronics, Inc.
10 Tripps Lane
E. Providence, R.I. 02914

Switchcraft, Inc.
Audio-Visual Div.
5555 N. Elston Ave.
Chicago, Ill. 60630

MULTIMEDIA PROGRAMMING EQUIPMENT

Hoppman Corp.
5410 Port Royal Rd.
Springfield, Va. 22151

Kalart Co, Inc.
Plainville, Conn. 06062

Raytheon Learning Systems Co.
Michigan City, Ind. 46360

PROJECTION SCREENS

a. Front Projection Screens

Charles Mayer Studios, Inc.
776 Commins St.
Akron, Ohio 44307

Da-Lite Screen Co., Inc.
Box 629
Warsaw, Ind. 46580

Knox-Bretford Mfg. Co.
9715 Soreng Ave.
Schiller Park, Ill. 60176

Radiant Corp.
8220 N. Austin Ave.
Morton Grove, Ill. 60053

b. Rear Projection Screens

Da-Lite Screen Co., Inc.
Box 629
Warsaw, Ind. 46580

Palacoat, Inc.
9764 Conklin Rd.
Blue Ash, Ohio 45242

PROJECTORS

Airequipt, Inc.
20 Jones St.
New Rochelle, N.Y. 10802

American Optical Co.
Eggert and Sugar Rds.
Buffalo, N.Y. 14215

Bausch & Lomb, Inc.
79169 Bausch St.
Rochester, N.Y. 14602

Bell & Howard Co.
7100 McCormick Rd.
Chicago, Ill. 60645

Buhl Optical Co.
1009 Beech Ave.
Pittsburgh, Pa. 15233

Charles Beseler Co.
219 S. 18th St.
East Orange, N.J. 07018

Dukane Corp.
103 North 11th St.
St. Charles, Ill. 60174

Eastman Kodak Co.
343 State St.
Rochester, N.Y. 14650

Fairchild Camera & Instrument Corp.
221 Fairchild Ave.
Plainview, N.Y. 11803

Graflex, Inc.
3750 Monroe Ave.
Rochester, N.Y. 14603

Hoppman Corp.
5410 Port Royal Rd.
Springfield, Va. 22151

Minnesota Mining & Mfg. Co.
3M Center
St. Paul, Minn. 55101

Projection Optics Co., Inc.
271 11th Ave.
East Orange, N.J. 07018

Radio Corporation of America
Front and Cooper Sts.
Camden, N.J. 08102

Standard Projector & Equipment Co., Inc.
1911 Pickwick Ave.
Glenview, Ill. 60025

Squibb Taylor, Inc.
10807 Harry Hines
Dallas, Tex. 75220

Victor Animatograph Corp.
Hultenius St.
Plainville, Conn. 06062

Viewlex, Inc.
Broadway Ave.
Holbrook, N.Y. 11741

REMOTE BLACKBOARD SYSTEMS (TELEPHONE-BASED)

Sylvania Electric Products, Inc.
P.O. Box 268
Bedford, Mass. 01730

Victor Comptometer Corp.
3900 N. Rockwell St.
Chicago, Ill. 60618

STORAGE CABINETS (FILM, TAPE, ETC.)

Advance Products Co., Inc.
2300 E. Douglas Ave.
Wichita, Kan. 67214

Jack Coffey Co., Inc.
P.O. Box 131
104 Lake View Ave.
Waukegan, Ill. 60085

Neumade Industries, Inc.
720 White Plains Road
Scarsdale, N.Y. 10583

Smith System Mfg. Co.
56 Emerald St. S.E.
Minneapolis, Minn. 55414

H. Wilson Corp.
444 W. Taft Dr.
South Holland, Ill. 60473

Wallach & Associates, Inc.
5701 Euclid Ave.
Cleveland, Ohio 44103

STUDENT RESPONSE EQUIPMENT

Alda Instrument, Ltd.
2444 Bloor St. W.
Toronto 9, Ontario, Canada

General Electronic Co.
SRS 1000 Program, P.O. Box 8
Schenectady, N.Y. 12301

Link Education Systems Div.
Binghamton, N.Y. 13902

Raytheon Learning Systems Co.
Michigan City, Ind. 46360

STUDY CARRELS

Advance Products Co., Inc.
2300 E. Douglas Ave.
Wichita, Kan. 67214

Educators Mfg. Co.
P.O. Box 1261
Tacoma, Wash. 98401

Howe Folding Furniture, Inc.
360 Lexington Ave.
New York, N.Y. 10017

McNeff Industries, Inc.
2414 Vinson
Dallas, Tex. 75207

Worden Co.
Holland, Mich. 49423

TEACHING MACHINES

a. Linear Program Teaching Machines

Groher Educational Corp.
575 Lexington Ave.
New York, N.Y. 10022

Honor Products Co.
22 Moulton St.
Cambridge, Mass. 02138

Mast Development Co.
2212 E. 12th St.
Davenport, Iowa 52803

Viewlex, Inc.
Broadway Ave.
Hollbrook, N.Y. 11741

b. Branching Program Teaching Machines

Videosonic, Inc.
P.O. Box 3310
Fullerton, Calif. 92634

Welch Scientific Corp.
7300 N. Linder Ave.
Skokie, Ill. 60076

c. Card Source Audio Visual Machines

Bell and Howell
7100 McCormick Rd.
Chicago, Ill. 60645

Electronic Futures
301 State St.
New Haven, Conn. 06473

d. Tachistoscopes: Desk Top

Craig Corp.
2302 E. 15th
Los Angeles, Calif. 90021

Educational Development Labs.
285 E. Pulaski Rd.
Huntington, N.Y. 11743

LaFayette Instrument Co.
Box 1279
LaFayette, Ind. 47902

e. Tachistoscopes: Projectors and Fittings

Educational Development Labs.
285 E. Pulaski Rd.
Huntington, N.Y. 11743

Graflex, Incorp.
3750 Monroe Ave.
Rochester, N.Y. 14603

LaFayette Instrument Co.
Box 1279
LaFayette, Ind. 47902

Rheem-Califone Corp.
5922 Bowcroft St.
Los Angeles, Calif. 90016

f. The Talking Typewriter

Responsive Environment Corp.
200 Sylvan Ave.
Englewood Cliffs, N.J. 07632

WIRELESS TEACHING SYSTEMS

Dictaphone Corp.
730 Third Ave.
New York, N.Y. 10017

Electronic Futures, Inc.
301 State St.
New Haven, Conn. 06473

P&H Electronics
426 Columbia St.
LaFayette, Ind. 47902

Norelco (North American Phillips Co., Inc.)
100 East 42nd St.
New York, N.Y. 10017

Appendix III

SUGGESTIONS FOR FURTHER READING

Cooper, Bernarr (ed). *ITFS: Instructional Television Fixed Service (2500 megahertz) What It Is . . . How to Plan.* Washington, D.C.: National Education Association, 1967.

De Bernardis, Amo, et al. *Planning Schools for New Media: A guide for Boards of Education, School Administrators and Architects.* Washington, D.C.: Government Printing Office, 1962.

Green, Alan C., et al. *Educational Facilities with New Media.* Washington, D.C.: National Education Association, 1966.

"Guide for Lighting Audiovisual Areas in Schools CP-30," *Illuminating Engineering,* July, 1966.

Hauf, Harold D., et al. *New Spaces for Learning: Designing College Facilities to Utilize Instructional Aids and Media.* Troy, New York: Rensselaer Polytechnic Institute, 1966 (revised).

Hocking, Elton. *Language Laboratory and Language Learning: Monograph 2.* Washington, D.C.: National Education Association, 1967 (2nd ed).

Lewis, Philip. "How to Buy and Use Learning Laboratories," *Nation's Schools,* Vol. 77, No. 5, May, 1966.

Lewis, William C. "Design for ITV: A guide to School Television Studio Planning," *Cablecasting and Educational Television,* February, 1968.

Lewis, William C. *Through Cable to Classroom: A guide to ITV Distribution Systems.* Washington, D.C.: National Education Association, 1967.

Molenda, Michael H. *Instructional Systems Development.* Syracuse, New York: Syracuse University Center for Instructional Communications, 1968.

Silberman, Harry F. *Applications of Computers in Education.* SP-2909/000/01. Santa Monica: System Development Corporation, 1967.

Standards for School Media Programs. Chicago: American Library Association, 1969. Also published—Washington, D.C.: National Education Association, 1969.

Stewart, Donald K. "The Cost Analysis of Dial Access Information Retrieval Systems," *Audiovisual Instruction,* May, 1967.

The Student-Teacher Computer Team: Focus on the Computer. Ontario, Canada: Ontario Institute for Studies in Education, 1967.

Williams, Billy Paul (ed). *The Audiovisual Equipment Directory.* Fairfax, Va.: National Audiovisual Association, Inc., Latest edition.

SOFTWARE
slide☐ film☐ disc☐ tape☐
record■ ribbon☐ other☐

programming:
prep.: comm■ local☐ other☐
availability easy■ diff☐
prep.time/program hrs
length/typ.program 20-60mins
kept up to date? yes■ no☐
by whom? NEW RELEASES
BY COMM. OUTLETS

ECONOMICS
first cost range $50-100+
installation cost $
operating cost/yr $
maintenance cost/yr $ 10+
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr☐
custod☐ school tech■ other☐
~~related facil.& equipt~~ OR
SERVICE CONTRACT
W/EQP SUPPLIER.

REFERENCES
MFGRS DATA

TEXT, SECTION IIA

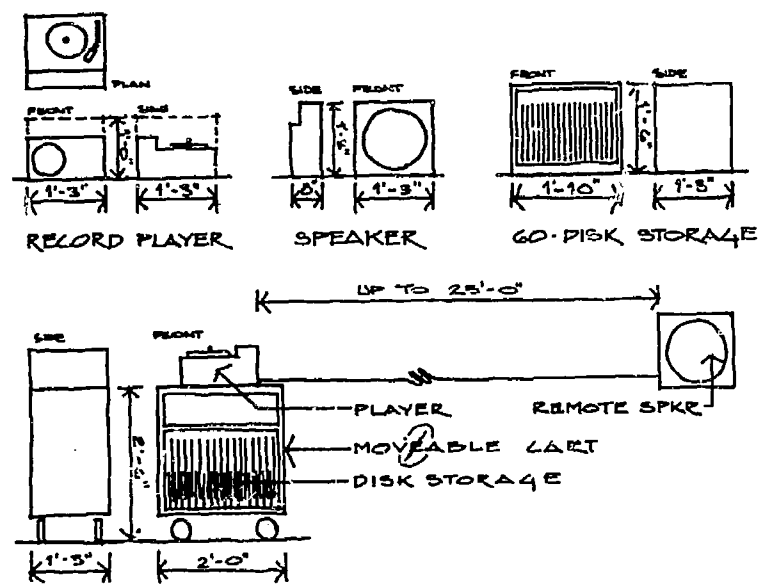
U.L.APPROVED yes■ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)
A PHONOGRAPH is used for classroom presentation of recorded music and drama, and "spoken word" materials. This easy to use and portable device may be used in the following ways:

(1) For direct presentation to large groups through speakers;
(2) For presentation to individuals or groups of individuals through headsets and listening centers;
(3) As a program source in language and learning labs, DAIRS, and other distribution systems.

Many of the functions performed by phonographs are being taken over by the more versatile tape recorder, especially as commercially prepared tapes now cover most of the range of recorded materials.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
HEADPHONES OR
SPEAKERS
PHONO. RECORDS
RECORD STORAGE
CART OR STAND

PHYSICAL CHARACTERISTICS
power:
25 watts 115volts phase
battery SOME yes■ no☐
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight UP TO 35 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open☐

ITEM: PHONOGRAPHS

TYPE: MISCELLANEOUS ELECTRONIC TEACHING EQUIPMENT

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student■
remote☐ local■ other☐
special technician yes☐ no■
time/operation 20-60 mins
no.students/operation
LARGE GROUP

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes■ no■

VISUAL
privacy reqd☐ not req■
illum.range fc
daylight reqd☐ not reqd☐
dimming reqd☐ not reqd☐
darkening reqd☐ not reqd☐
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db
IF USED WITH HEAD-PHONES, NO PRIVACY IS REQUIRED.

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS A-V,
BOGEN, DUKANE,
McCLURE, NEWCOMB,
RHEEM CALIFONE,
V-M
OTHERS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD A

WARE
...le □ film □ disc □ tape ■
record □ ribbon □ other □

programming:
prep.: comm ■ local ■ other □
availability easy ■ diff □
prep.time/program VARIES hrs
length/typ.program 20-40 mins
kept up to date? yes ■ no □
by whom? LOCALLY BY USERS.

COSTS
first cost range $150-300
installation cost $
operating cost/yr $
maintenance cost/yr $ 15-25
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency: 6 TIMES/YR.
regular ■ 6mo □ 1yr □ 2yr □
as nec □ 3yr □ 5yr □ 10yr □
repair time:
hrs ■ dys □ wks □ mos □
location: on premises ■
in place □ factory □ other □
personnel: mfr □
custod □ school tech ■ other □
~~related facil. & equip:~~ OR SERVICE CONTRACT W/EQP. SUPPLIER.

REFERENCES
MFGRS DATA

TEXT, SECTION IIA V

U.L.APPROVED yes ■ no □ pend □

DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

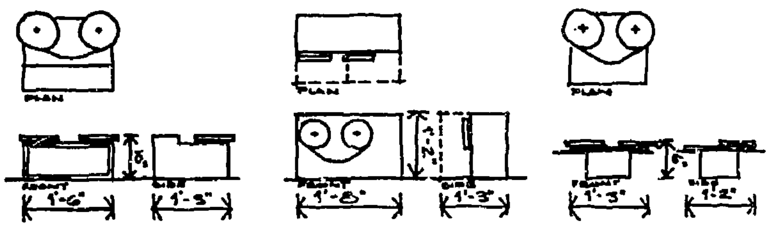
The TAPE RECORDER is a versatile tool which may be used for both preparation and presentation of audio programs. The portable and/or desk mounted tape recorders are intended for use through a variety of outputs (see DATA SHEET ~~K-1~~ A: PHONOGRAPHS).

The larger console models may be used for group presentations or as a component of a language laboratory or other teaching aid system.

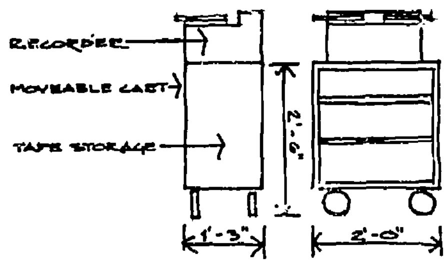
The AUDIO TAPE RECORDER, illustrated here, should not be confused with the VIDEO TAPE RECORDER which is a more complex and costly device used with television equipment. Tapes from the two devices are not interchangeable. For the video tape recorder, see DATA SHEET ~~E-5~~ E-E: VIDEO TAPE RECORDERS.

SPACE REQUIREMENTS

TAPE RECORDERS: PORTABLE



DESK MOUNTED



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
MICROPHONES
HEADPHONES OR SPEAKERS
TAPES OR CARTRIDGES
STORAGE
STAND (OPT.)

PHYSICAL CHARACTERISTICS
power:
5-50 watts 115 volts phase
battery SOME yes ■ no □
stand-by power yes □ no ■
umb.cables: no. size
telephone connect. yes ■ no ■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes □ no ■

color/fin. choice yes ■ no □

DIRECT DEMANDS ON BLDG.
weight 5 TO 50 lbs
vibration
shock
floor
ceiling
partitions
mobility yes ■ no □
service flexib. yes ■ no □
security locked □ open □

ITEM: TAPE RECORDERS

TYPE: MISCELLANEOUS ELECTRONIC TEACHING EQUIPMENT

PEOPLE
user: teach □ stud ■ other □
operator:
technic □ teacher ■ student ■
remote □ local ■ other □
special technician yes □ no ■
time/operation mins
no.students/operation

CONTROLS
remote □ local ■ other □
switching:
master □ ind. ■ spec □ other □
by student yes ■ no ■

VISUAL
privacy reqd □ not req ■
illum.range fc
daylight reqd □ not reqd ■
dimming reqd □ not reqd ■
darkening reqd □ not reqd ■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd □ des ■ not req □
noise level db
HEADSETS PROVIDE ACOUSTIC PRIVACY.

THERMAL (MAGNETIC TAPE)
oper.temp.range 60°-90°F
oper.humidity range 20-80%

MANUFACTURERS AMPEX, AUDIOTRONICS, MAGNECORD, RCA, SONY, V-M
OTHERS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD 8

SOFTWARE
slide☐ film☐ disc☐ tape■
record☐ ribbon☐ other☐
22 TRACK MAG. TAPE
+ 1 RECORD TRACK
programming:
prep.: comm■ local■ other☐
availability easy■ diff■
prep.time/program hrs
length/typ.program 15 mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS
first cost range $ 6000-
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life
4 PROGRAMS, 3 LEARNING LOOPS, 30 RECEIVERS

MAINTENANCE
frequency:
regular■ 6mo■ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:

REFERENCES
MFGRS DATA
TEXT SECTION II B

U.L.APPROVED yes■ no☐ pend☐

DATA SHEET

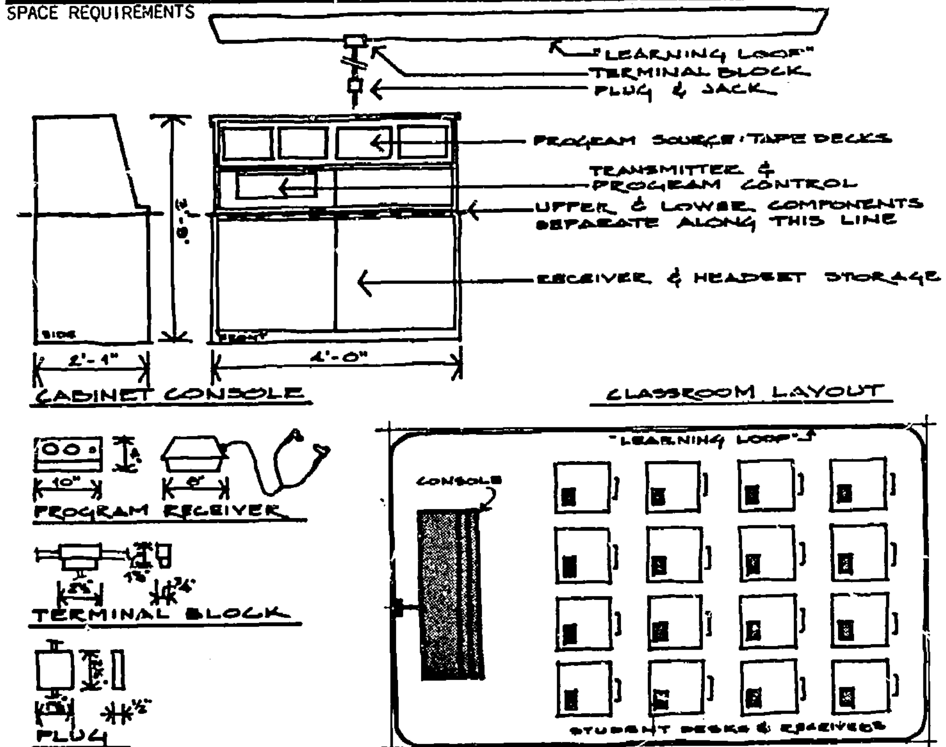
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The WIRELESS LOOP SYSTEM is similar in performance to a wired language laboratory as it offers several different recorded programs to a number of students. It differs from the regular installation in that one wire loop around the room perimeter transmits a radio frequency (RF) signal to student receivers located within the loop.

The system has three major components, only one of which need be permanently in the classroom. The CABINET CONTROL contains the program sources -- tape decks or phonographs -- and the program control which switches and feeds the programs to the antenna. The ANTENNA or LEARNING LOOP is a permanently mounted adhesive plastic strip mounted at a convenient height around the room. The STUDENT RECEIVERS pick up the signal and feed it to student headsets. When not in use, the receivers and headsets are stored in the base of the cabinet control. The cabinet control is wheeled and is reasonably portable.

With the addition of Audio-Notebooks (see DATA SHEET ~~K-2~~ X: AUDIO-NOTEBOOK) in place of receivers, the system functions as an audio-active comparative language lab.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS
The maximum area which may be enclosed within the "learning loop" is 10,000 square feet. The loop may be mounted at any convenient height, although one manufacturer recommends mounting from 3' to 6' above the floor.

RELATED EQUIPMENT
TAPES
AUDIO NOTEBOOK
AUDIO SECRETARY
HEADSETS

PHYSICAL CHARACTERISTICS
power: CONSOLE
watts 115 volts phase
battery RECEIVERS yes■ no☐
stand-by power yes☐ no■
umb.cables: no. 1 size 3/16" x 1/8"
telephone connect. yes☐ no■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor | "LEARNING LOOP"
ceiling | IS MOUNTED
partitions | TO ONE
mobility yes■ no☐
service flexib. yes☐ no■
security locked■ open☐

ITEM:

TYPE: WIRELESS TEACHING SYSTEM

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation 15 * mins
no.students/operation
UP TO 100
W/AUDIO NOTEBOOK

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes■ no☐

VISUAL
privacy reqd☐ not req☐
illum.range NORMAL fc
daylight reqd☐ not reqd☐
dimming reqd☐ not reqd☐
darkening reqd☐ not reqd☐
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db
HEADSETS PROVIDE SOME ACOUSTIC PRIVACY.

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
ELECTRONIC FUTURE INCORPORATED

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD C

TWARE
de□ film□ disc□ tape■
ord■ ribbon□ other□

programming:
prep.: comm■ local■ other□
availability easy■ diff■
prep.time/program SEVERAL hrs
length/typ.program 20-60 mins
kept up to date? yes■ no□
by whom? TEACHERS

ECONOMICS
first cost range $
installation cost $10%
operating cost/yr $10%
maintenance cost/yr $15%
cost/student/year $
lease cost $
equipment life
APPROX $200 TO $400 PER STUDENT

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE

REFERENCES
H.E.W. – PLANNING SCHOOLS FOR NEW MEDIA (1962)

MFGRS DATA

TEXT, SECTION I / II C

U.L.APPROVED yes■ no□ pend□

DATA SHEET

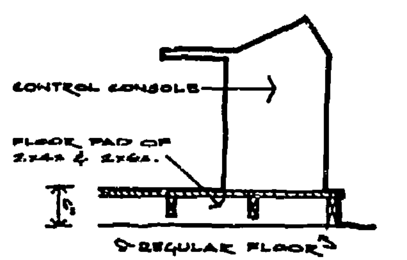
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The LANGUAGE LABORATORY is a teaching space in which students perform drills to improve their language skills. In these drills they are aided by simple electronic devices and supervised by a teacher technician. Additional information on these labs is found in Section I / II C of the text.

