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AUTHOR Thomas, Hollie B.; And Others
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ABSTRACT

A project was undertaken to design and field test a facility development model for competency-based vocational education programs in Florida. During the first phase of the project, the researchers conducted an in-depth case study of programs and facilities in which successful competency-based technical education programs had been conducted. Next, an analysis was made of the discrepancies between the findings of the case study and the current standards for programs and facilities. After identifying program and facility standards for selected vocational and technical education programs, the researchers developed a model for establishing standards for competency-based programs. The model provided for identification of what is to be taught, how it will be taught, what is needed to teach the programs, and how much space is needed. The final step in the model entails an evaluation of the space required for the program. Based on the field tests of the model in architectural drafting, automotive mechanics, and licensed practical nursing programs, the researchers recommended using a computer to assist in implementing the assessment model and revising the model to include more detailed provisions for assessing the need for instructional materials. (MN)

FINAL REPORT

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From July 1, 1980 to June 30, 1983

DEVELOPMENT OF A FACILITY DETERMINATION MODEL FOR CBVE PROGRAMS IN THE STATE OF FLORIDA

Hollie B. Thomas, Project Director
Preston O. Howard, Research Assistant
Donna J. Davis, Research Assistant

The Florida State University
College of Education
Department of Educational Leadership
Tallahassee, Florida 32306

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INTRODUCTION

Need

As the American economy continues its erratic course where some industries are booming while others are declining, the challenge to vocational education remains greater now than ever before. Computer technology in the 1980s will invade virtually all major occupations, radically changing the work place world. Computers, and other high-technology spin-offs, will become an integral part of many Americans' lives. In Florida, already a leader in space-age technology, the needs to incorporate this new technology into existing curricula will be vital to the economic survival of the state.

This portends many changes for vocational education. As new technological tools join the more traditional methods now in use, vocational education programs must quickly adapt to the changing needs of business and industry. This will not only involve changes to the curricula of the various vocational programs, but it will also demand a modern and comprehensive planning and support system for those vocational programs. Vocational education must be able to integrate the new technology into the classroom. This will be true for many areas, including printing, automotive mechanics, and medicine, in addition to the early users of this technology, like office occupations.

The Vocational Education Act of 1963 was enacted nearly twenty years ago....At that time, over 75 percent of the states used a facility planning methodology which allotted a certain amount of floor area for each student to be housed in a given program (Kirbkunas, 1966a). Since then, the bulk of professional research into improved methods of planning educational facilities has come to emphasize the design of the facility based upon the nature of the instruction that is planned to occur in the program. As Nerden (1968, p. 14) states:

> The building should serve the program. The facility should not be planned until the groups to be served and the curriculums to be provided are finalized. There is little wisdom in approximating the square footage, student capacity and equipment budget until these basic questions have been answered.

And if, as many researchers maintain, the vocational facility must be designed to support the needs of these many rapidly changing programs, that will demand a flexible and responsive method of planning those vocational facilities. Facility planning methods adopted in the 1950s are likely to need modification for use in the 1980s.

Exactly how is the present method of planning vocational facilities deficient, if at all? And, what are the necessary elements of an improved method? The answers are not simple. But, vocational educators are finding it increasingly difficult to meet the changing needs of the American work place with facilities planned using a formula that specifies minimum square footage allowances