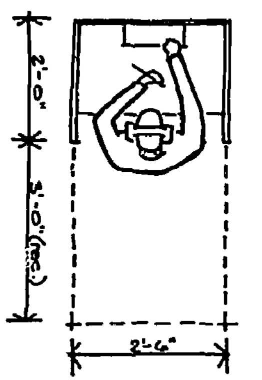
There are three types of language labs, differentiated by the degree and manner of student participation, these are: audio-passive, listening only; audio-active, listening and response; and audio-active comparative, where each student has access to a tape deck to record his responses. The student tape decks may be located in the student carrel or in racks in the equipment room.

Space requirements and layouts of language labs are determined by local criteria, e. g., the type of equipment chosen, the use or not of visual aids, the number of users, the length of program, the rate of turnover, and future plans. If visual aids are to be projected, a stepped floor and curved carrel rows are recommended. (CONTINUED)

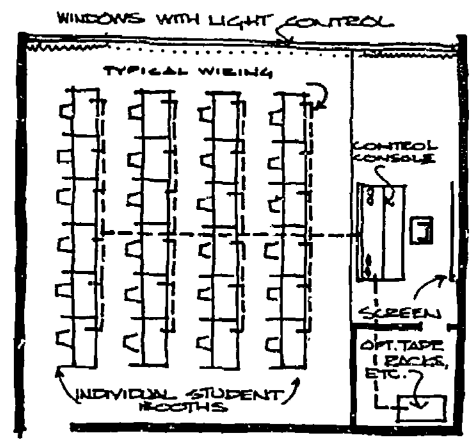
SPACE REQUIREMENTS



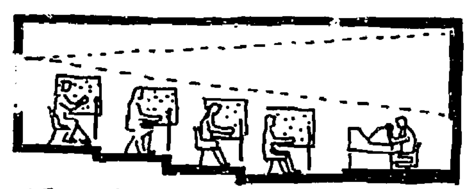
SECTION AT CONTROL CONSOLE



STUDENT BOOTH



TYPICAL LEARNING LAB



SECTION - STEPPED FLOOR IS DESIRABLE WHEN VISUAL AIDS PROJECTION IS PLANNED.

COMMENTS AND SPECIAL REQUIREMENTS

EQUIPMENT MANUFACTURER	NO. OF STUDENTS	NO. OF PROGRAMS	POWER
American Seating	up to 40	5	
Chester Dialog	up to 40	typ. 5	
	poss. 120	up to 21	
RCA EDC-101	up to 64	5	

RELATED EQUIPMENT
CONTROL CONSOLE
SWITCH MECHANISMS
PROGRAM SOURCES

CABLES

PHYSICAL CHARACTERISTICS
power: SEE COMMENTS
watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. ↓ size ½" O.D.
telephone connect. yes□ no■
max.cable length
2 CABLES PER STUDENT POSITION
heat dissipation BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight VARIES lbs
vibration
shock
floor | SEE DESCRIPTION
ceiling | SHEET I/2 E
partitions
mobility yes□ no■
service flexib. yes□ no■
security locked□ open■

PEOPLE
user: teach□ stud■ other□
operator:
technic□ teacher■ student□
remote■ local■ other□
special technician yes□ no■
time/operation mins
no.students/operation
SEE COMMENTS

CONTROLS
remote■ local■ other□
switching:
master■ ind.■ spec□ other□
by student yes■ no□

VISUAL
privacy reqd□ not req■
illum.range 50 + fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd□ des■ not req□
noise level db
HEADPHONES PROVIDE ACOUSTIC PRIVACY.

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
AMERICAN SEATING
CHESTER ELEC. LABS.
R.C.A.
OTHERS

ITEM: LANGUAGE LAB I: STUDENT CARRELS AND GENERAL LAYOUT

TYPE: LANGUAGE (LEARNING) LABORATORIES

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD D
San Francisco Washington, D.C.

SOFTWARE
slide☐ film☐ disc☐ tape■
record■ ribbon☐ other☐

programming:
prep.: comm■ local■ other☐
availability easy■ diff■
prep.time/program 2-10 hrs
length/typ.program 20-60 mins
kept up to date? yes■ no☐
by whom? TEACHERS

ECONOMICS
first cost range $
installation cost $ 10%
operating cost/yr $ 10%
maintenance cost/yr $ 15%
cost/student/year $
lease cost $
equipment life 10 YEARS
APPROX. $200 TO $400
PER STUDENT

MAINTENANCE
frequency: 6 TIMES/YR.
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:
SERVICE AREA & EQP.
STORAGE REQD.

REFERENCES
MFGRS DATA

TEXT, SECTION 7 IIC

U.L.APPROVED yes■ no☐ pend☐

DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

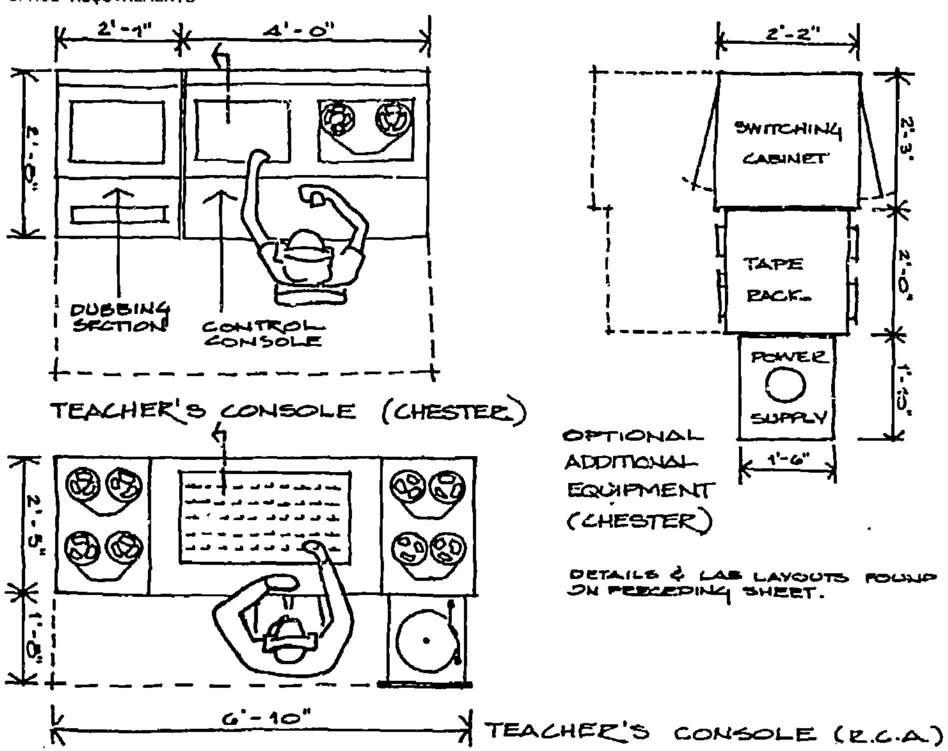
Subfloor and partition wiring requirements vary with the equipment chosen, the complexity of the installation, and future plans. Each installation should be designed for its needs.

Consoles, tape racks, switching devices, and power supplies are mounted on a "computer floor;" this item is a wooden pad built of a 2" by 4" or 2" by 6" frame with planking for a walking surface. Wiring and any venting equipment is carried in this pad.

The learning laboratory program may require that the installation be designed for future upgrading of equipment and facilities -- the addition of dial access selectors and switch boxes, television monitors, etc. -- or other forms of flexiblity.

The equipment of the language lab is similar to some of the equipment used in dial access information retrieval systems.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
SEE SHEET 7-1 D

PHYSICAL CHARACTERISTICS
power: SEE SHEET 7-1 D
watts volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size 5"O.D.
telephone connect. yes☐ no■
max.cable length
TO CONSOLE, 2 CABLES EA PROGRAM SOURCE
heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight VARIES lbs
vibration
shock
floor SEE "DESCRIPTION"
ceiling
partitions
mobility yes☐ no☐
service flexib. yes☐ no☐
security locked☐ open☐

PEOPLE
user: teach☐ stud☐ other☐
operator:
technic☐ teacher☐ student☐
remote☐ local☐ other☐
special technician yes☐ no☐
time/operation mins
no.students/operation
SEE SHEET 7-1 D

CONTROLS
remote■ local☐ other☐
switching:
master■ ind.■ spec☐ other☐
by student yes■ no■

VISUAL
privacy reqd☐ not reqd■
illum.range 50+ fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not reqd☐
noise level db
SEE SHEET 7-1 D

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
AMERICAN SEATING
CHESTER ELEC. LABS
RCA

ITEM: LANGUAGE LAB II: CONTROLS AND RELATED EQUIPMENT

TYPE: LANGUAGE (LEARNING) LABORATORIES

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD E

RE
film☐ disc☐ tape■
■ ribbon☐ other☐

programming:
prep.: comm■ local■ other☐
availability easy■ diff☐
prep.time/program 1 - 5 hrs
length/typ.program 20 - 60 mins
kept up to date? yes■ no☐
by whom? LOCALLY BY TEACHER USERS

COSTS
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE SEE BELOW
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs☐ dys☐ wks☐ mos☐
location: on premises☐
in place☐ factory■ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:
VARIES WITH TYPE & COST OF EQUIPMENT

REFERENCES
A-V EQUIPMENT DIRECTORY (1967)
MFGRS DATA
TEXT SECTION II C

U.L.APPROVED yes■ no☐ pend☐

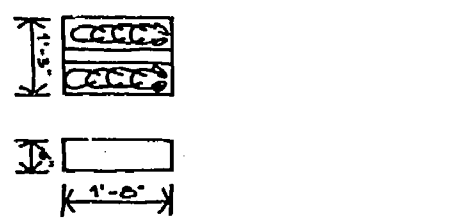
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

PORTABLE AND MOBILE LANGUAGE LABORATORIES cover a spectrum of uses from the simple passive listening center equipment to complex comparative response labs not unlike fixed installations.

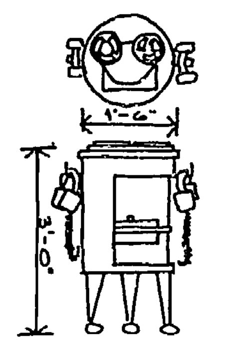
The briefcase type LISTENING CENTER merely permits additional numbers of headsets to be used as tape recorder or phonograph outputs. There are large table model listening centers available. The "Suzette" allows for several program sources and individual teacher-student communication.

The larger units reproduce most of the functions of the audio-active language lab. Some of these devices require classroom wiring as do the permanent installations. Others contain sufficient wiring to be completely flexible in service. A related device is the "wireless" language lab, see DATA SHEET ~~H-1~~ C: WIRELESS TEACHING SYSTEM.

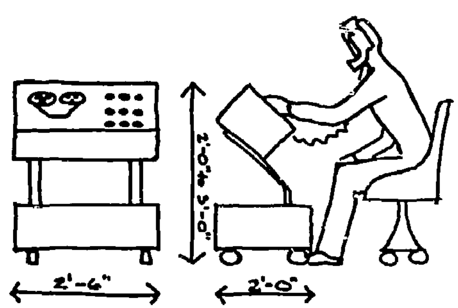
SPACE REQUIREMENTS



PORTABLE GROUP LISTENING CENTER



"SUZETTE"



PORTABLE "AUDIO-ACTIVE" LAB

RELATED EQUIPMENT
HEADSETS

TAPES
RECORDS

PHONOGRAPH OR TAPE DECK FOR LISTENING CTR.

PHYSICAL CHARACTERISTICS
power: SEE COMMENTS
watts 115 volts phase
battery VARIES yes☐ no☐
stand-by power yes☐ no■
umb.cables: no. — size
telephone connect. yes☐ no■
max.cable length

heat dissipation NIL BTU
noise generated NIL db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight VARIES lbs
vibration
shock
floor
ceiling SEE DESCRIPTION.
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked■ open☐

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation
SEE COMMENTS

CONTROLS
remote☐ local■ other☐
switching:
master■ ind.☐ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd☐ not req■
illum.range 50+ fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db
HEADSETS PROVIDE ACOUSTIC PRIVACY

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS AUDIO-TCH, A-V, BELL & HOWELL, DUKANE, RHEEM, CALIFONE, RCA, WEBSTER, OTHERS

ITEM: PORTABLE LANGUAGE LABS, LISTENING CENTERS

TYPE: LANGUAGE (LEARNING) LABORATORIES

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS

ITEM	NO. OF STUDENTS	NO. OF PROGRAMS	BATTERY POWER
Listening center, portable	typ. 8	1	yes
Listening center	up to 36	1	no
Portable language lab	up to 36	5	no
"Suzette"	8 plus teacher	up to 5	no

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD F

-TWARE
ide☐ film☐ disc☐ tape☐
cord☐ ribbon☐ other☐

programming: TYPICALLY
prep.: comm☐ local■ other☐
availability easy☐ diff■
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no☐
by whom? LECTURER

ECONOMICS SEE COMMENT
first cost range $2400
installation cost $ 75
operating cost/yr $
maintenance cost/yr $ 170
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:
PHONE CO. SERVICES
DATAPHONES

REFERENCES
MFGRS. DATA.

BUSINESS OFFICE,
TELEPHONE CO.

TEXT SECTION II D

U.L.APPROVED yes☐ no☐ pend☐

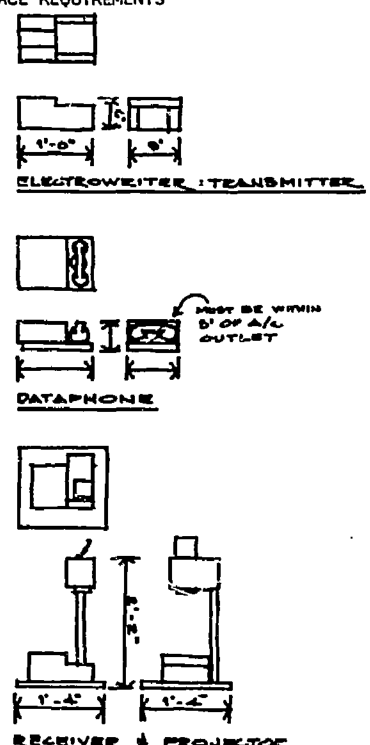
DATA SHEET

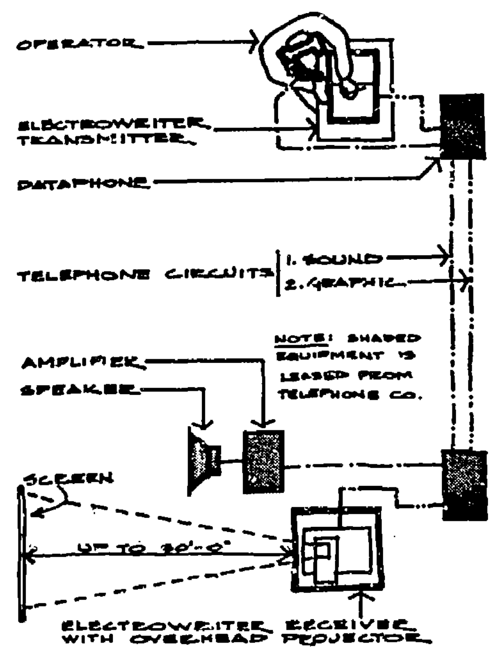
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

One of numerous electronic teaching aids making use of the telephone lines for communication purposes is the REMOTE BLACKBOARD. Operation is quite simple, an instructor writes his lesson on the transmitter plate which is connected to a DATAPHONE. The DATAPHONE changes the electrical signals from the stylus into impulses which are sent along regular telephone lines to as many as six remote receiver locations. There a second DATAPHONE reverses the process and directs a stylus which writes the message on the receiver plate. An overhead projector then throws the message onto a screen.

The lecturer wears a headset connected directly to the DATAPHONE. At the receiving end, sound may be reproduced directly by headsets or speakerphones, or amplified on equipment provided by the phone company.

SPACE REQUIREMENTS





COMMENTS AND SPECIAL REQUIREMENTS
Cost figures are for the items purchased only; the DATAPHONE and sound equipment must be leased from the phone company. The following charges are the rates in San Francisco:

Installation charge, per DATAPHONE	$15.00
Monthly charge, per DATAPHONE	8.00
Monthly line rental, per DATAPHONE	4.10
Toll charges for use of long distance lines.	

RELATED EQUIPMENT
SCREEN
TRANSPARENT ROLLS
SPEAKERPHONES
AMPLIFIERS
SPEAKERS

PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. 2 size 3/16" od
telephone connect. yes■ no☐
max.cable length
DATAPHONE 5' FROM
AC OUTLET
heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes☐ no■
security locked☐ open■

ITEM: REMOTE BLACKBOARD, ELECTROWRITER TYPE

TYPE: TELEPHONE BASED TEACHING SYSTEMS

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote■ local☐ other☐
special technician yes☐ no■
time/operation mins
no.students/operation
UP TO 6 REMOTE
STATIONS.
CONTROLS
remote■ local☐ other☐
switching:
master■ ind.☐ spec☐ other☐
by student yes☐ no■

VISUAL SEE SHEET N 4-12
privacy reqd☐ not req■
illum.range 30 - 50 fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle 30 °
horiz.view angle 90 °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
VICTOR ELECTRO-
WRITER

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD G
San Francisco Washington, D.C.

...WARE
...le□ film□ disc□ tape■
...rd□ ribbon□ other□
programming:
prep.: comm■ local■ other□
availability easy□ diff□
prep.time/program 5-20 hrs
length/typ.program 15-30 mins
kept up to date? yes■ no□
by whom? TEACHER-USERS
ECONOMICS TOTAL SYSTEM
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life
AUDIO, 720 STA, $1000/STA
AUDIO-VIDEO, 710 STA, $6000/STA
MAINTENANCE
frequency:
regular□ 6mo□ 1yr□ 2yr□
as nec■ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE APPROX 100 □'
REFERENCES
MANUFACTURER'S DATA
TEXT, SECTION § II E
U.L.APPROVED yes□ no□ pend□

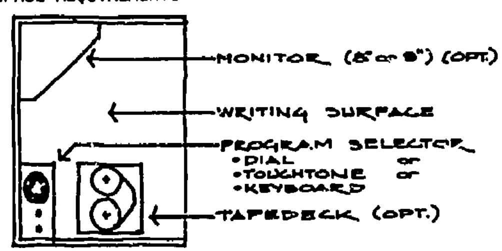
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

A DIAL ACCESS INFORMATION RETRIEVAL SYSTEM (DAIRS) consists of three components. These are: a student carrel, a switching mechanism, and one or more program sources.

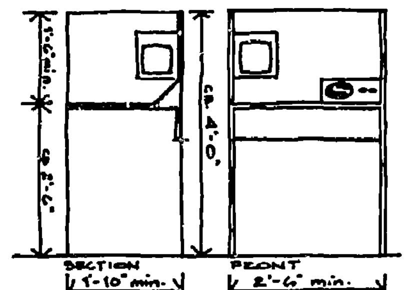
The student comes into contact with the DAIRS through the STUDENT CARREL, a small, semi-private, working and listening cubicle. The student at the carrel selects a program from a program directory. He then dials the program number on the selector device in the carrel. After a brief interval, varying with the type of system, he is connected with either a program tape deck or a buffer tape deck.

The equipment of the carrel varies with both the type and the scope of the system, but it must always contain two items -- a remote selection device and at least one output. The remote selection device may be a dial, a touch-tone, a keyboard, or a digital selector.

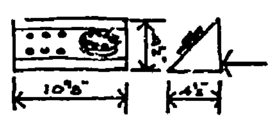
SPACE REQUIREMENTS



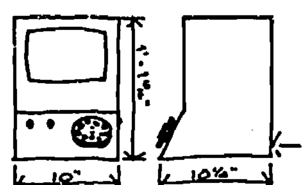
CARREL LAYOUT



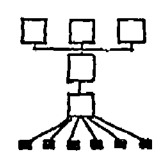
MINIMUM DIMENSIONS



DIAL SELECTOR



MONITOR/SELECTOR



RELATED EQUIPMENT
SWITCHING EQP.
PROGRAM SOURCE & EQP.
RECORDERS
STUDENT CHAIRS
STORAGE
PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. 1* size 'e.o.u.
telephone connect. yes□ no■
max.cable length NO LIMIT
*"TWO-WIRE" CABLE.
heat dissipation BTU
noise generated db
safety hazard: yes□ no■
color/fin. choice yes■ no□
IN SOME FURNITURE LINES.
DIRECT DEMANDS ON BLDG.
weight VARIES lbs
vibration
shock
floor | WIRING REQD
ceiling | SEE SYSTEM
partitions | SPECS.
mobility yes□ no■
service flexib. yes□ no■
security locked□ open■

PEOPLE
user: teach□ stud■ other□
operator:
technic□ teacher□ student■
remote□ local■ other□
special technician yes■ no■
time/operation mins
no.students/operation 1
PER CARREL MAX.
2000 CARRELS.
CONTROLS
remote□ local■ other□
switching:
master□ ind.■ spec□ other□
by student yes■ no□
VISUAL
privacy reqd□ not req■
illum.range 50 PLUS fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °
CARREL FURNITURE PROVIDES VISUAL & ACOUSTIC PRIVACY
ACOUSTIC
privacy reqd□ des□ not req■
noise level db
HEADSET INSURES PRIVACY.
THERMAL
oper.temp.range °F
oper.humidity range %
MANUFACTURERS
AMPEX, CHESTER
RCA, RAYTHEON
OTHERS

ITEM: STUDENT CARREL

TYPE: DIAL ACCESS INFORMATION RETRIEVAL SYSTEM COMPONENT

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS

Equipment shown is typical, check specifications of particular DAIRS for exact dimensions and requirements. Generally, components of one DAIPS manufacturer are not compatible with those of other manufcaturers.

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD H

SOFTWARE
slide□ film□ disc□ tape■
record■ ribbon□ other□
IF CONSOLE IS A PROGRAM SOURCE
programming:
prep.: comm□ local□ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

ECONOMICS SEE TEXT, SEC. II E
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE REQD. CA 100 □

REFERENCES
MANUFACTURER'S DATA

TEXT, SECTION 4 II E

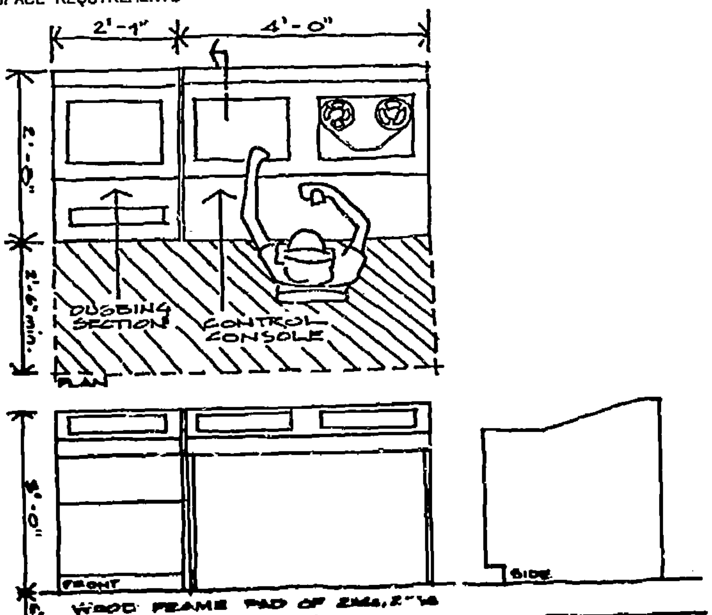
U.L.APPROVED yes□ no□ pend□

DATA SHEET

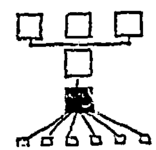
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

A group of DAIRS student carrels and program sources may be controlled by one teacher from the optional CONTROL CONSOLE. This may be desirable if the DAIRS is to be used as a language laboratory or for additional teacher supervision or assistance. The console is not necessary to the operation of a large DAIRS. In small systems, the console may contain, as well as controls, either program sources or elements of the switching mechanism, or both.

SPACE REQUIREMENTS



CONTROL CONSOLE



COMMENTS AND SPECIAL REQUIREMENTS
Equipment shown is typical, check specifications of particular DAIRS for exact dimensions and requirements. Generally components from one DAIRS manufacturer cannot be used with those of another.

RELATED EQUIPMENT
STUDENT CARRELS
SWITCHING MECHANISM
PROGRAM SOURCES
OPERATOR'S CHAIRS

PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. X size 6" od
telephone connect. yes■ no■
max.cable length
1 LINE/TERMINAL
heat dissipation SOME BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor SEE SHEET, 2 ID + E
ceiling
partitions
mobility yes□ no■
service flexib. yes□ no■
security locked□ open■

PEOPLE
user: teach■ stud□ other□
operator:
technic□ teacher■ student□
remote□ local■ other□
special technician yes■ no□
time/operation mins
no.students/operation
CHESTER - 40, RCA - 64
AMER. STG. - 40

CONTROLS
remote□ local■ other□
switching:
master■ ind.■ spec□ other□
by student yes■ no□
CONSOLE OVERRIDES STUDENT CONTROL

VISUAL
privacy reqd□ not req■
illum.range 50 fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd□ des□ not req■
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
AMPEX, CHESTER, RCA, AMER. STG.
OTHERS

ITEM: OPTIONAL CONTROL CONSOLE FOR GROUP INSTRUCTION

TYPE: DIAL ACCESS, INFORMATION RETRIEVAL SYSTEM COMPONENT

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD I

ARE
☐ film☐ disc☐ tape☐
☐ ribbon☐ other☐

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS SEE TEXT, SEC. IIE
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

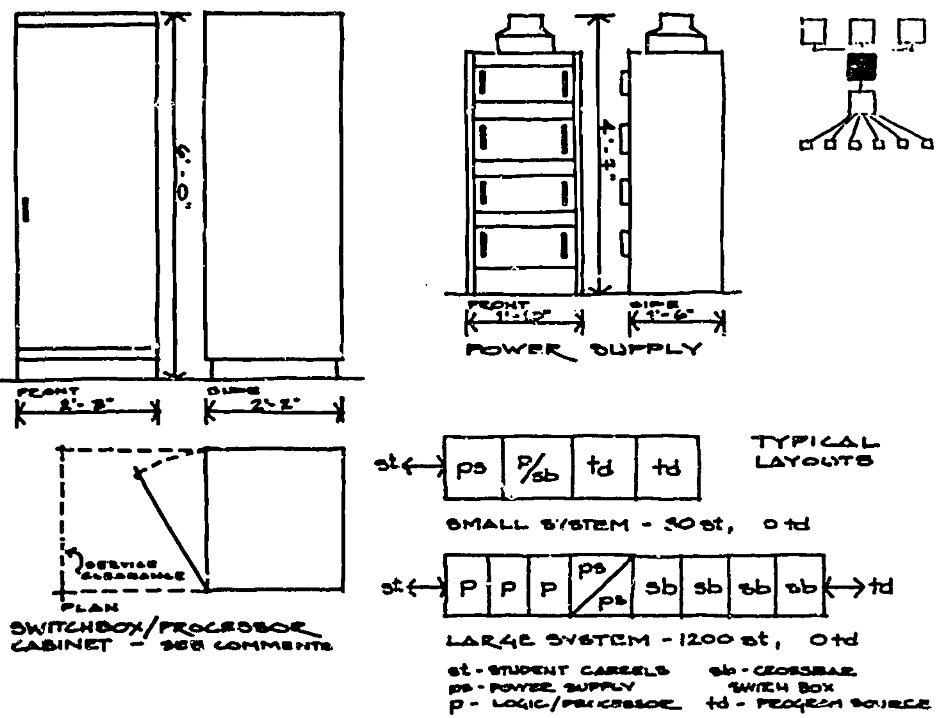
MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐school tech☐ other☐
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE REQD. CA 100♯
REFERENCES
MANUFACTURER'S DATA
DAIRS MODEL SPECIFICATIONS IIE
TEXT, SECTION E
U.L.APPROVED yes☐ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The switching mechanism of the DAIRS is in two parts. In the first part, the PROCESSOR, electric signals from the carrel selectors are translated into commands for the switches. The processor may be either rotary switches or solid state circuitry, although almost all new installations are solid state. The second part, the CROSSBAR SWITCHING DEVICES, implements the commands of the processor by connecting the carrel with the desired program source.

In a small DAIRS, these operations may be combined in one cabinet. Generally less than thirty carrels and five programs can be handled in this manner. In large systems, there may be an entire bank of equipment performing each operation. Typically, separate power supplies are required for each operation.

SPACE REQUIREMENTS



RELATED EQUIPMENT
STUDENT CARRELS & SELECTORS
PROGRAM SOURCES
POWER SUPPLIES
PARTS STORAGE
AIR CONDITIONING
VENTILATING EQP.

PHYSICAL CHARACTERISTICS
power:
watts volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes■ no■
max.cable length

heat dissipation YES BTU
noise generated YES db

safety hazard: yes■ no☐

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor REQUIRES
ceiling OWN ROOM.
partitions SEE SHT C-K
mobility yes☐ no■
service flexib. yes☐ no■
security locked☐ open■

PEOPLE
user: teach☐ stud☐ other■
operator:
technic☐ teacher☐ student■
remote■ local☐ other☐
special technician yes■ no☐
time/operation mins
no.students/operation
UP TO 2000 AT PRESENT.
CONTROLS
remote■ local☐ other☐
switching:
master■ ind.☐ spec☐other☐
by student yes■ no☐

VISUAL
privacy reqd☐ not req■
illum.range 40 fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■not req☐
noise level SOME db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
AMPEX, CHESTER, NORTH ELECTRIC, RCA
OTHERS

ITEM: SWITCHING MECHANISMS

TYPE: DIAL ACCESS INFORMATION RETRIEVAL SYSTEM COMPONENTS

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS

These items are typical, check specific DAIRS specifications for exact requirements. Generally components from one manufacturer are not compatible with those of another.

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD J

...□ disc□ tape■
ribbon□ other□

...ning:
comm■ local■ other□
ava...ability easy□ diff■
prep.time/program 5-20 hrs
length/typ.programs- 60 mins
kept up to date? yes□ no□
by whom? TEACHER -
AUTHORS

ECONOMICS SEE TEXT, SEC. IIE
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE REQUIRED.

REFERENCES
MANUFACTURER'S DATA

DAIRS MODEL SPECIFICATIONS

TEXT, SECTION IIE

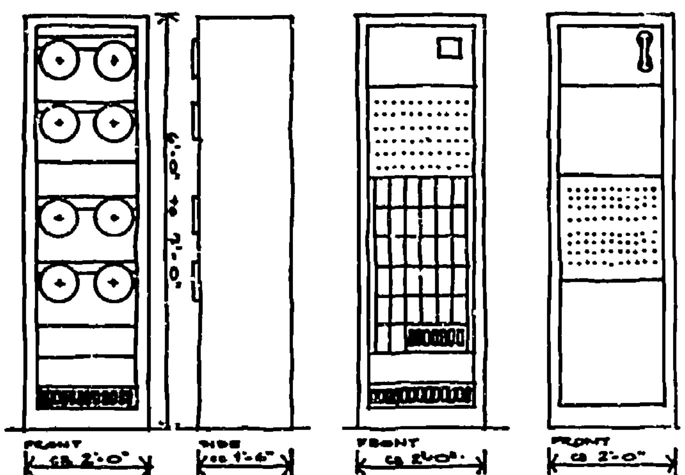
U.L.APPROVED yes□ no□ pend□

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

Presently, there are three program sources available to the DAIRS — video tapes, audio tapes, and live performances. TAPE DECK PROGRAM SOURCES, either audio or video, are contained in upright cabinets of from four to sixteen audio tape transports and up to four video tape transports per cabinet. The decks may have one, two, or four tracks for audio, each with a separate master program. Other types of equipment housed in such cabinets are:

AMPLIFIERS, one is required for each tape deck.
CONTROLS AND MONITORS to check the performance of the system.
PROGRAM BUFFERS on which master program tapes are recorded at high speed onto buffer tapes which are then played back at regular speed to the carrels. This insures that the master program is always available.
REMOTE STUDENT RECORDERS for audio active comparative carrels.

SPACE REQUIREMENTS

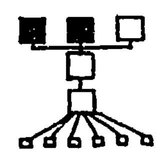


AUDIO PROGRAM EQUIPMENT

t	t	t	t	a	t	t	t	t	c

TYPICAL LAYOUT - 32 PROGRAMS

t : TAPE TRANSPORTS (4-CHANNEL)
a : AMPLIFIERS - MORE REQD WITH MULTI-CHANNEL TAPES.
c : STATUS CONTROL WITH MONITOR



FIGURES , TEXT

RELATED EQUIPMENT
STUDENT CARRELS W/SELECTORS
POWER SUPPLIES
SWITCH. MECH.
PROGRAM SOURCES
AIR CONDITIONING & VENTILATING EQP.
PROGRAM MONITORS
STORAGE

PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. ↓ size ca .50"
telephone connect. yes□ no■
max.cable length
1 CABLE PER PROGRAM SOURCE.
heat dissipation YES BTU
noise generated YES db

safety hazard: yes■ no□

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor | REQUIRE
ceiling | OWN
partitions | ROOM
mobility yes□ no■
service flexib. yes□ no■
security locked□ open■
APPROX 20 $/CABINET OR ABOUT 6 $/PROGRAM SOURCE.

PEOPLE
user: teach□ stud□ other■
operator:
technic□ teacher□ student■
remote■ local□ other□
special technician yes■ no□
time/operation mins
no.students/operation
UP TO 2000 AT PRESENT.

CONTROLS
remote■ local□ other□
switching:
master■ ind.■ spec□ other□
by student yes■ no□

VISUAL
privacy reqd□ not req■
illum.range 40-50 fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd■ des□ not req□
noise level db

THERMAL
oper.temp.range 60°-90 °F
oper.humidity range 20°-80%

MANUFACTURERS
AMPEX, CHESTER, NORTH ELECTRIC, RCA
OTHERS

ITEM: PROGRAM SOURCES AND RELATED EQUIPMENT

TYPE: DIAL ACCESS INFORMATION RETRIEVAL SYSTEM COMPONENTS

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS
Equipment shown is typical, check specific DAIRS specifications for exact requirements. Components of one DAIRS manufacturer generally cannot be used with components of another.

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDK
San Francisco Washington, D.C.

DATA SHEET	
ITEM:	SLIDE AND FILMSTRIP PROJECTORS
TYPE:	FILM PROJECTION SYSTEM COMPONENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDL
San Francisco Washington, D.C.

RE
film☐ disc☐ tape☐
■ ribbon☐ other■
STRIP

programming:
prep.: comm■ local■ other☐
availability easy■ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no☐
by whom? SLIDES - BY USERS, FILMSTRIPS - BY COMMERCIAL.

COSTS SEE COMMENTS
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr☐
custod☐school tech■ other☐
~~related facil. & equip.~~ OR SERVICE CONTRACT MAY BE PROVIDED BY EQP. SUPPLIER

REFERENCES
A-V EQUIPMENT DIRECTORY
N.E.A. - EDUCATIONAL FACILITIES W/NEW MEDIA

TEXT, SECTION III A 4

U.L.APPROVED yes☐no☐pend☐

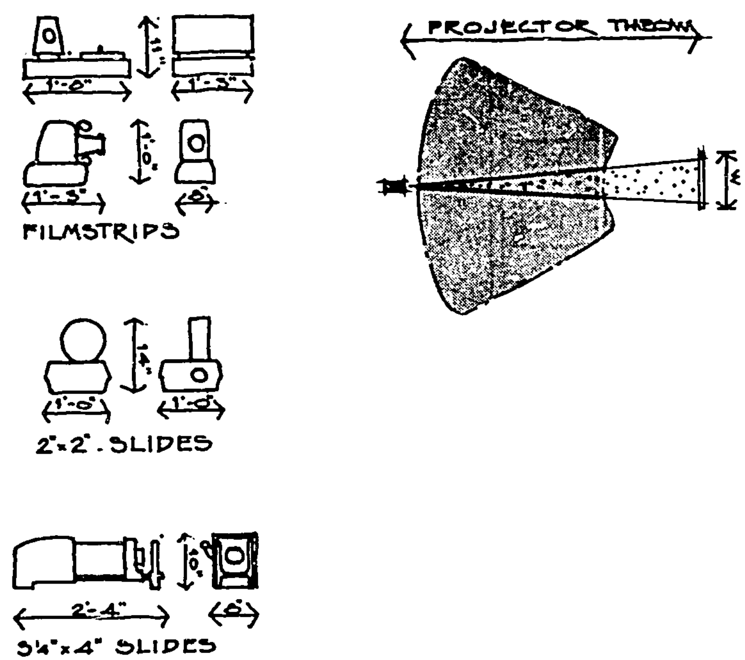
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

For various reasons, the 35mm, or 2" by 2", SLIDE PROJECTOR is the most commonly used in this medium. The availability of materials, which may be prepared with a simple 35mm camera, has led to this popularity. 35mm projectors are available in many price ranges, may be remotely controlied and random accessed, and can easily be adapted to large or small space or television film chain operation.

The 3 1/4" by 4" SLIDE PROJECTOR does not enjoy the popularity of the 35mm, partially because of its greater size and cost. A larger, more intense image is projected by the 3 1/4 by 4 making its use desirable in very large spaces. Some materials are available only in 3 1/4 by 4 slides.

FILMSTRIP PROJECTORS are an important classroom tool, both for class and individual use. The filmstrip may have a sound track or an accompanying record to provide sound.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

PROJECTOR TYPE	PROJECTOR THROW	COST	WEIGHT
35mm Slide	1W to 6W	$100/400	up to 15 lbs.
3 1/4 by 4 Slide	min, 1W	$300/3000	up to 40 lbs.
Filmstrip	1W to 6W	$150/300	up to 15 lbs.

RELATED EQUIPMENT
SCREEN
CART OR STAND
MULTIPLEXER

FOR FILM CHAIN SEE SHEET ~~B-3~~ CC

PHYSICAL CHARACTERISTICS
power: 100 TO 1000 W.
watts 117 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
max.cable length

heat dissipation 60MB BTU
noise generated NIL db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight UP TO 40 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic■ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐other☐
by student yes☐ no■

VISUAL
privacy reqd■ not req☐
illum.range SLIDES 5-10fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd■ not reqd☐
vert.view angle 30°
horiz.view angle 120
FILMSTRIPS: 10-15fc
REAR PROJECTION NORMAL LEVELS.

ACOUSTIC
privacy reqd☐ des☐not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS BELL & HOWELL, KODAK, GRAFLEX, VICTOR, OTHERS

DATA SHEET

SOFTWARE
slide ■ film ☐ disc ☐ tape ☐
record ☐ ribbon ☐ other ■
TRANSPARENCIES & CELLOPHANE ROLLS
programming:
prep.: comm ■ local ■ other ☐
availability easy ■ diff ☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes ■ no ☐
by whom? USERS

[illegible]
first cost range $1250
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular ☐ 6mo ☐ 1yr ☐ 2yr ☐
as nec ■ 3yr ☐ 5yr ☐ 10yr ☐
repair time:
hrs ☐ dys ☐ wks ☐ mos ☐
location: on premises ☐
in place ☐ factory ☐ other ☐
personnel: mfr ■
custod ☐ school tech ☐ other ☐
related facil.& equip:

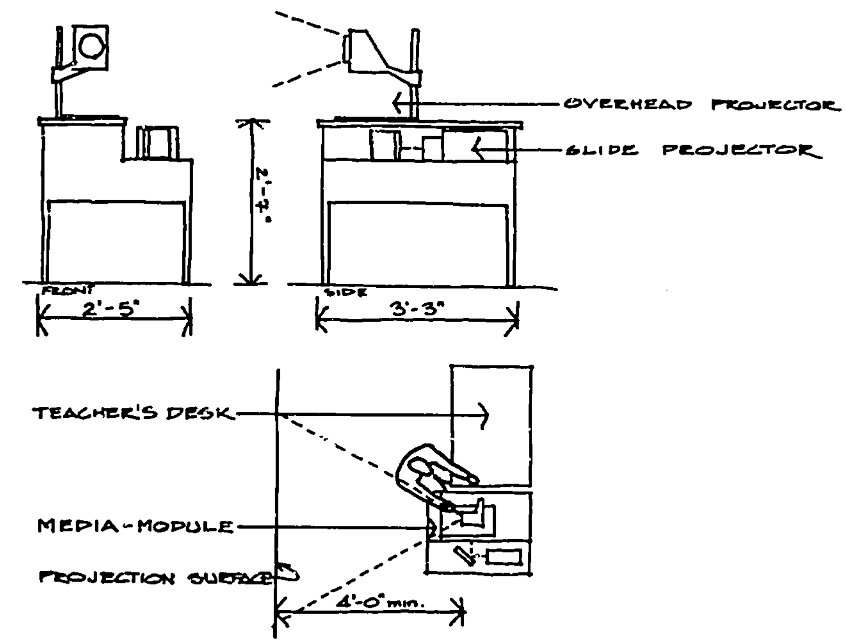
REFERENCES
MFGRS DATA
TEXT SECTION III B

U.L.APPROVED yes ☐ no ☐ pend ☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

This mobile device combines the desk side advantages of the overhead projector (q. v.) with a slide and a filmstrip projector. The configuration of the unit is such that the image of the slide or frame is projected through the plate of the overhead projector. The teacher is thus able to write or draw upon the image. The combined image is then seen on the screen.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
SCREEN OR DISPLAY SURFACE
FILM & SLIDES
TRANSPARENCIES
CELLOPHANE ROLLS
INK, ETC.

PHYSICAL CHARACTERISTICS
power:
1000 watts 115 volts phase
battery yes ☐ no ■
stand-by power yes ☐ no ■
umb.cables: no. size
telephone connect. yes ☐ no ■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes ☐ no ■

color/fin. choice yes ☐ no ■

DIRECT DEMANDS ON BLDG.
weight 110 lbs
vibration
shock
floor
ceiling
partitions
mobility yes ■ no ☐
service flexib. yes ■ no ☐
security locked ☐ open ■

PEOPLE
user: teach ■ stud ☐ other ☐
operator:
technic ☐ teacher ■ student ☐
remote ☐ local ■ other ☐
special technician yes ☐ no ■
time/operation mins
no.students/operation
CLASSROOM GROUP

CONTROLS
remote ☐ local ■ other ☐
switching:
master ☐ ind. ■ spec ☐ other ☐
by student yes ☐ no ■

VISUAL
privacy reqd ☐ not req ■
illum.range 30 fc
daylight reqd ☐ not reqd ■
dimming reqd ■ not reqd ☐
darkening reqd ☐ not reqd ■
vert.view angle 30 °
horiz.view angle 90 °

ACOUSTIC
privacy reqd ☐ des ☐ not req ☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range

MANUFACTURERS
HOPPMAN

ITEM: MULTI-PROJECTOR MODULE

TYPE: FILM PROJECTION SYSTEM COMPONENT

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD
San Francisco Washington, D.C.

SOFTWARE (partly cut off)

~~□~~ film□ disc□ tape□
□ ribbon□ other■ TRANSPARENCIES & ←
CELLOPHANE ROLLS
programming:
prep.: comm□ local□ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

ECONOMICS

first cost range	$120-300
installation cost	$
operating cost/yr	$
maintenance cost/yr	$
cost/student/year	$
lease cost	$
equipment life	

MAINTENANCE

frequency:
regular□ 6mo□ 1yr□ 2yr□
as nec■ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys□ wks□ mos□
location: on premises■
in place□ factory□ other□
personnel: mfr□
custod□ school tech■ other□
~~related facil. & equip.~~ OR SERVICE CONTRACT W/EQP. SUPPLIER

REFERENCES

MFGRS DATA
TEXT SECTION III. B

U.L.APPROVED yes■ no□ pend□

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.

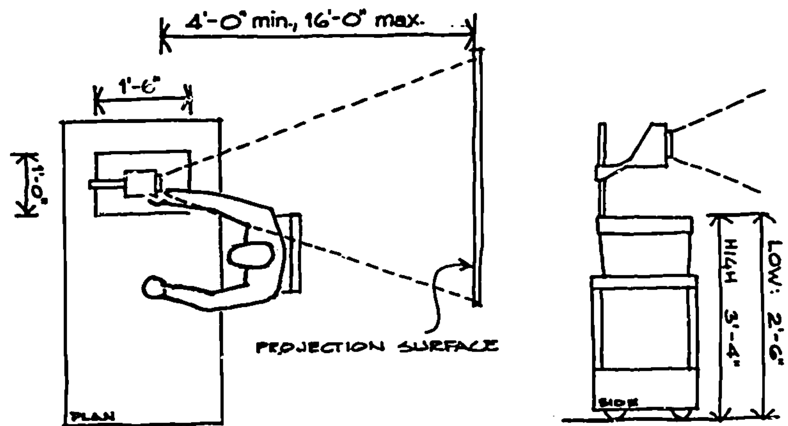
(wherever "other" has been checked on this page, please describe here or below.)

The OVERHEAD PROJECTOR allows the teacher to remain at his desk and perform many of the tasks he formerly did at the chalkboard -- drawings and large written materials to illustrate lessons. Commercially or locally prepared transparencies may also be projected with the overhead projector.

The projector typically is placed beside the teachers desk on a movable cart, although newer desks may have built in projector holders, a fact that refects the acceptance of this most useful classroom tool.

The projector is also used as a component of the "blackboard by wire" system. For further details of this system see DATA SHEET ~~F-1~~ G: REMOTE BLACKBOARD. Information is also found in Section ~~F~~ II D of the text.

SPACE REQUIREMENTS



PROJECTOR AT DESK

ON CART

RELATED EQUIPMENT

DISPLAY SURFACE OR SCREEN
STAND
CELOPHANE ROLLS
INK, ETC.
AS REMOTE BLACKBOARD, SEE SHEET ~~F-1~~ G

PHYSICAL CHARACTERISTICS

power: UP TO 1000 W
watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. size
telephone connect. yes□ no■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.

weight 20-40 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no□
service flexib. yes■ no□
security locked□ open□

PEOPLE

user: teach□ stud■ other□
operator:
technic□ teacher■ student□
remote□ local■ other□
special technician yes□ no■
time/operation mins
no.students/operation
CLASSROOM GROUP

CONTROLS

remote□ local■ other□
switching:
master□ ind.■ spec□other□
by student yes□ no■

VISUAL

privacy reqd□ not req■
illum.range 30-50 fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle 30°
horiz.view angle 90°

ACOUSTIC

privacy reqd□ des□ not req■
noise level db

THERMAL

oper.temp.range °F
oper.humidity range %

MANUFACTURERS

MANUFACTURERS BESELER, BUHL OPTICAL, GRAPLEX, 3M, TECHNIFAX
OTHER

ITEM: OVERHEAD PROJECTOR

TYPE: FILM PROJECTION SYSTEM COMPONENTS

COMMENTS AND SPECIAL REQUIREMENTS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD

SOFTWARE
slide☐ film☐ disc☐ tape☐
record☐ ribbon☐ other☐
OPAQUE MATERIALS
UP TO 10" x 10"
programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS
first cost range $250-400
installation cost $
operating cost/yr $
maintenance cost/yr $ 10
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs☐ dys☐ wks☐ mos☐
location: on premises☐
in place☐ factory☐ other☐
personnel: mfr☐
custod☐ school tech☐ other☐
~~related facil.& equip:~~ OR
SERVICE CONTRACT
W/EQP. SUPPLIER

REFERENCES
A-V EQUIPMENT
DIRECTORY (1967)
MFGRS DATA

TEXT, SECTION ØIIC

U.L.APPROVED yes☐ no☐ pend☐

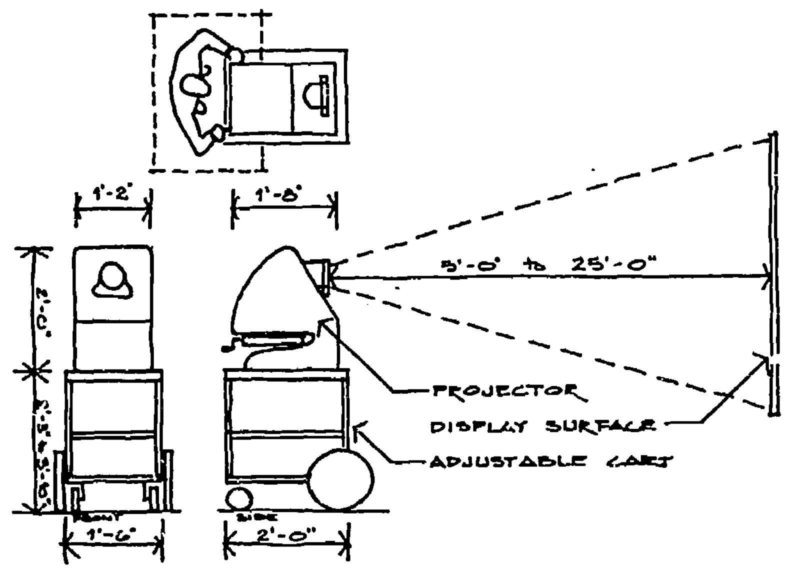
DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

Books, photographs, and other opaque materials may be projected onto a screen or light wall surface with the OPAQUE PROJECTOR. The size and weight of the projector as well as the weakness of its projected image have reduced its use, however, in favor of other devices such as the overhead projector.

A second use of this device is the projection of enlarged diagrams, sketches, maps, and photos onto large sheets of paper. Drawing over the projected image produces a quick and inexpensive, rough enlargement of the material.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
CART OR STAND
DISPLAY SURFACE
OR SCREEN
LIGHT POINTER

PHYSICAL CHARACTERISTICS
power:
1000watts 115 volts phase
battery yes☐ no☐
stand-by power yes☐ no☐
umb.cables: no. size
telephone connect. yes☐ no☐
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight UP TO 40 lbs
vibration
shock
floor
ceiling
partitions
mobility yes☐ no☐
service flexib. yes☐ no☐
security locked☐ open☐

PEOPLE
user: teach☐ stud☐ other☐
operator:
technic☐ teacher☐ student☐
remote☐ local☐ other☐
special technician yes☐ no☐
time/operation mins
no.students/operation
CLASSROOM GROUP

CONTROLS
remote☐ local☐ other☐
switching:
master☐ ind.☐ spec☐ other☐
by student yes☐ no☐

VISUAL
privacy reqd☐ not req■
illum.range 5-10 fc
daylight reqd☐ not reqd■
dimming reqd■ not reqd☐
darkening reqd■ not reqd☐
vert.view angle °
horiz.view angle 90 °

ACOUSTIC
privacy reqd☐ des☐ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS AMERICAN
OPTICAL, BESELER,
SQUIBB TAYLOR,
OTHERS

ITEM: OPAQUE PROJECTOR

TYPE: FILM PROJECTION SYSTEM COMPONENT

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD 0

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDP
San Francisco Washington, D.C.

ITEM: 8mm AND 16mm MOTION PICTURE PROJECTORS

TYPE: FILM PROJECTION SYSTEMS

[SOFT]WARE
[vi]de☐ film■ disc☐ tape☐
[rec]ord☐ ribbon☐ other☐

programming:
prep.: comm■ local☐ other☐
availability easy■ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no☐
by whom? NEW RELEASES BY COMMERCIAL SUPPLIERS

ECONOMICS
first cost range $200/500
installation cost $
operating cost/yr $
maintenance cost/yr $ 30
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises☐
in place☐ factory☐ other■
personnel: mfr☐
custod☐ school tech☐ other■
related facil.& equip:
EQP SUPPLIER PROVIDES SERVICE CONTRACT

REFERENCES
N.E.A.- EDUCATIONAL FACILITIES WITH NEW MEDIA

MFGRS. DATA

TEXT. SECTION 4 III D

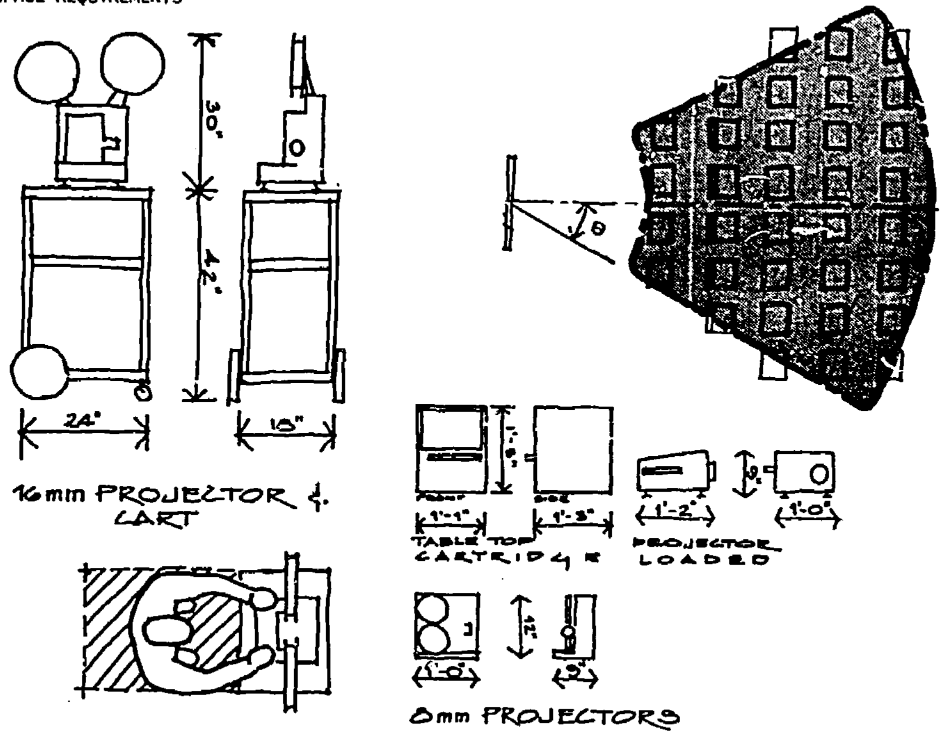
U.L.APPROVED yes☐ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The 16mm MOTION PICTURE PROJECTOR is the most commonly used motion picture projector. This reel film device is simple to use, easy to maintain and store, and has good performance even in quite large spaces. It is available with a variety of sound reproduction mechanisms. The widest selection of motion pictures, including many first-run commercial offerings, is available on 16mm film.

The introduction of the 8mm film cartridge or magazine as well as smaller size and weight have greatly increased the popularity of the 8mm MOTION PICTURE PROJECTOR for classroom use. One of the major advantages still enjoyed by 16mm is the smaller selection of films available in 8mm. The 8mm is available as a table top model with a small, page-size, rear projection screen.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
SCREEN
CART OR STAND
SPEAKERS
FILM

FOR FILM CHAIN SEE SHEET E-5CC

LENSES
SELF THREADER
TAKE UP REELS

PHYSICAL CHARACTERISTICS
power: 800 TO 1000 W
watts 117 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. 1 size '8'od
telephone connect. yes☐ no■
max.cable length 10' TO 17'

TO REMOTE SPEAKERS
heat dissipation SOME BTU
noise generated YES db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight 15 - 50 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic■ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation
VARIES

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd■ not req☐
illum.range SEE BELOW fc
daylight reqd☐ not reqd■
dimming reqd■ not reqd☐
darkening reqd■ not reqd☐
vert.view angle °
horiz.view angle °
LOW LUMEN: 5-10 fc
HIGH LUMEN: 15-25 fc

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
BELL & HOWELL,
GRAFLEX, RCA,
VICTOR, KALART
TECHNICOLOR

OTHER

WARE
e☐ film☐ disc☐ tape☐
rd☐ ribbon☐ other☐

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.prog m mins
kept up to date: yes☐ no☐
by whom?

ECONOMICS
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE (OF FILM)
frequency: PER USE
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr☐
custod☐ school tech■ other☐
related facil.& equip:
FILM EDITOR, SPLICER & CLEANER

REFERENCES
H. E. W. - PLANNING SCHOOLS FOR NEW MEDIA (1962)

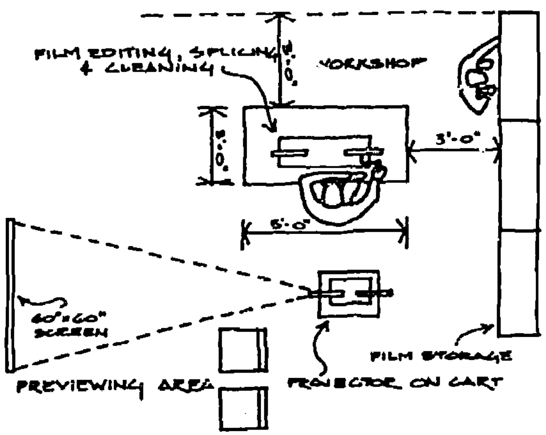
U.L.APPROVED yes☐ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

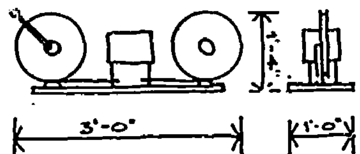
A WORKSHOP for editing, cleaning, and repairing film will be useful to all but the smallest film libraries. Good practice demands that films be inspected often for defects, damages, and wear. Good care results in longer film life and improved performance quality.

The film workshop should be located near the film storage and distribution areas and near the darkroom where films are processed. It may also be desirable to set aside a small area where teachers may preview films and other displays before presentation. This area need not have permanent seating if chairs are available.

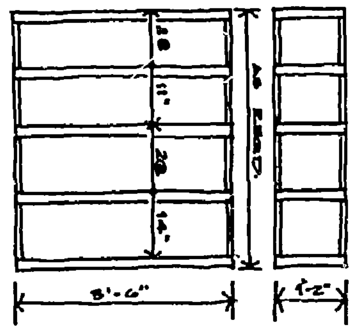
SPACE REQUIREMENTS



FILM WORKSHOP LAYOUT



16mm FILM EDITOR (8mm SLIGHTLY SMALLER)



FILM STORAGE RACK

RELATED EQUIPMENT
FILM EDITOR
WORK TABLE(S)
FILM STORAGE RACKS
PROJECTOR & CART
SCREEN (60" x 60")

PHYSICAL CHARACTERISTICS
power:
watts 117 volts phase
battery yes☐ no☐
stand-by power yes☐ no☐
umb.cables: no. size
telephone connect. yes☐ no☐
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor
ceiling
partitions
mobility yes☐ no■
service flexib. yes☐ no■
security locked☐ open☐
SHOP SHOULD BE LOCKED FOR SECURITY.

PEOPLE
user: teach☐ stud☐ other☐
operator:
technic■ teacher☐ student☐
remote☐ local■ other☐
special technician yes■ no☐
time/operation mins
no.students/operation

CONTROLS
remote☐ local☐ other☐
switching:
master☐ ind.☐ spec☐ other☐
by student yes☐ no☐

VISUAL
privacy reqd■ not req☐
illum.range 40 - 50 fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd■ not reqd☐
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level CONSIDERABLE

THERMAL (FOR FILM)
oper.temp.range BELOW 80°F
oper.humidity range 25-60 %

MANUFACTURERS (EDITORS)
BELL & HOWELL, HARWALD, KODAK
(FURNITURE)
A-V, STD.-LUXOR OTHERS

ITEM: FILM MAINTENANCE AND EDITING WORKSHOP

TYPE: FILM PROJECTION SYSTEM COMPONENT

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDQ
San Francisco Washington, D.C.

DATA SHEET

[...]WARE
[..]□ film■ disc□ tape□
record■ ribbon□ other□

programming:
prep.: comm■ local□ other□
availability easy■ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no□
by whom? NEW RELEASES BY COMM. SUPPLIERS

[...]
first cost range $900-1500
installation cost $
operating cost/yr $
maintenance cost/yr $ 50
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular□ 6mo□ 1yr□ 2yr□
as nec■ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys□ wks□ mos□
location: on premises■
in place□ factory□ other□
personnel: mfr□
custod□ school tech■ other□
~~related facil.& equipt~~ OR SERVICE CONTRACT WITH EQP. SUPPLIER

REFERENCES
A-V EQUIPMENT DIRECTORY (1967)
MFGRS DATA

TEXT, SECTION III.D,E 4

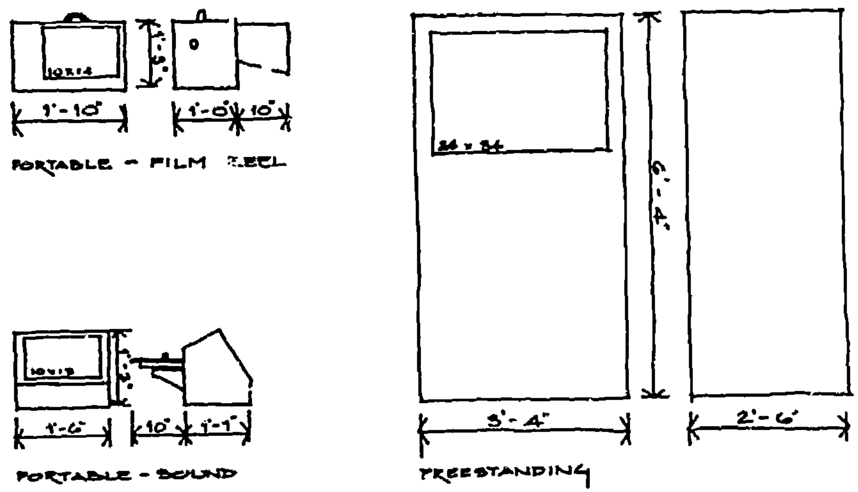
U.L.APPROVED yes■ no□ pend□

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The REPETITIVE PROJECTOR displays brief films when activated by the viewer. At the end of the program it rewinds the film if necessary and either shuts itself off to await the next viewer or repeats the entire program automatically.

Small, portable units, designed for small group viewing, are available as well as large freestanding consoles. The larger consoles are used where larger audiences are expected or where problems of security -- fairs, etc.,- are anticipated.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
CARTS OR STANDS
FILMS - MAGAZINE REEL

PHYSICAL CHARACTERISTICS
power: 100 TO 1000 W
watts 117 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. size
telephone connect. yes□ no■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight SMALL 40lbs
vibration CONSOLE - 400#
shock
floor MUST CARRY LOAD
ceiling
partitions
mobility yes■ no□
service flexib. yes■ no□
security locked■ open■
LARGE UNITS MAY BE MOVED ON SPECIAL CARTS.

PEOPLE
user: teach□ stud■ other□
operator:
technic□ teacher□ student■
remote□ local■ other□
special technician yes□ no■
time/operation mins
no.students/operation
VARIES, UP TO 40.

CONTROLS
remote□ local■ other□
switching:
master□ ind.□ spec■ other■
by student yes■ no□
MAY BE SELF RE-CYCLING

VISUAL
privacy reqd□ not req■
illum.range 25-40 fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle 30 °
horiz.view angle 40-80 °

ACOUSTIC
privacy reqd□ des■ not req□
noise level LOW db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS BUSCH, HARWALD, HOFFMAN, MOVIE MITE, VICTOR-KALART

OTHER

ITEM: REPETITIVE FILM PROJECTORS

TYPE: FILM PROJECTION SYSTEMS COMPONENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD®
San Francisco Washington, D.C.

SOFTWARE
slide■ film■ disc☐ tape☐
record☐ ribbon☐ other☐

programming:
prep.: comm■ local■ other☐
availability easy■ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no☐
by whom?

first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr☐
custod■ school tech☐ other☐
related facil.& equip:

REFERENCES
R.P.I. - NEW SPACES FOR LEARNING
MFGRS DATA - R.C.A.
TEXT, SECTION III-H
U.L.APPROVED yes☐ no☐ pend☐

DATA SHEET

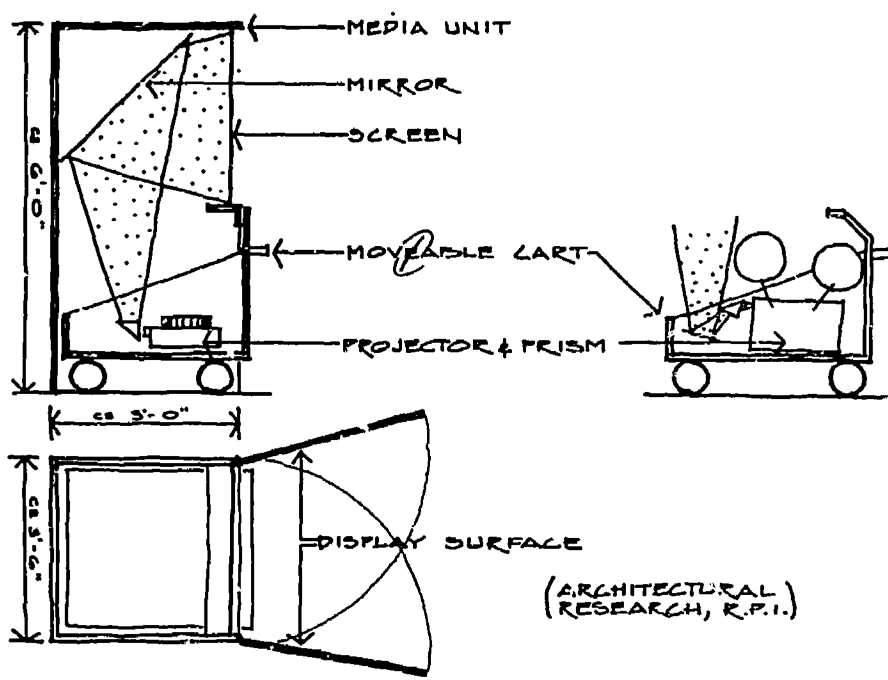
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

This MEDIA MODULE concept, developed by the Architectural Research Division of Rensselaer Polytechnic Institute, combines some of the mobility of the multi-projector console with the design and room layout desirability of the fixed rear screen. Various projectors with pre-calibrated prism and mirror systems are mounted on moveable carts. A built-in cabinet in each space has an open lower section into which the cart with the desired projector is "plugged in."

The unit -- screen cabinet and media carts -- may be fabricated locally either in the school shops or under contract to local design and specification.

A related device is the RCA AVS-16 REAR SCREEN PROJECTOR CABINET. This unit may be built in or mounted on a rolling base. The AVS-16 contains optical relay lenses which couple to a 2" projector lens and allow the cabinet to be used with filmstrip, slide, and motion picture projectors. The AVS-16 is available with a 12" speaker for sound use.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
PROJECTORS:
8mm MOTION PICT.
16mm MOTION PICT.
35mm SLIDE
35mm FILMSTRIP

PHYSICAL CHARACTERISTICS
power: AS PER PROJECTOR
watts volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
~~max.cable length~~ CABINET SHOULD PROVIDE AC SERVICE OUTLET.
heat dissipation BTU
noise generated db
SEE THERMAL & ACOUSTICS
safety hazard: yes☐ no■
color/fin. choice yes■ no☐

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor | CABINET IS
ceiling | BUILT IN.
partitions
mobility yes☐ no■
service flexib. yes■ no☐
security locked■ open☐

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation
CLASSROOM GROUP

CONTROLS
remote■ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd☐ not req■
illum.range NORMAL fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle 30°
horiz.view angle 40°-50°

ACOUSTIC
privacy reqd■ des☐ not req☐
noise level db
CABINET SHOULD PROVIDE ACOUSTIC INSULATION.

THERMAL
oper.temp.range °F
oper.humidity range %
CABINET SHOULD BE VENTED.

MANUFACTURERS
SEE "DESCRIPTION"
RCA

ITEM: FIXED SCREEN CABINET, PLUG IN MEDIA CARTS

TYPE: FILM PROJECTION SYSTEM COMPONENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD S

ARE
■ film■ disc□ tape□
□ ribbon□ other■
TRANSPARENCIES

programming:
prep.: comm■ local■ other□
availability easy■ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

first cost range $5000
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular□ 6mo□ 1yr□ 2yr□
as nec■ 3yr□ 5yr□ 10yr□
repair time:
hrs□ dys□ wks□ mos□
location: on premises□
in place□ factory□ other□
personnel: mfr■
custod□school tech□ other□
related facil.& equip:

REFERENCES
N.E.A. - EDUCATIONAL FACILITIES WITH NEW MEDIA (1960)
MFGRS DATA

TEXT, SECTION III H 4

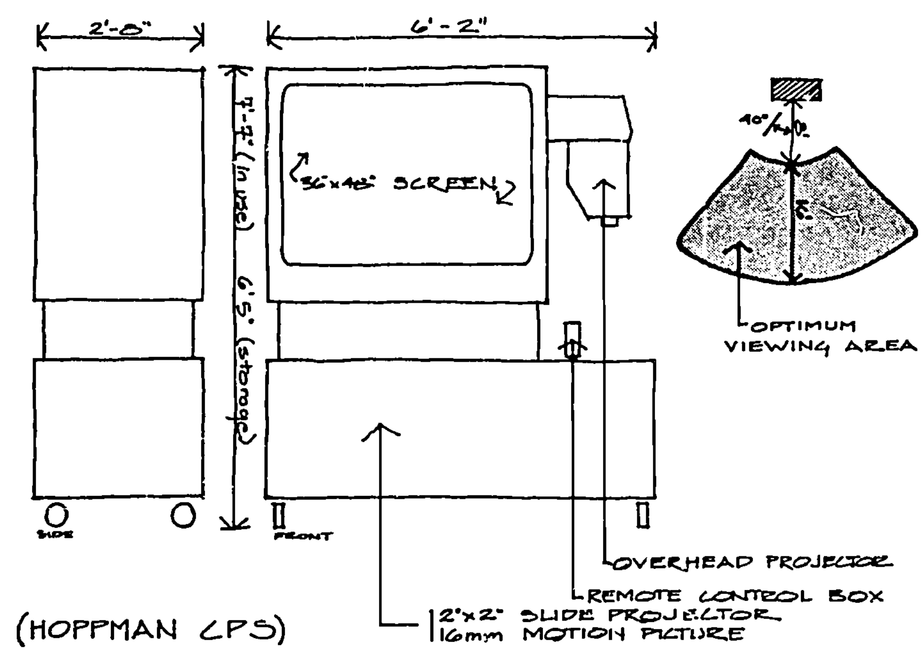
U.L.APPROVED yes□no□pend□

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

This MULTI-MEDIA PROJECTOR permits rear screen projection of various media without the need for building screens, booths, etc., into the classroom. The height of the console which raises the screen to a good viewing height, requires that the screen housing be lowered before the unit can be moved through standard doors.

The console is available with various projector combinations. Viewing area is calculated as with any rear screen projection system (see DATA SHEET G-5:V REAR SCREEN PROJECTION) A 25' cable with a simple control box allows the teacher remote control of the presentation. Related devices are found on the following data sheets.

SPACE REQUIREMENTS



(HOPPMAN CPS)

RELATED EQUIPMENT
FILMS
SLIDES
TRANSPARENCIES
STORAGE

PHYSICAL CHARACTERISTICS
power:
1725watts 115volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. size
telephone connect. yes□ no■
max.cable length REMOTE CONTROL CABLE-25'

heat dissipation BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight 600 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no□
service flexib. yes■ no□
security locked■ open□

PEOPLE
user: teach□ stud■ other□
operator:
technic□ teacher■ student□
remote□ local■ other□
special technician yes□ no■
time/operation mins
no.students/operation
CLASSROOM GROUP

CONTROLS
remote□ local■ other□
switching:
master□ ind.■ spec□other□
by student yes□ no■

VISUAL
privacy reqd□ not req■
illum.range NORMAL fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle 30°
horiz.view angle 40°-80°

ACOUSTIC
privacy reqd□ des□not req□
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
HOPPMAN
RCA

ITEM: MULTI-PROJECTOR CONSOLE

TYPE: FILM PROJECTION SYSTEMS COMPONENT

COMMENTS AND SPECIAL REQUIREMENTS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD T

SOFTWARE
slide ☐ film ■ disc ☐ tape ☐
cord ☐ ribbon ☐ other ☐

programming:
prep.: comm ☐ local ☐ other ☐
availability easy ☐ diff ☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes ☐ no ☐
by whom?

ECONOMICS
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular ☐ 6mo ☐ 1yr ☐ 2yr ☐
as nec ■ 3yr ☐ 5yr ☐ 10yr ☐
repair time:
hrs ☐ dys ☐ wks ☐ mos ☐
location: on premises ☐
in place ■ factory ☐ other ☐
personnel: mfr ☐
custod ■ school tech ☐ other ☐
related facil.& equip:

REFERENCES
POLACOAT, INC.

TEXT SECTION III H

U.L.APPROVED yes ☐ no ☐ pend ☐

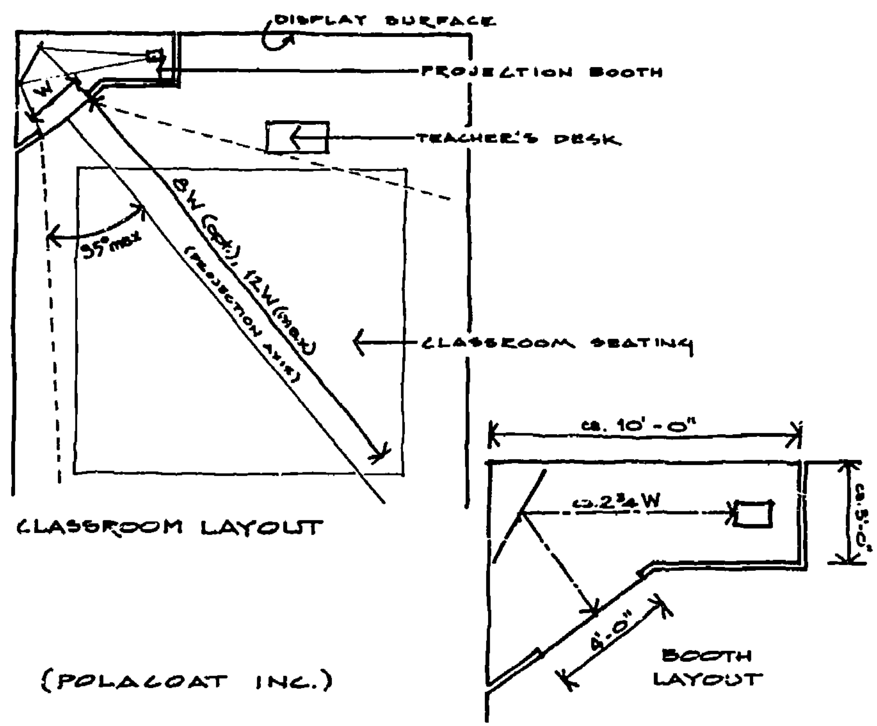
DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The REAR SCREEN PROJECTION CABINET is particularly applicable to classroom rehabilitation and renovation. It offers better noise and heat insulation than the media module and better security in that it may be locked.

This scheme, developed by POLACOAT, INC., provides the advantages of rear screen projection, although the placement of the booth to the side of the classroom forces the viewers to sit at an angle when the screen is being used. Remote control apparatus is necessary with this installation.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
PROJECTORS
SOUND APPARATUS
MULTIPLEXER (OPT.)
PROJECTOR CARTS

REMOTE CONTROL APPARATUS

PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes ☐ no ■
stand-by power yes ☐ no ■
umb.cables: no. size
telephone connect. yes ☐ no ■
max.cable length

heat dissipation YES BTU
noise generated YES db

safety hazard: yes ☐ no ■

color/fin. choice yes ■ no ☐

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor — UNIT IS BUILT
ceiling — INTO BLDG
partitions
mobility yes ☐ no ■
service flexib. yes ■ no ☐
security locked ■ open ☐
SERVICE OUTLETS MUST BE PROVIDED WITHIN BOOTH.

PEOPLE
user: teach ☐ stud ■ other ☐
operator:
technic ☐ teacher ■ student ☐
remote ■ local ☐ other ☐
special technician yes ☐ no ☐
time/operation mins
no.students/operation
UP TO 40 IN DESKS
60 IN CHAIRS

CONTROLS
remote ■ local ☐ other ☐
switching:
master ☐ ind. ■ spec ☐ other ☐
by student yes ☐ no ■

VISUAL WITHIN BOOTH
privacy reqd ■ not req ☐
illum.range IDEAL 0 fc
daylight reqd ☐ not reqd ■
dimming reqd ☐ not reqd ■
darkening reqd ■ not reqd ☐
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd ■ des ☐ not req ☐
noise level CONSIDERABLE
BOOTH MUST PROVIDE ACOUSTIC INSULATION.

THERMAL
oper.temp.range °F
oper.humidity range %
MUST BE VENTILATED

MANUFACTURERS
SCREEN: POLACOAT

ITEM: REAR SCREEN PROJECTOR CABINET (CLASSROOM)

TYPE: FILM PROJECTION SYSTEM COMPONENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDU
San Francisco Washington, D.C.

FTWARE
ide□ film■ disc□ tape□
cord□ ribbon□ other□

programming:
prep.: com□ local□ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

ECONOMICS
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular□ 6mo□ 1yr□ 2yr□
as nec■ 3yr□ 5yr□ 10yr□
repair time:
hrs□ dys□ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr□
custod■ school tech□ other□
related facil.& equip:

REFERENCES
N.E.A. - EDUCATIONAL FACILITIES WITH NEW MEDIA (1960)
ARCH. RECORD: "A-V SYSTEMS - LARGE GROUPS"
TEXT, SECTION G III H
U.L.APPROVED yes□ no□ pend□

DATA SHEET

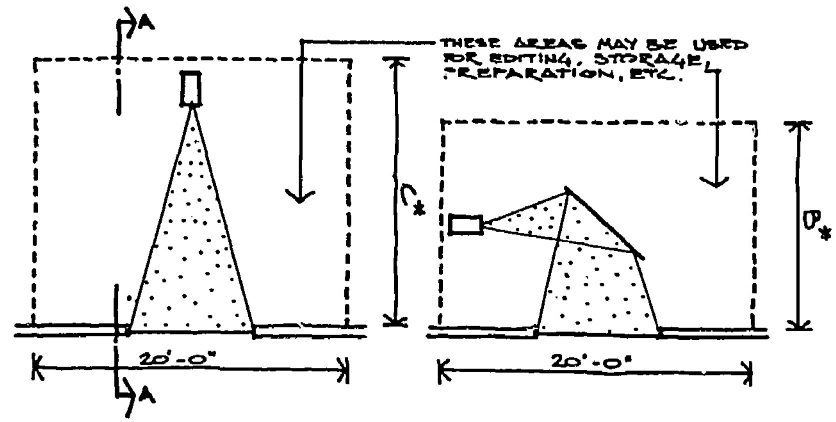
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

REAR SCREEN PROJECTION has numerous advantages over front screen projection, the most important being that rear screen projection allows a higher ambient light level in the viewing area. Facilities must be built in and require a good deal of additional space for operation. The amount of additional room required makes use of this space for film editing and storage, and program and display preparation highly desirable.

If several spaces are served and/or several projection techniques are used, a provision should be made for an operator or a small projection crew which may be students not in class.

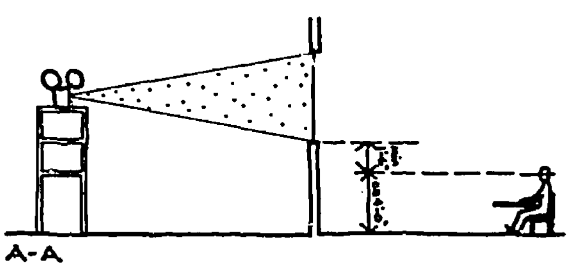
Other information on rear screen projection is found in Section G of the text.

SPACE REQUIREMENTS



* NUMBER OF STUDENTS	B	C
100	10'-0"	14'-0"
300	15'-6"	17'-6"
650	17'-0"	21'-0"
1000	21'-0"	25'-0"

(ARCH. RECORD)



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
PROJECTORS
MULTIPLEXER
MIRRORS &/OR PRISMS
FILM EDITING EQP.
FILM STORAGE RACKS

REMOTE CONTROL APPARATUS

PHYSICAL CHARACTERISTICS
power:
watts 115 volts phase
battery yes□ no□
stand-by power yes□ no□
umb.cables: no. size
telephone connect. yes□ no□
max.cable length

heat dissipation YES BTU
noise generated YES db

safety hazard: yes□ no□

color/fin. choice yes□ no□

DIRECT DEMANDS ON BLDG.
weight lbs
vibration | BOOTH MUST
shock | BE BUILT IN
floor | TO SCHEME
ceiling | OF BLDG
partitions
mobility yes□ no■
service flexib. yes□ no■
security locked■ open□
OUTLETS MUST BE PROVIDED TO SERVICE ALL EQUIPMENT.

PEOPLE
user: teach□ stud■ other□
operator:
technic■ teacher■ student□
remote■ local□ other□
special technician yes■ no■
time/operation mins
no.students/operation
UP TO 1000

CONTROLS
remote■ local□ other□
switching:
master■ ind.□ spec□ other□
by student yes□ no■

VISUAL
privacy reqd■ not req□
illum.range SEE BELOW fc
daylight reqd□ not reqd■
dimming reqd■ not reqd□
darkening reqd■ not reqd□
vert.view angle °
horiz.view angle °
LOW AMBIENT LIGHT WITHIN BOOTH DURING PROJECTION (0-5 fc)
ACOUSTIC
privacy reqd■ des□ not req□
noise level BOOTH db
MUST BE ACOUSTIC ISOLATED FROM VIEWING SPACE.

THERMAL
oper.temp.range °F
oper.humidity range %
VENTILATION & COOLING OF SPACE REQUIRED.

MANUFACTURERS (SCREEN)
POLACOAT, INC.

OTHERS

ITEM: REAR SCREEN PROJECTOR BOOTH

TYPE: FILM PROJECTION SYSTEM COMPONENTS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.

tWARE
de☐ film☐ disc☐ tape☐
ord☐ ribbon☐ other☐

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS
first cost range $.50-3/☐
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life
COST VARIES WITH TYPE, QUALITY, MOUNTING & SIZE OF SCREEN.

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr☐
custod■ school tech☐ other☐
related facil.& equip:

REFERENCES
A-V EQUIPMENT DIRECTORY
ARCH. GRAPHIC STANDARDS
N.E.A.-EDUCATIONAL FACILITIES-NEW MEDIA TEXT, SECTION 4 III H

U.L.APPROVED yes☐ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The size and surface of the FRONT PROJECTION SCREEN largely determines the optimum viewing area for materials projected onto it. There are four types of screen surfaces which are shown below.

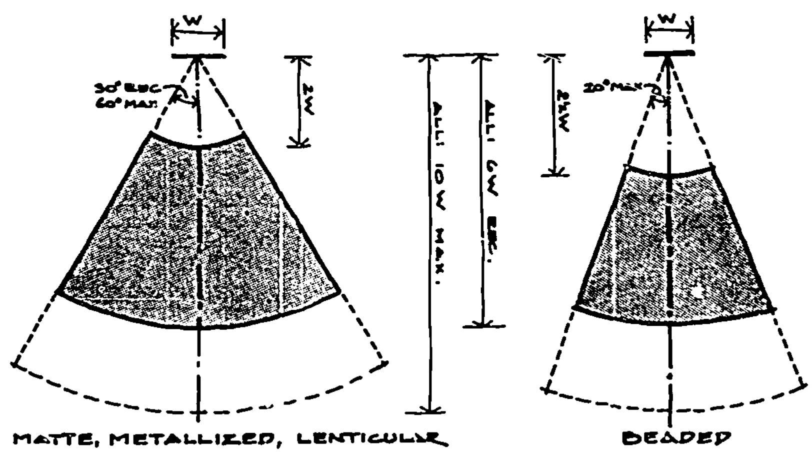
The most common screen sizes for classroom use are: 40"x40",48"x48",60"x60",70"x70".

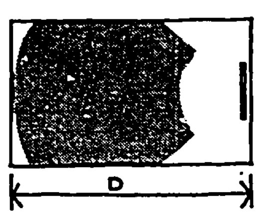
The most common sizes for large group use are: 8'x8',10'x10',9'x12',12'x12'.

Special sizes are available up to 30'x30'.

It should be noted that the optimum viewing area for a 40"x40" screen is practically identical with that of a 23" television monitor, making this an ideal combination for the classroom.

SPACE REQUIREMENTS





ROOM & SCREEN SIZE
IF ROOM SIZE OR GROUP SEATING AREA IS KNOWN, THEN
PREFERRED $W = \frac{D}{6}$
MINIMUM $W = \frac{D}{10}$

COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
FILM PROJECTION EQUIPMENT
SCREEN MOUNTS
TRIPOD MOUNTS
ELECTRIC OPERATING MOTORS

PHYSICAL CHARACTERISTICS
power:
watts volts phase
battery yes☐ no☐
stand-by power yes☐ no☐
umb.cables: no. size
telephone connect. yes☐ no☐
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no☐

color/fin. choice yes☐ no☐

DIRECT DEMANDS ON BLDG.
weight VARIES lbs
vibration
shock
floor
ceiling | MAY BE MOUNTED TO EITHER
partitions |
mobility yes■ no☐
service flexib. yes☐ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher☐ student☐
remote☐ local☐ other☐
special technician yes☐ no■
time/operation mins
no.students/operation
VARIES, SEE DIAGRAMS

CONTROLS
remote☐ local☐ other☐
switching:
master☐ ind.☐ spec☐ other☐
by student yes☐ no☐

VISUAL
privacy reqd■ not reqd☐
illum.range FOR REC.
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd■ not reqd☐
vert.view angle 30 °
horiz.view angle SEE °
DIAGRAMS; LIGHT LEVELS, SEE PROJECTION MEDIA SHEETS

ACOUSTIC
privacy reqd☐ des☐ not reqd☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS DA-LITE, KNOX, MAYER, RADIANT, TECHNIFAX
OTHERS

ITEM: FRONT PROJECTION SCREENS

TYPE: FILM PROJECTION SYSTEM COMPONENTS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD
San Francisco Washington, D.C.

SOFTWARE
slide☐ film☐ disc☐ tape■
record☐ ribbon☐ other■
CARDS

programming:
prep.: comm■ local■ other☐
availability easy■ diff■
prep.time/program hrs
length/typ.program mins
kept up to date? yes■ no☐
by whom? LOCALLY BY TEACHER AUTHORS

ECONOMICS
first cost range $50 TO $1500
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ days■ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:

REFERENCES
MFGRS DATA

TEXT, SECTION III K

U.L.APPROVED yes☐ no☐ pend☐

DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

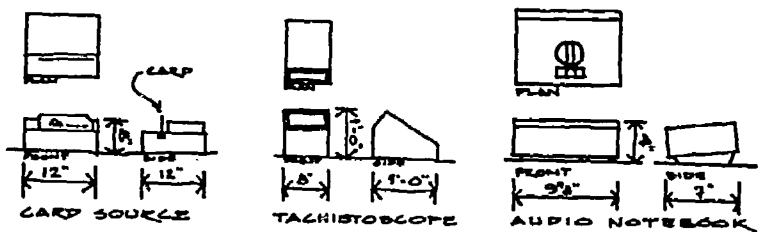
Besides the programmed instructors, there are a number of other individual desk top electronic teaching aids. This sheet illustrates some of these:

(1) The CARD SOURCE TEACHING DEVICE is a sound and visual teaching aid used in reading and language skill drills. The program source is a card similar in size and shape to a computer punch card. The card is inserted by the student into a slot on the machine and presents a picture and a sound. Space is available on the card sound track for the student to record his response for comparison.

(2) The TACHISTOSCOPE is a device used to increase reading speed and comprehension by briefly presenting words, symbols, phrases, etc., to the student.

(3) The AUDIO NOTEBOOK is a program source with a 23 track recording tape. Coupled with a headset, the device functions as a small learning laboratory. It may also be used as part of the "wireless" loop system (see DATA SHEET H-1).

SPACE REQUIREMENTS



TEACHING AIDS

COMMENTS AND SPECIAL REQUIREMENTS

ITEM	BATTERY POWER	WEIGHT
Card Source Teaching Aid	no	20 lb.
Audio Notebook	yes	9 lb.
Tachistoscope	yes	15 lb.

RELATED EQUIPMENT
CARD SOURCE:
CARDS

TACHISTOSCOPE:
SCREEN
TARGETS
STORAGE

AUDIO-NOTEBOOK:
HEADSETS
TAPES
BRIEFCASE
LISTENING CENTER (SEE ALSO SHEET C H-1)

PHYSICAL CHARACTERISTICS
power: SEE COMMENTS
watts volts phase
battery yes☐ no☐
stand-by power yes☐ no☐
umb.cables: no. size
telephone connect. yes☐ no☐
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight SEE COMMENTS
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher☐ student■
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation 1

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes■ no☐

VISUAL T-SCOPE ONLY
privacy reqd☐ not req■
illum.range NORMAL fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des☐ not req■
noise level db
HEADSETS PROVIDE ACOUSTIC PRIVACY

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
E. F. I.
BELL & HOWELL
OTHERS

ITEM: MISCELLANEOUS DEVICES

TYPE: TEACHING MACHINES

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDX
San Francisco Washington, D.C.

SOFTWARE
slide☐ film■ disc☐ tape■
record■ ribbon☐ other☐

programming:
prep.: comm■ local■ other☐
availability easy■ diff■
prep.time/program 10 - 15 hrs
length/typ.program 20 - 30 mins
kept up to date? yes■ no☐
by whom? LOCALLY BY TEACHER AUTHORS

ECONOMICS
first cost range $ 50 to $2000
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises■
in place☐ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:

REFERENCES
MFGRS DATA

TEXT, SECTION III K

U.L.APPROVED yes■ no☐ pend☐

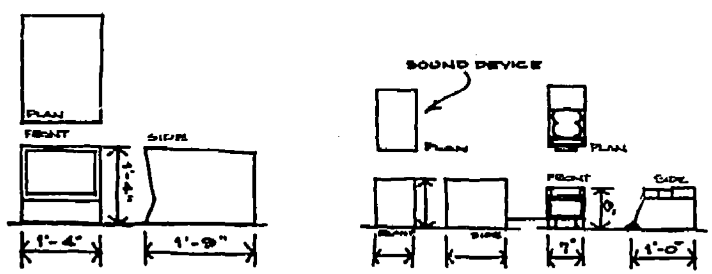
DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

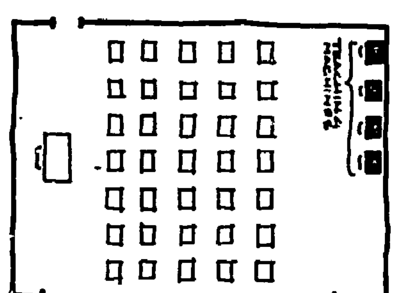
The PROGRAMMED INSTRUCTOR, commonly known as the "TEACHING MACHINE," is a very important teaching tool. The device consists of a filmstrip or printed paper program source; a display device, usually a small rear screen projector; a method of selecting and recording student responses; and possibly a sound program source. All of these devices fit on desk top, although a custom built and mounted installation can be made. Further information on programmed instructors and other teaching machines is found in Section III K of the text.

In present classroom use, a space at the rear of the room is provided in which several of the teaching machines are located. Students are given individual programs by the teacher and then go to the machines on their own according to a daily schedule. Magazines containing programs are easy to insert into the machines.

SPACE REQUIREMENTS



PROGRAMMED INSTRUCTORS



CLASSROOM LAYOUT

COMMENTS AND SPECIAL REQUIREMENTS
Space may be required for program preparation by teacher-authors. This space should include: writing desks, typewriters, graphic preparation areas, and material and reference storage. Programs may also be stored in this area, in which case a previewer is probably desirable.

RELATED EQUIPMENT
DESK OR CART
STORAGE
PROGRAM CARTRID.
HEADSETS FOR SOUND OPERATION

PHYSICAL CHARACTERISTICS
power: SMALL: 200W; LGE 300 watts 115 volts phase
battery SOME yes■ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
max.cable length

heat dissipation SLIGHT BTU
noise generated NIL db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight UP TO 20 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open☐
MOST ARE OPEN.

ITEM: PROGRAMMED INSTRUCTORS

TYPE: TEACHING MACHINES

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher☐ student■
remote☐ local■ other☐
special technician yes☐ no■
time/operation 20 - 30 mins
no.students/operation 1

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes■ no☐

VISUAL
privacy reqd☐ not req■
illum.range CLASSROOM fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des☐ not req■
noise level SLIGHT db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS BORG-WARNER, MAST DEVELOPMENT, PACKARD-BELL, WELCH
OTHERS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD

ARE
☐ film☐ disc☐ tape☐
d☐ ribbon☐ other☐

programming: SEE DESCR. →
prep.: comm☐ local■ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ-program mins
kept up to date? yes☐ no☐
by whom?

COSTS SMALL $150
first cost range LGE $ 2000
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises☐
in place☐ factory☐ other☐
personnel: mfr■
custod☐ school tech■ other☐
related facil.& equip:

REFERENCES
A-V EQUIPMENT DIRECTORY (1967)
MFGRS DATA

TEXT SECTION III L

U.L.APPROVED yes■ no☐ pend☐

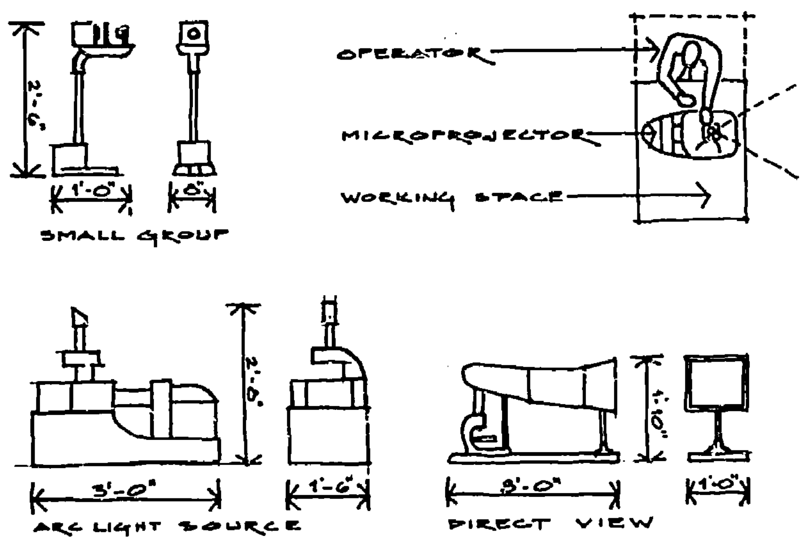
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The MICROPROJECTOR, like the overhead projector is used by the instructor to enlarge classroom demonstrations. With this device, however, the instructor is actually working on the microscopic materials being projected.

Sufficient surface area for experiments, materials, tools, etc., should be provided adjacent to the microprojector location.

A related device is the television microprojector chain, information on this chain is found on DATA SHEET ~~E-2~~ BB: CAMERA CHAINS.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
STAND OR CART
WORK SURFACE
DISPLAY SURFACE OR SCREEN

PHYSICAL CHARACTERISTICS
power: SMALL 100-500, LGE 1450 watts 115 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
max.cable length

heat dissipation SOME BTU
noise generated SOME db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight UP TO 75 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd☐ not req■
illum.range 5-15 fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd■ not reqd☐
vert.view angle °
horiz.view angle 80°-90°

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS BAUSCH & LOMB, DIOSCOPE, GRAFLEX, LEITZ, RCA
OTHERS

ITEM: MICROPROJECTORS

TYPE: FILM PROJECTION SYSTEM COMPONENTS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSDZ
San Francisco Washington, D.C.

SOFTWARE
slide☐ film☐ disc☐ tape☐
record☐ ribbon☐ other☐
SEE DESCRIPTION

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program 30-90 mins
kept up to date? yes☐ no☐
by whom?

COST
first cost range $100-240
installation cost $80
operating cost/yr $
maintenance cost/yr $20-25
cost/student/year $
lease cost $
equipment life
PER OUTLET, NOT INCLUDING MATV, &c.

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec■ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys☐ wks☐ mos☐
location: on premises☐
in place☐ factory■ other■
personnel: mfr☐
custod☐ school tech■ other■
related facil.& equip:

REFERENCES
AUDIO-VISUAL EQUIPMENT DIRECTORY (1969)
E.F.L.-DESIGN FOR ETV
H.E.W.-PLANNING SCHOOLS FOR NEW MEDIA

TEXT, SECTION 1E

U.L.APPROVED yes■ no☐ pend☐

DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

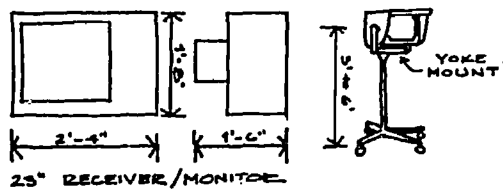
The simplest television installation is a receiver and an antenna. This system can receive programs "off the air" from commercial and educational television stations. Special antenna arrays and convertors may permit it to receive ITV and 2500 mHz signals. Greater sophistication is achieved when there is a central receiving antenna, the MATV, and a distribution system within the school.

This receiver, or a similar device, the "monitor," may be used to display programs from various sources. The monitor resembles the regular receiver in dimensions and performance, but it can receive only a single video signal.

The receiver or monitor may be mounted on the wall, ceiling, or floor in a "yoke mount." It may also be placed on a convenient shelf or mounted in a movable cart.

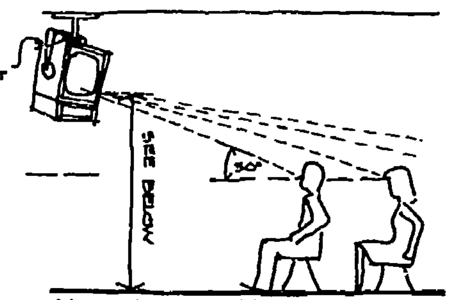
Recent developments such as transistorized monitors offer great advantages such as their much lower power consumptions -- e. g. a 23" transistorized monitor draws only 50 to 65 watts as opposed to 225 watts for a tube model.

SPACE REQUIREMENTS

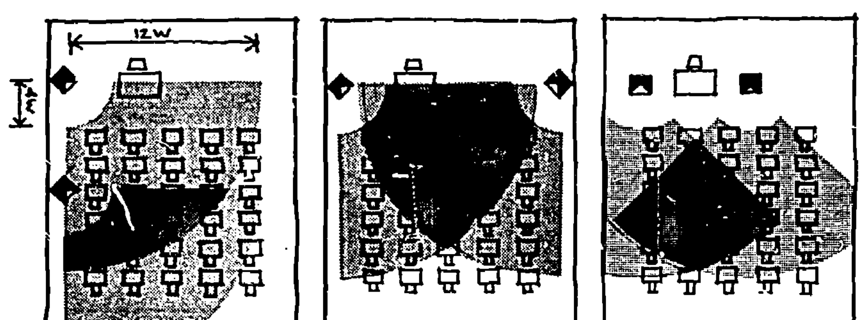


23" RECEIVER/MONITOR

SIZE OF SCREEN	4W	12W
17"	4'-11"	14'-9"
19"	5'-1"	15'-2"
21"	5'-4"	15'-0"
23"	6'-6"	19'-4"
24"	7'-5"	21'-5"
27"	9'-8"	24'-5"



MOUNTING HEIGHT



CLASSROOM WITH 2-23" MONITORS*

COMMENTS AND SPECIAL REQUIREMENTS

The height of the bottom of the picture tube above the floor is approximately equal to the height of the viewers' eyes above the floor plus the nominal size (diagonal measure) of the picture tube.

*The most commonly used classroom and large group monitors have 23" and 25" picture tubes.

RELATED EQUIPMENT
ANTENNA
OR
M.A.T.V.
OR
CCTV SYSTEM
OR
CAMERA CHAIN
OR
FILM CHAIN
OR
STUDIO
STAND OR CART

PHYSICAL CHARACTERISTICS
power: FOR 23" TUBE
225 watts 115 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. 1 size 1/4" O.D.
telephone connect. yes☐ no■
max.cable length

heat dissipation NIL BTU
noise generated NIL db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight 60 - 200 lbs
vibration
shock
floor | MAY BE
ceiling | MOUNTED TO
partitions | ~~EITHER~~ ANY
mobility yes■ no☐
service flexib. yes■ no☐
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic☐ teacher■ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation 6, 15, 30, 60 mins
no.students/operation
DEPENDS ON TUBE SIZE

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd☐ not req■
illum.range 30-35 fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle 0 - 30°
horiz.view angle 90°

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS ADMIRAL, GE, MAGNAVOX, PACKARD-BELL, PHILCO-FORD, RCA
OTHERS

ITEM: CLASSROOM RECEIVER OR MONITOR

TYPE: TELEVISION TEACHING AIDS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD AA
San Francisco Washington, D.C.

SOFTWARE
slide■ film□ disc□ tape□
record□ ribbon□ other■
LAB. MATERIALS

programming:
prep.: comm□ local■ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

COSTS
first cost range $25000 +
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises■
in place□ factory■ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:

REFERENCES
G. P. L. – A VIEW OF ETV (1966)
MFGR'S DATA
TEXT, SECTION ~~F~~ B

U.L.APPROVED yes■ no□ pend□

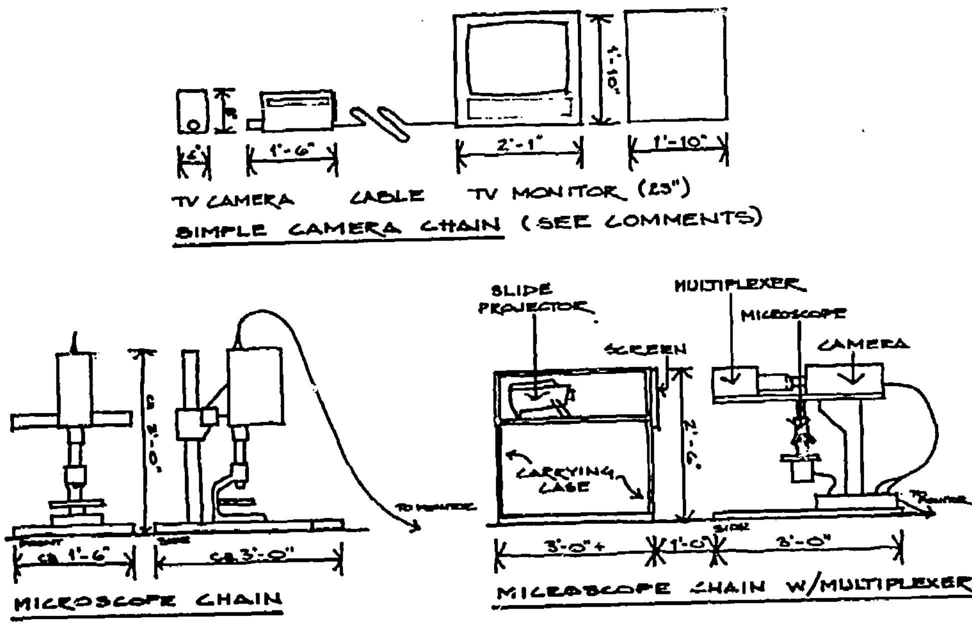
DATA SHEET

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

When a television camera and a television monitor are connected together, a CAMERA CHAIN is created. This camera chain is the simplest "in-house" program source and is the basic form of any in-house system. All these systems, no matter how complex, have these three elements -- the camera or cameras, a connection possibly with very complex mixing and switching capabilities, and a monitor or monitors to display the program.

The camera may be used to broadcast directly live action, materials seen through other optical instruments such as a microscope, or programs projected directly into it in a film chain. The program may be displayed immediately on the monitor, or stored on tape by a video tape recorder for future broadcasting.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS
For specialized camera chains, see the following DATA SHEETS: ~~E-3~~ CC, FILM CHAINS AND MULTIPLEXERS; ~~E-4~~ DD, MOBILE CONSOLE; and ~~E-5~~ EE, VIDEO TAPE RECORDERS.

RELATED EQUIPMENT
POWER SOURCE
MATERIALS
A-V MOBILE CONSOLE OR MASTER CONTROL
TV DISTRIBUTION SYSTEM

PHYSICAL CHARACTERISTICS
power: SIMPLE CHAIN
300 watts 120volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. 1 size ½" O.D.
telephone connect. yes□ no■
max.cable length 1000' OR AS SPECIFIED

heat dissipation NIL BTU
noise generated NIL db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight 60# – 150 lbs
vibration
shock
floor (TABLETOP
ceiling OPERATION)
partitions
mobility yes■ no□
service flexib. yes■ no□
security locked□ open■

ITEM: CAMERA CHAINS

TYPE: TELEVISION TEACHING AIDS

PEOPLE
user: teach□ stud■ other□
operator:
technic□ teacher■ student□
remote□ local■ other□
special technician yes□ no■
time/operation mins
no.students/operatic.

CONTROLS
remote□ local■ other□
switching:
master□ ind.■ spec□ other□
by student yes□ no■

VISUAL SEE SHEET ~~F-1~~ AA
privacy reqd□ not req□
illum.range fc
daylight reqd□ not reqd□
dimming reqd□ not reqd□
darkening reqd□ not reqd□
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd□ des□ not req□
noise level db

THERMAL
oper.temp.range 18° – 110 °F
oper.humidity range – 95 %

MANUFACTURERS
GPL, RAYTHEON, RCA, SYLVANIA
WESTINGHOUSE

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD BB
San Francisco Washington, D.C.

WARE SEE SHEETS ...-162 LTR
...e☐ film☐ disc☐ tape☐
...rd☐ ribbon☐ other☐

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS
first cost range $ ●
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life
B & W: $20000 MIN.
COLOR: $55000 MIN.
SINGLE CHAIN: $5000 +

MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:

REFERENCES
4 P.L. - A VIEW OF ETV (1966)
H.E.W. - PLANNING FOR NEW MEDIA

MFGRS DATA
TEXT, SECTION #IIB

U.L.APPROVED yes☐ no☐ pend☐

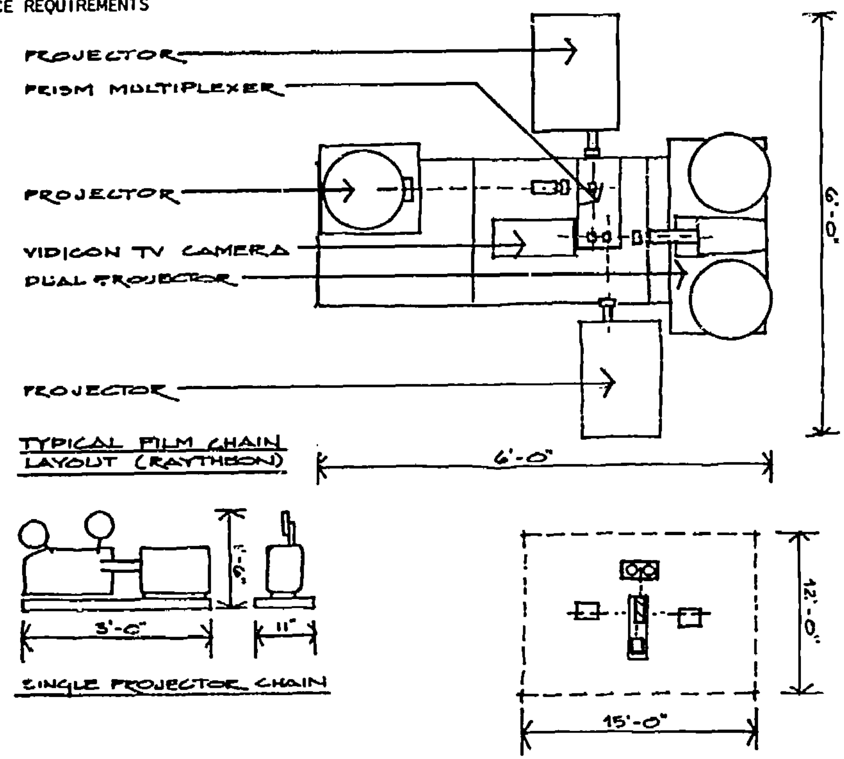
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

A FILM CHAIN consists of one or more film projectors optically linked to a television camera. The projectors throw an image directly into the camera which converts this optical information into a video signal that may be stored on tape or displayed on other television equipment.

A device of mirrors and prisms may be used when several projectors are linked with one television camera. Such a device is known as a "multiplexer." The mechanism may physically alter the alignment of mirrors and prisms to admit only the desired projector ray into the camera lens or it may selectively activate the projectors.

A large multiplexer requires a good deal of space as shown below. When used in the TV studio, it is desirable to place the multiplexer in an isolated space such as the film room.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS
The H. E. W. REPORT (see References) recommends a minimum of 12' by 15' for the multiplexer and projectors. It further recommends that this space be visually and acoustically isolated from the control room.

RELATED EQUIPMENT
PROJECTORS WITH MATCHED LENS
TV MONITORS
PLUS
CAMERA CONTROL
OR
MASTER CONTROL
OR
MOBILE CONSOLE

PHYSICAL CHARACTERISTICS
power: SINGLE CHAIN
100 watts 120 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes☐ no■
max.cable length

heat dissipation SOME BTU
noise generated db

safety hazard: yes☐ no■

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight S&L-50, MPLX-200 lbs
vibration
shock
floor
ceiling
partitions
mobility yes☐ no■
service flexib. yes☐ no■
security locked☐ open■

PEOPLE
user: teach☐ stud☐ other■
operator:
technic■ teacher☐ student☐
remote☐ local■ other☐
special technician yes☐ no■
time/operation mins
no.students/operation

CONTROLS
remote☐ local■ other☐
switching:
master■ ind.☐ spec☐ other☐
by student yes☐ no■

VISUAL
privacy * reqd■ not reqd☐
illum.range 5-10* fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd■ not reqd☐
vert.view angle °
horiz.view angle °
* UNLESS UNIT IS HOODED

ACOUSTIC
privacy reqd☐ des■ not reqd☐
noise level- db

THERMAL
oper.temp.range 14° - 110°F
oper.humidity range - 95%

MANUFACTURERS
4 PL, RAYTHEON, RCA, SYLVANIA, WESTINGHOUSE

ITEM: FILM CHAIN (TELEVISION)

TYPE: TELEVISION TEACHING AIDS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD CC

SOFTWARE
slide ■ film ■ disc ☐ tape ■
record ☐ ribbon ☐ other ☐
SEE RELEVANT DATA SHEETS FOR DETAILS
programming:
prep.: comm ☐ local ☐ other ☐
availability easy ☐ diff ☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes ☐ no ☐
by whom?

COSTS
first cost range $MIN.
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life
ABOUT $10,000, COST DEPENDS ON CONFIGURATION

MAINTENANCE
frequency:
regular ■ 6mo ☐ 1yr ☐ 2yr ☐
as nec ☐ 3yr ☐ 5yr ☐ 10yr ☐
repair time:
hrs ■ dys ■ wks ☐ mos ☐
location: on premises ■
in place ☐ factory ☐ other ☐
personnel: mfr ■
custod ☐ school tech ☐ other ☐
related facil.& equip:
SERVICE AREA & EQUIPMENT STORAGE REQUIRED

REFERENCES
MFGR'S DATA

TEXT, SECTION E

U.L.APPROVED yes ☐ no ☐ pend ☐

DATA SHEET

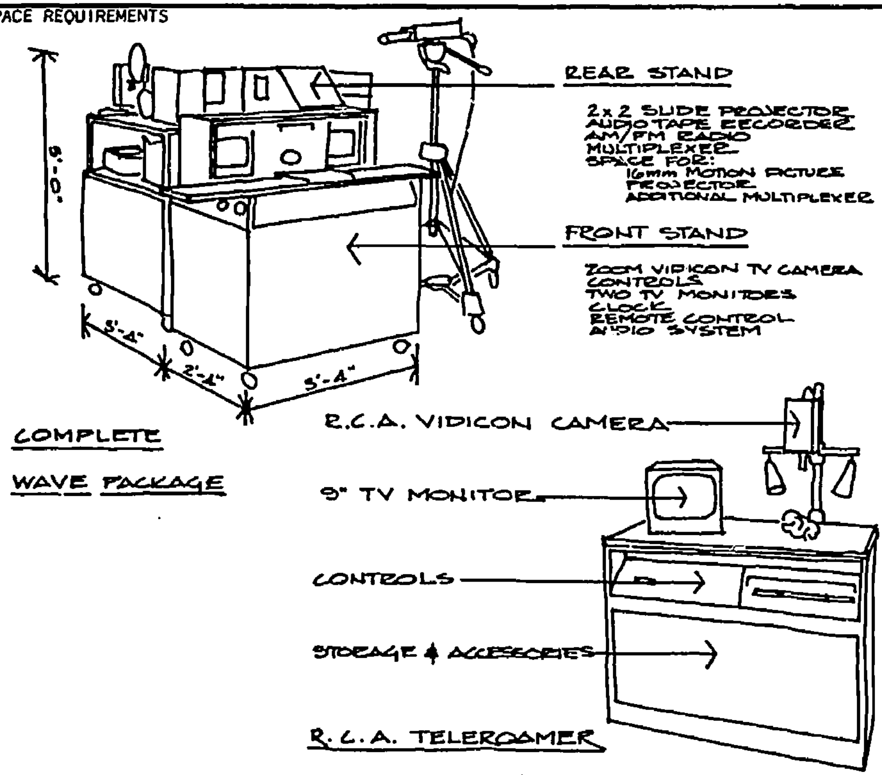
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

This mobile console unit, known under numerous names, is a small television studio which contains circuits which permit mixing, switching, and control of several camera and film chains. Signals from the console may be fed into any television distribution system.

The unit can be located in the classroom and moved from room to room -- most units are small enough to pass through standard doors. The controls are simple enough to allow a teacher to operate them while conducting a class. The console may also be used as the nucleus of a small studio.

Most of the units are available in a variety of configurations to meet a number of user needs. Additional information on the console may be found in Section E of the text.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS
Either of the illustrated systems may be purchased in smaller packages designed to meet specific user needs, such as microprojector chains, film chains, etc.

RELATED EQUIPMENT
ANY & ALL EQUIPMENT SHOWN IN DIAGRAM MAY BE INCORPORATED

CCTV SYSTEM
V.T.R.
REMOTE CAMERAS

PHYSICAL CHARACTERISTICS
power:
175watts 120volts phase
battery yes ☐ no ■
stand-by power yes ☐ no ■
umb.cables: no. 1 +size 5/8"od
telephone connect. yes ☐ no ■
max.cable length
1 CABLE/CAMERA ALSO
heat dissipation SOME BTU
noise generated SOME db

safety hazard: yes ☐ no ■

color/fin. choice yes ☐ no ■

DIRECT DEMANDS ON BLDG.
weight 200 - 500 lbs
vibration
shock
floor MUST CARRY LOAD
ceiling
partitions
mobility yes ■ no ☐
service flexib. yes ■ no ☐
security locked ■ open ☐

PEOPLE
user: teach ☐ stud ☐ other ■
operator:
technic ■ teacher ■ student ☐
remote ☐ local ■ other ☐
special technician yes ■ no ■
time/operation mins
no.students/operation

CONTROLS
remote ☐ local ■ other ☐
switching:
master ☐ ind. ■ spec ☐ other ☐
by student yes ☐ no ■

VISUAL
privacy reqd ☐ not reqd ■
illum.range 15-150 fc
daylight reqd ☐ not reqd ■
dimming reqd ☐ not reqd ■
darkening reqd ☐ not reqd ■
vert.view angle °
horiz.view angle °
REQUIRES ADEQUATE SUBJECT LIGHTING

ACOUSTIC
privacy reqd ☐ des ☐ not req ☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
GPL
RCA
WESTINGHOUSE
SYLVANIA

ITEM: MOBILE STUDIO

TYPE: TELEVISION TEACHING AIDS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD

TWARE
de□ film□ disc□ tape■
ord□ ribbon□ other□
"OR 2" VIDEO TAPE

programming:
prep.: comm■ local■ other□
availability easy□ diff□
prep.time/program MANY hrs
length/typ.program mins
kept up to date? yes□ no□
by whom? USERS

COSTS ~~COLOR $ 4200~~
first cost range BW $ ~~2500~~
~~installation cost~~ TO $ 20000 — see EXC Table II-6
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises■
in place□ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA &
EQUIPMENT STORAGE

REFERENCES
MF4RB DATA

TEXT, SECTION II B

U.L.APPROVED yes□ no□ pend□

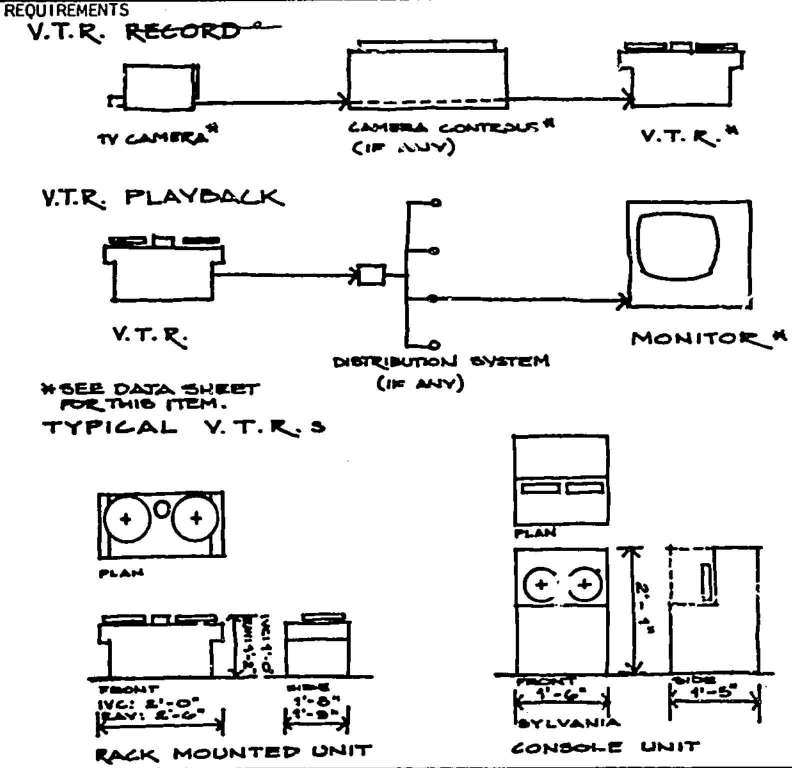
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The VIDEO TAPE RECORDER records a program taken from a video signal source onto a one-half, one or two-inch magnetic tape. The tape may then be replayed over a television distribution system as desired. The recorder also places the audio portion of the program onto a track of the tape

Presently both video tape recorders and tapes are expensive, but it seems likely that these costs will be greatly reduced in the near future.

Color video tape recorders are similar to black and white (monochrome) units, involving only a more complex recording head, and more sophisticated recording and playback circuitry.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS
Additional information about related equipment may be found on the following DATA SHEETS:

CB E-2 CAMERA CHAINS
DD E-4 MOBILE CONSOLE
FF E-6 CONTOL ROOM EQUIPMENT

RELATED EQUIPMENT
VIDEO SIGNAL SOURCE
CAMERA CHAIN
FILM CHAIN
"OFF THE AIR"

TAPE STORAGE

PLAYBACK
DIST. SYSTEM
MONITORS

AUDIO SOURCE
MICROPHONES
DUBBING EQUIP.
"OFF THE AIR"

PHYSICAL CHARACTERISTICS
power: TYPICAL
350 watts 115 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. 1 size
telephone connect. yes□ no■
max.cable length

heat dissipation BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight 20 TO 150 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no□
service flexib. yes□ no■
security locked□ open□
UNITS MAY BE MOBILE
MOUNTED IN CARTS

PEOPLE
user: teach□ stud□ other■
operator:
technic■ teacher□ student□
remote□ local■ other□
special technician yes■ no□
time/operation mins
no.students/operation

CONTROLS VTE ONLY
remote□ local■ other□
switching:
master□ ind.■ spec□ other□
by student yes□ no■

VISUAL
privacy reqd□ not req■
illum.range fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd□ des□ not req□
noise level db

THERMAL
oper.temp.range 34°-110 °F
oper.humidity range %

MANUFACTURERS AMPEX,
G.P.L., I.V.C.,
RAYTHEON, RCA,
SYLVANIA, SONY,
SHIBADEN
OTHER

ITEM: VIDEO TAPE RECORDER (VTR)

TYPE: TELEVISION TEACHING AIDS

DATA SHEET

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD EE

WARE
e□ film□ disc□ tape□
rd□ ribbon□ other□

programming:
prep.: comm□ local□ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?

ECONOMICS
first cost range $45000
installation cost $10000
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:

REFERENCES
4.P.L. - A VIEW OF ETV (1966)
H.E.W. - PLANNING SCHOOLS FOR NEW MEDIA
MFGRS DATA
TEXT, SECTION II B

U.L.APPROVED yes□ no□ pend□

DATA SHEET

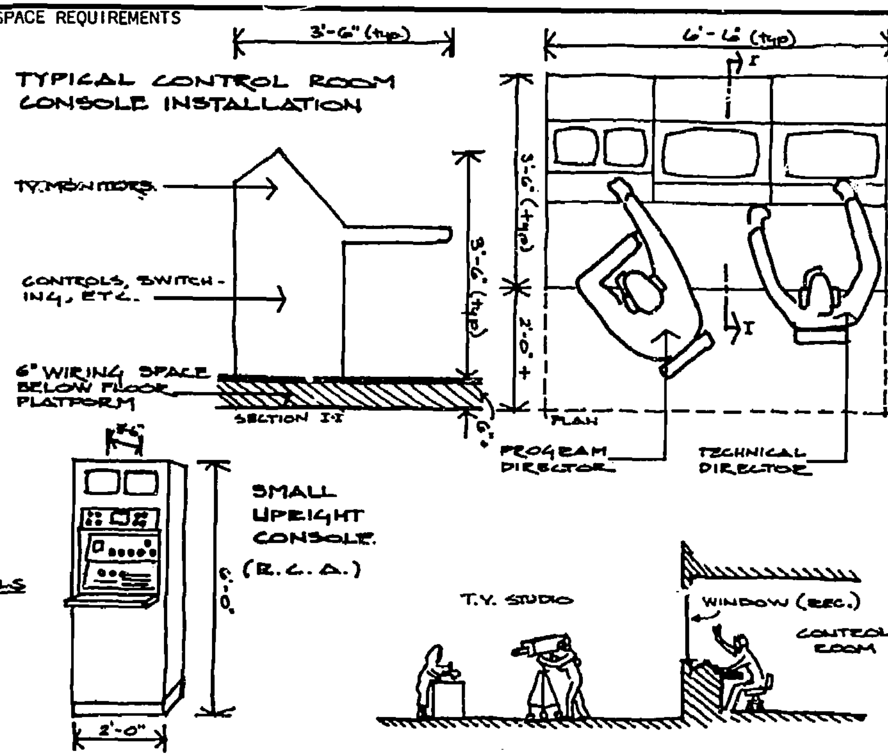
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The operations of the television studio are controlled from a DIRECTOR'S CONSOLE located in the studio control room. This console contains controls and circuits for switching, mixing, and amplifying signals from the several camera chains. It also contains the circuitry for feeding the programs to the distribution system.

The CONTROL ROOM is located adjacent to, but acoustically insulated from, the studio proper. A thermopane glass window is sometimes placed between the two spaces to allow direct visual observation of the studio by the directors.

The increase in number of CCTV installations has led the major equipment manufacturers to develop packaged studios. These are graded packages containing cameras, switching and control equipment, audio equipment, consoles, and studio monitoring equipment. They are graded from the simple two camera package, such as the RCA unit illustrated, to complete studios for ten to a dozen cameras or camera chains.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
FILM CHAIN
VTR
ATR
CAMERAS
DIST. SYSTEM
AUDIO INPUTS
STUDIO EQPT.

PHYSICAL CHARACTERISTICS
power: RANGE 2000 TO 5000 watts 120 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. size 1/4"
telephone connect. yes□ no■
max.cable length
1 PER CAMERA, 1 TO DISTRIBUTION
heat dissipation YES BTU
noise generated db

safety hazard: yes■ no□
MAY BE PROTECTED
color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor
ceiling
partitions
mobility yes□ no■
service flexib. yes□ no■
security locked□ open□

ITEM: TV STUDIO - CONTROL ROOM EQUIPMENT

TYPE: TELEVISION TEACHING AIDS

PEOPLE
user: teach□ stud□ other■
operator:
technic■ teacher□ student□
remote□ local■ other□
special technician yes■ no□
time/operation mins
no.students/operation

CONTROLS
remote□ local■ other□
switching:
master■ ind.□ spec□ other□
by student yes□ no■

VISUAL
privacy reqd□ not req■
illum.range WORKING 5-10 fc
daylight reqd□ not reqd■
dimming reqd■ not reqd□
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °
IF STUDIO IS VISUALLY ISOLATED 40-50 fc

ACOUSTIC
privacy reqd□ des■ not req□
noise level db

THERMAL
oper.temp.range 14° - 110°F
oper.humidity range - 95 %

MANUFACTURERS 4PL
RCA
SYLVANIA
AMPEX

OTHERS

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD FF

SOFTWARE
slide□ film□ disc□ tape□
record□ ribbon□ other□

programming:
prep.: comm■ local■ other□
availability easy□ diff□
prep.time/program hrs
length/typ.program mins
kept up to date? yes□ no□
by whom?
PROGRAMING MAY BE OFF THE AIR - COMM. OR ETV, IN HOUSE ITV, CAMERA OR FILM CHAIN

ECONOMICS
first cost range $2000 TO $18000
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys□ wks□ mos□
location: on premises□
in place□ factory■ other■
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:

REFERENCES
A-V EQUIPMENT DIRECTORY (1967)
N.E.A. - EDUCATIONAL FACILITIES - NEW MEDIA
MFGRS DATA
TEXT, SECTION IV.B

U.L.APPROVED yes□ no□ pend□

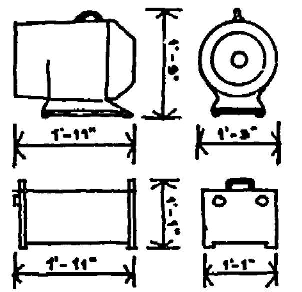
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

Television programs may be presented to large groups by means of a TV PROJECTOR. This device projects a TV image onto a regular front or rear projection screen. Because of the low brightness of this image and the problems inherent in magnifying the 500 line image, a very low ambient light level, 5 to 10 footcandles, can be tolerated. For this reason some experts prefer the use of multiple large screen monitors instead. Improvements, however, are being made in the projector and the related equipment.

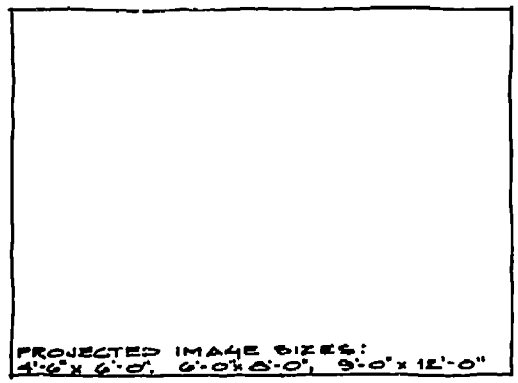
The TV PROJECTOR plugs in to the normal building television distribution system or may be able to receive programs off the air using its own equipment.

Another possible advantage to this device is that it may be rented for occasional use and need not be purchased outright.

SPACE REQUIREMENTS



TV PROJECTOR & CONTROL



RELATED EQUIPMENT
SCREEN
PROGRAM SOURCES (SEE SHEET E-1)
AA

PHYSICAL CHARACTERISTICS
power:
550 watts 117 volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. 1 size 50'
telephone connect. yes□ no■
max.cable length 400' BUT AT EXTRA COST.

heat dissipation SOME BTU
noise generated db

safety hazard: yes□ no■

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.
weight 120 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no□
service flexib. yes■ no□
security locked□ open■

PEOPLE
user: teach□ stud■ other□
operator:
technic■ teacher□ student□
remote□ local■ other□
special technician yes□ no■
time/operation mins
no.students/operation
UP TO 1000

CONTROLS
remote□ local■ other□
switching:
master□ ind.■ spec□ other□
by student yes□ no■

VISUAL
privacy reqd■ not req□
illum.range 5 - 10 fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd■ not reqd□
vert.view angle 0° - 30°
horiz.view angle 120°

ACOUSTIC
privacy reqd□ des■ not req□
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
DALTO, GENERAL TV, KALART/TELEBEAM AMPHICON

ITEM: TELEVISION PROJECTOR

TYPE: TELEVISION TEACHING AIDS

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS
The projector throw with this device is approximately two times the image width.

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD 6G
San Francisco Washington, D.C.

DATA SHEET

RE
film☐ disc☐ tape☐
☐ ribbon☐ other☐

programming:
prep.: comm☐ local☐ other☐
availability easy☐ diff☐
prep.time/program hrs
length/typ.program mins
kept up to date? yes☐ no☐
by whom?

ECONOMICS
first cost range $40000 TO $50000
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular☐ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs☐ dys☐ wks☐ mos☐
location: on premises☐
in place☐ factory☐ other☐
personnel: mfr☐
custod☐ school tech☐ other☐
related facil.& equip:

REFERENCES
MFGRS DATA

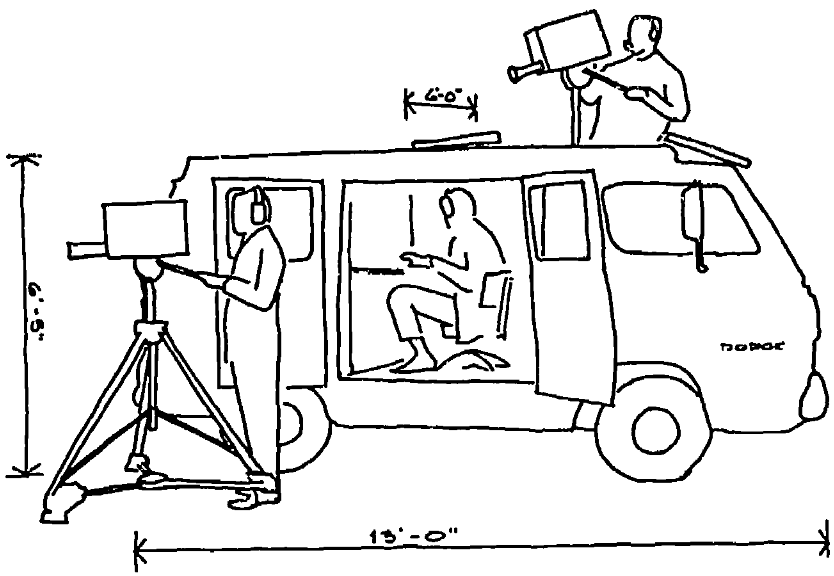
U.L.APPROVED yes☐ no☐ pend☐

DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

The TELEVISION VAN is a mobile self-contained small television studio mounted on a small truck. Power for the studio and cameras is provided by a gasoline or diesel generator located on a generator trailer which the van tows. A large school system might consider such a device for coverage of special events of importance, for televising from schools without facilities, for interviews, or for the teaching of television as a vocation.

The major demand that the van makes upon the building is for the provision of secure and dry garage and maintenance space. Television reception equipment to pick up the van's signals may also be required.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

RELATED EQUIPMENT
CAMERAS
RECEPTION
AUX. GENERATOR TRAILER.

PHYSICAL CHARACTERISTICS
power: ON EXTERNAL
1000 watts 120 volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. 2 size 2"
telephone connect. yes☐ no■
max.cable length 75'

heat dissipation BTU
noise generated db

safety hazard: yes■ no☐

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight 5000 lbs
vibration
shock
floor
ceiling
partitions
mobility yes■ no☐
service flexib. yes☐ no☐
security locked■ open☐

ITEM: TV VAN

TYPE: TELEVISION TEACHING AIDS

PEOPLE
user: teach☐ stud☐ other■
operator:
technic■ teacher☐ student☐
remote☐ local■ other☐
special technician yes■ no☐
time/operation mins
no.students/operation

CONTROLS
remote☐ local■ other☐
switching:
master☐ ind.■ spec☐ other☐
by student yes☐ no■

VISUAL
privacy reqd☐ not req☐
illum.range fc
daylight reqd☐ not reqd☐
dimming reqd☐ not reqd☐
darkening reqd☐ not reqd☐
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des☐ not req☐
noise level db

THERMAL
oper.temp.range °F
oper.humidity range %

MANUFACTURERS
GPL
SYLVANIA
RCA
AMPEX

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD
San Francisco Washington, D.C.

DATA SHEET

SOFTWARE
slide☐ film☐ disc■ tape☐
record☐ ribbon☐ other■
PUNCHCARDS

programming:
prep.: comm■ local■ other☐
availability easy☐ diff■
prep.time/program 10-20 hrs
length/typ.program 10-120 mins
kept up to date? yes■ no☐
by whom? TEACHER-AUTHORS

ECONOMICS SEE TEXT, B-32
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $40-125
lease cost/YEAR $750000
equipment life

MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs☐ dys■ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:
100 SERVICE AREA; ALSO STORAGE & OFFICE AREAS.

REFERENCES
1500 SYSTEM MANUAL

TEXT, SECTION B

U.L.APPROVED yes☐ no☐ pend☐

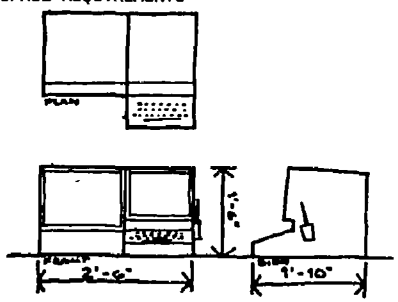
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

IBM provides powerful hardware for Computer Aided Instruction with its 1500 SERIES EDUCATIONAL COMPUTERS. The 1500 Series offers the most advanced terminal equipment presently available. Besides the normal TELETYPEWRITER, the 1512, there is available the 1510 VIDEO EQUIPPED TERMINAL WITH KEYBOARD, and the 1518 IMAGE DISPLAY UNIT.

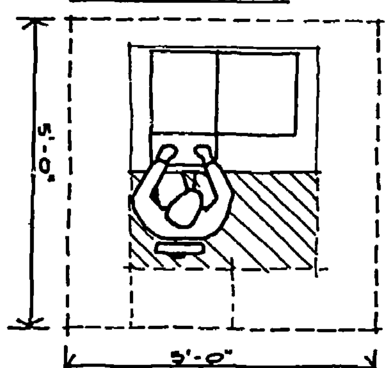
As many as 128 Terminals may be joined to a single CENTRAL PROCESSOR UNIT. These connections are effected by two components which may be used in any combination. The STATION CONNECTOR joins up to four terminals to the C.P.U., while the JUNCTION BOX has a capacity of 12 terminals.

The basic CENTRAL PROCESSOR is the 1131 IBM paired with the IBM 1133 MULTIPLEXER which connects and switches the junction boxes and station connectors. The capabilities and sophistication of the 1131/1133 may be expanded by the addition of "peripherals" such as printers, card readers, additional memory units, and other equipment.

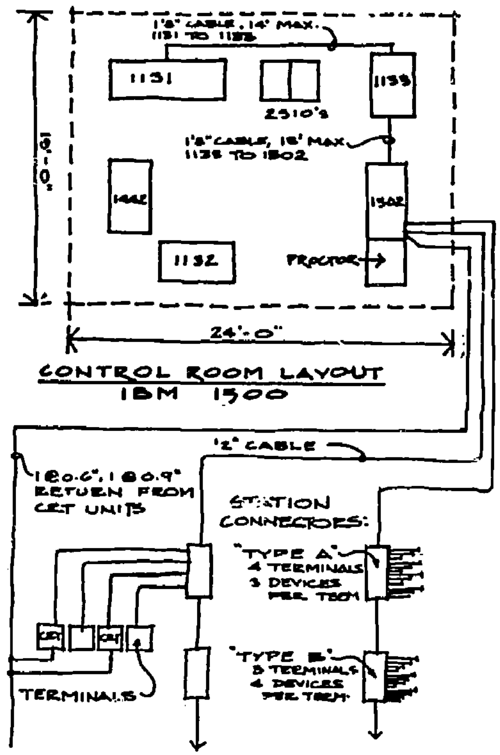
SPACE REQUIREMENTS



IBM 1500 TERMINAL WITH IMAGE DISPLAY



IBM 1510 STUDENT TERMINAL STATION



CONTROL ROOM LAYOUT
IBM 1500

COMMENTS AND SPECIAL REQUIREMENTS

TERMINAL, IBM 1510:	POWER: 120 vac, .30 kva	HEAT:	478 BTU
CENTRAL PROCESSING:	POWER: 120/208, 20 kva	HEAT:	2000 BTU

NOTE: The Control Room Layout illustrated is typical of such installations. The layout of each Control Room will vary, however, with the needs and size of the system. Therefore, the planner should consult the equipment manufacturer or his representative for exact space requirements and details.

RELATED EQUIPMENT
AT TERMINAL:
1510 DISPLAY/KBOARD
1512 IMAGE PROJ.
1518 TYPEWRITER

CPU "PERIPHERALS:"
CARD READERS
PRINTERS
CONTROL CONSOLE
ADDITIONAL MEMORY

AIR CONDITIONING EQUIPMENT

FIRE PROTECTION APPARATUS.

PHYSICAL CHARACTERISTICS
power: SEE COMMENTS
watts volts phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. size
telephone connect. yes■ no■
max.cable length TOTAL OF ALL CABLES = 2000'
SEE DIAGRAMS
heat dissipation SEE BTU
noise generated COMMENTS

safety hazard: yes■ no☐

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor" COMPUTER FLOOR"
ceiling
partitions
mobility yes☐ no■
service flexib. yes☐ no■
security locked☐ open■
MFGR: 1500 LOAD DOES NOT EXCEED ALLOWABLE LOADS UNDER BLDG CODES.

ITEM: IBM 1500 SYSTEM

TYPE: COMPUTER AIDED INSTRUCTION SYSTEMS

PEOPLE
user: teach☐ stud☐ other☐
operator:
technic■ teacher☐ student☐
remote☐ local■ other☐
special technician yes■ no☐
time/operation 10-120 mins
no.students/operation MAX. 128 TERMINALS.

CONTROLS
remote■ local☐ other☐
switching:
master■ ind.☐ spec☐ other☐
by student yes■ no☐

VISUAL
privacy reqd☐ not req■
illum.range 50 PLUS fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level db

THERMAL
oper.temp.range 60°-90°F
oper.humidity range 8-80%

MANUFACTURERS
IBM

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD II
San Francisco Washington, D.C.

...WARE	
...a□ film□ disc■ tape■	
...rd□ ribbon□ other■	
...NCHCARD	
programming:	
prep.: comm■ local■ other□	
availability easy□ diff■	
prep.time/program 10-20 hrs	
length/typ.program 10-120 mins	
kept up to date? yes■ no□	
by whom? TEACHER - AUTHORS	

ECONOMICS IN NYC.

first cost range	$
installation cost	$
operating cost/yr	$
maintenance cost/yr	$
cost/student/year	$
lease cost	$
equipment life	

CPU + 192 TERMINALS RENTAL $60000/MO.

MAINTENANCE

frequency:
regular■ 6mo□ 1yr□ 2yr□
as nec□ 3yr□ 5yr□ 10yr□
repair time:
hrs■ dys■ wks□ mos□
location: on premises□
in place■ factory□ other□
personnel: mfr■
custod□ school tech□ other□
related facil.& equip:
SERVICE AREA - MIN. OF 60 # REQD.

REFERENCES

PLANNING MANUAL RCA SPECTRA-70

TEXT: SECTION B

U.L.APPROVED yes□ no□ pend□

DATA SHEET

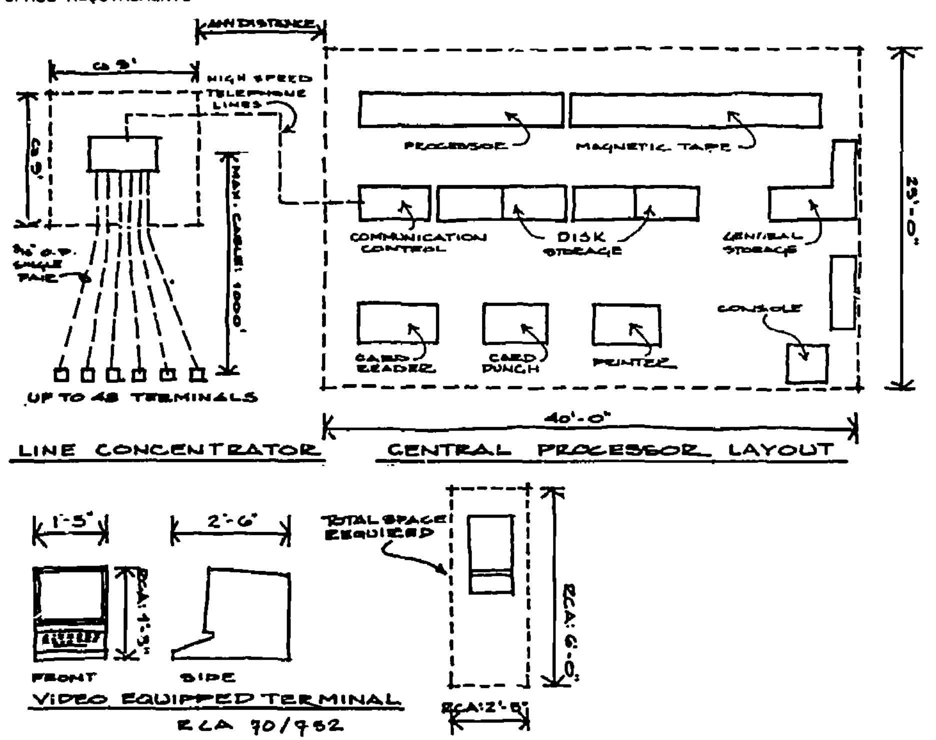
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

R. C. A. offers a Computer Aided Instruction System based upon their commercial SPECTRA-70 Computers. At the present time this CAI System, known as EDUCATIONAL-70 is capable of drill and practice programming.

The system is able to handle a relatively large number of remotely located terminals simultaneously. Groups of terminals in one location are connected to "regional installations" containing a 70/680 LINE CONCENTRATOR. Up to 4 such line concentrators are connected to a remote CENTRAL PROCESSING UNIT by high-speed telephone lines. The entire system has a capacity of 192 student terminals.

The STUDENT TERMINAL may be equipped with either a standard teletypewriter or the newer 70/752 Video Equipped Terminal. Other combinations with video interrogators are available.

SPACE REQUIREMENTS



COMMENTS AND SPECIAL REQUIREMENTS

TERMINAL, RCA 70/752:	POWER: 120 vac, .35 kva	HEAT: 1150 BTU
CENTRAL PROCESSOR:	POWER: 120/208, 125 kva	HEAT: 50000 BTU

The equipment layout illustrated on this sheet is typical, specific installations should be designed after consultation with the manufacturer or his representative.

RELATED EQUIPMENT

TERMINALS:
TELETYPEWRITER

AIR CONDITIONING EQUIPMENT

FIRE PROTECTION APPARATUS

PHYSICAL CHARACTERISTICS

power: SEE COMMENTS
watts volts phase
battery yes□ no■
stand-by power yes□ no■
umb.cables: no. 1 size 3/16"
telephone connect. yes■ no■
max.cable length 1000'
1 SINGLE PAIR LINE PER TERMINAL
heat dissipation SEE BTU
noise generated COMMENTS

safety hazard: yes■ no□

color/fin. choice yes□ no■

DIRECT DEMANDS ON BLDG.

weight SEE BELOW lbs
vibration
shock
floor "COMPUTER FLOOR"
ceiling
partitions
mobility yes□ no■
service flexib. yes□ no■
security locked□ open■
MFGR: LOADS DO NOT EXCEED NORMAL ALLOWABLE LOADS.

PEOPLE

user: teach□ stud■ other□
operator:
technic■ teacher□ student□
remote□ local■ other□
special technician yes■ no□
time/operation 10 - 120 mins
no.students/operation MAX. OF 192.

CONTROLS

remote■ local■ other□
switching:
master■ ind.■ spec□ other□
by student yes■ no□

VISUAL

privacy reqd□ not req■
illum.range 50 PLUS fc
daylight reqd□ not reqd■
dimming reqd□ not reqd■
darkening reqd□ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC

privacy reqd□ des□ not req■
noise level db

THERMAL

oper.temp.range 60° - 90 °F
oper.humidity range 20-80 %
VENTING REQD.
EQP. HAS OWN AIR MOVING MACHINERY.

MANUFACTURERS

RCA EDUCATIONAL SYSTEMS

ITEM: R. C. A. EDUCATIONAL-70 COMPUTER SYSTEM

TYPE: COMPUTER AIDED INSTRUCTION SYSTEM

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC. BSD
San Francisco Washington, D.C.

SOFTWARE
slide☐ film☐ disc■ tape■
record☐ ribbon☐ other☐

programming:
prep.: comm☐ local■ other☐
availability easy☐ diff■
prep.time/program 10-20 hrs
length/typ.program 10-12 mins
kept up to date? yes■ no☐
by whom? TEACHER AUTHORS

ECONOMICS SIMILAR TO OTHER CAI SYSTEMS.
first cost range $
installation cost $
operating cost/yr $
maintenance cost/yr $
cost/student/year $
lease cost $
equipment life

MAINTENANCE
frequency:
regular■ 6mo☐ 1yr☐ 2yr☐
as nec☐ 3yr☐ 5yr☐ 10yr☐
repair time:
hrs■ dys■ wks☐ mos☐
location: on premises☐
in place■ factory☐ other☐
personnel: mfr■
custod☐ school tech☐ other☐
related facil.& equip:
SMALL SERVICE AREA, OFFICE & VIEWING AREA RECOMMENDED.

REFERENCES
PROJECT GROW (PHILA.) SPECS & MANUAL

TEXT, SECTION 5

U.L.APPROVED yes☐ no☐ pend☐

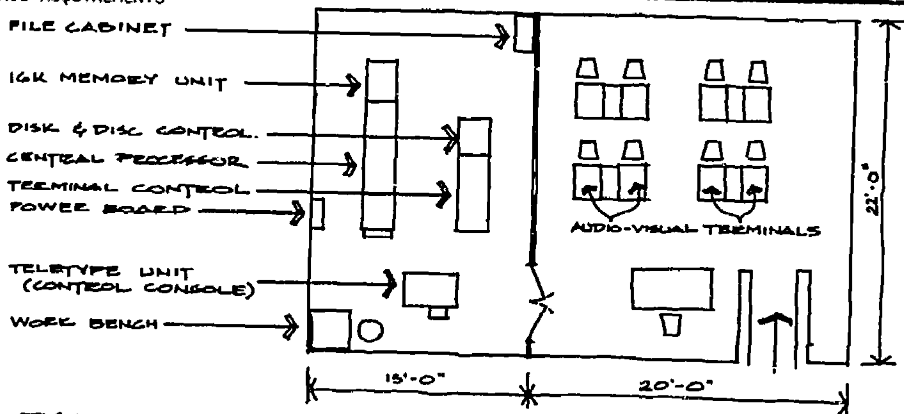
DESCRIPTION, TEACHING FUNCTION, OPERATION ETC.
(wherever "other" has been checked on this page, please describe here or below.)

PHILCO-FORD manufactures a Computer Aided Instruction System based upon their line of commercial computers. This system has been installed in various experimental projects, including PROJECT GROW of the Philadelphia School System.

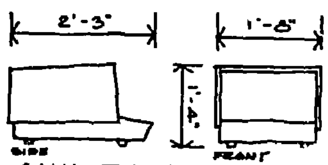
The STUDENT TERMINAL may be equipped with either the standard Teletypwriter Unit or a audio-video terminal known as SAVI. The CENTRAL PROCESSOR UNIT is modified from commercial equipment and is controlled by a Teletypewriter as control console.

At the present time, Philco-Ford appears to be orienting their equipment towards use in school rehabilitating and updating. One of their main advantages, the small space requirements of the system, makes it attractive in new construction as well.

SPACE REQUIREMENTS



TYPICAL COMPUTER & TERMINAL ROOM LAYOUTS
ROOSEVELT JUNIOR HIGH, PHILADELPHIA, PA.



SAVI TERMINAL

RELATED EQUIPMENT
AIR HANDLING EQP.
FIRE PROTECTION APPARATUS
CLASSROOM EQP.

PHYSICAL CHARACTERISTICS
power: SEE COMMENTS
watts 120/208 volts 5 phase
battery yes☐ no■
stand-by power yes☐ no■
umb.cables: no. * size 5/8"od.
telephone connect. yes☐ no■
max.cable length
1 CABLE/TERMINAL
heat dissipation SEE BTU
noise generated COMMENT db

safety hazard: yes■ no☐

color/fin. choice yes☐ no■

DIRECT DEMANDS ON BLDG.
weight lbs
vibration
shock
floor COMPUTER FLOOR
ceiling
partitions
mobility yes☐ no■
service flexib. yes☐ no■
security locked☐ open■

PEOPLE
user: teach☐ stud■ other☐
operator:
technic■ teacher☐ student☐
remote☐ local■ other☐
special technician yes■ no☐
time/operation 10-120 mins
no.students/operation

CONTROLS
remote■ local☐ other☐
switching:
master■ ind.■ spec☐ other☐
by student yes■ no☐

VISUAL
privacy reqd☐ not req■
illum.range 50 PLUS fc
daylight reqd☐ not reqd■
dimming reqd☐ not reqd■
darkening reqd☐ not reqd■
vert.view angle °
horiz.view angle °

ACOUSTIC
privacy reqd☐ des■ not req☐
noise level LOW db

THERMAL CPU:
oper.temp.range 60°-80 °F
oper.humidity range 45-65%
IDEAL: 68° to 74°F
TERMINAL: MAX 100°
MAX 95%

MANUFACTURERS
PHILCO-FORD

ITEM: PHILCO-FORD COMPUTER ASSISTED INSTRUCTION SYSTEM

TYPE: COMPUTER AIDED INSTRUCTION SYSTEM

DATA SHEET

COMMENTS AND SPECIAL REQUIREMENTS

TERMINAL, SAVI UNIT:	POWER:	120/208, .17 kva	HEAT: 600 BTU
TERMINAL, TELETYPE:	POWER:	120/208, .50 kva	HEAT: 1370 BTU
CENTRAL PROCESSING:	POWER:	120/208, 8.30 kva	HEAT: 29000 BTU

The equipment layout illustrated is typical, specific installations should be designed after consultation with the system manufacturer of his representative.

COMMUNICATIONS MEDIA

BUILDING SYSTEMS DEVELOPMENT, INC.
San Francisco Washington, D.C.
BSD KK

OTHER REPORTS FROM EFL

The following reports are available from EFL, 477 Madison Avenue, New York, New York, 10022 without charge.

A COLLEGE IN THE CITY: AN ALTERNATIVE. A report of a new approach to the planning of urban campuses, with facilities dispersed through the community, designed to serve community needs and to stimulate community redevelopment. (1969)

BRICKS AND MORTARBOARDS. A guide for the decision-makers in higher education: how the colleges and universities can provide enough space for burgeoning enrollments; how the space can be made adaptable to the inevitable changes in the educational process in the decades ahead. (One copy available without charge. Additional copies $1.00). (1964)

CAMPUS IN THE CITY. EFL's annual report for 1968 and an essay on the physical problems and trends in planning of urban colleges and universities and their potential role as a catalyst in the remaking of the cities.

COLLEGE STUDENTS LIVE HERE. A report on the what, why, and how of college housing; reviews the factors involved in planning, building, and financing student residences. (1962)

DESIGN FOR ETV–PLANNING FOR SCHOOLS WITH TELEVISION. A report on facilities, present and future, needed to accommodate instructional television and other new educational programs. Prepared for EFL by Dave Chapman, Inc., Industrial Design. (1960) (Revised 1968)

DESIGN FOR PAPERBACKS: A HOW-TO REPORT ON FURNITURE FOR FINGERTIP ACCESS. Physical solutions to the problems of displaying paperback books for easy use in schools. (1968)

THE EARLY LEARNING CENTER. A Stamford, Conn. school built with a modular construction system provides an ideal environment for early childhood education.

EDUCATIONAL CHANGE AND ARCHITECTURAL CONSEQUENCES. A report on school design that reviews the wide choice of options available to those concerned with planning new facilities or updating old ones. (1968)

THE IMPACT OF TECHNOLOGY ON THE LIBRARY BUILDING. A position paper reporting an EFL conference on this subject. (1967)

RELOCATABLE SCHOOL FACILITIES. A survey of portable, demountable, mobile, and divisible schoolhousing in use in the United States and a plan for the future. (1964)

THE SCHOOLHOUSE IN THE CITY. An essay on how the cities are designing and redesigning their schoolhouses to meet the problems of real estate costs, population shifts, segregation, poverty, and ignorance. (1966)

THE SCHOOL LIBRARY: FACILITIES FOR INDEPENDENT STUDY IN THE SECONDARY SCHOOL. A report on facilities for independent study, with standards for the size of collections, seating capacity, and the nature of materials to be incorporated. (1963)

SCHOOL SCHEDULING BY COMPUTER/THE STORY OF *GASP*. A report of the computer program developed by MIT to help colleges and high schools construct their complex master schedules. (1964)

SCSD: THE PROJECT AND THE SCHOOLS. A second report on the project to develop a school building system for a consortium of 13 California school districts. (1965)

TRANSFORMATION OF THE SCHOOLHOUSE. A report on educational innovations in the schoolhouse during the last decade. With financial data for the year 1968. (1969)

PROFILES OF SIGNIFICANT SCHOOLS

A series of reports which provide information on some of the latest developments in school planning, design, and construction.

SCHOOLS WITHOUT WALLS–open space and how it works. (1965)
THREE HIGH SCHOOLS REVISITED: Andrews, McPherson, and Nova. (1967)
MIDDLE SCHOOLS–controversy and experiment. (1965)
ON THE WAY TO WORK–five vocationally oriented schools. (1969)

CASE STUDIES OF EDUCATIONAL FACILITIES

A series of reports which provide information on specific solutions to problems in school planning and design.

8. THE SCHOOLS AND URBAN RENEWAL. A case study of the Wooster Square renewal project in New Haven, Connecticut. (1964)
9. AIR STRUCTURES FOR SCHOOL SPORTS. A study of air-supported shelters as housing for playfields, swimming pools, and other physical education activities. (1964)
10. THE NEW CAMPUS IN BRITAIN: IDEAS OF CONSEQUENCE FOR THE UNITED STATES. Recent British experience in university planning and its implications for American educators, architects, and planners. (1965)
11. DIVISIBLE AUDITORIUMS. Operable walls convert little-used auditoriums and theatres into multipurpose, highly utilized space for the performing arts and instruction. (1966)
12. THE HIGH SCHOOL AUDITORIUM: SIX DESIGNS FOR RENEWAL. Renovation of little-used auditoriums in old and middle-aged schools to accommodate contemporary educational, dramatic, and music programs. (1967)
13. EXPERIMENT IN PLANNING AN URBAN HIGH SCHOOL: THE BALTIMORE CHARETTE. A two-week meeting enabled community people to tell educators and planners what they expect of a school in a ghetto. (1969)

TECHNICAL REPORTS

1. ACOUSTICAL ENVIRONMENT OF SCHOOL BUILDINGS. Acoustics of academic space in schools. An analysis of the statistical data gathered from measurement and study. (1963)
2. TOTAL ENERGY. On-site electric power generation for schools and colleges, employing a single energy source to provide light, heat, air conditioning, and hot water. (1967)

3. 20 MILLION FOR LUNCH. A primer to aid school administrators in planning and evaluating school food service programs. (1968)
4. CONTRAST RENDITION IN SCHOOL LIGHTING. A discussion of requirements for school lighting, with 18 case studies. (1970)

COLLEGE NEWSLETTER

A periodical on design questions for colleges and universities.

FILMS

The following films have resulted from EFL-funded efforts and are available for loan or purchase as indicated:

TO BUILD A SCHOOLHOUSE. A 28-minute color film outlining the latest trends in school design. Available on loan without charge from EFL in care of Association Films, Inc., 600 Madison Avenue, New York, N.Y. 10022, and for purchase at $93.45 from EFL.

ROOM TO LEARN. A 22-minute color film on The Early Learning Center in Stamford, Connecticut, an open-plan early childhood school with facilities and program reflecting some of the best current thinking. Prepared by The Early Learning Center under a grant from EFL and available on loan without charge from Association Films, Inc., 600 Madison Avenue, New York, N.Y. 10022, and for purchase at $125.00 from The Early Learning Center Inc., 12 Gary Road, Stamford, Conn. 06903.

A CHILD WENT FORTH. A 28-minute color film on inner-city and ghetto schools and school building problems. Available on loan without charge or for purchase at $75 from The Library, American Institute of Architects, 1735 New York Avenue N.W., Washington, D.C. 20006. A 45-minute version is also available on loan from the AIA Library or for purchase at $440 from Larry Madison Productions, Inc., 253 East 49 Street, New York, N.Y. 10017.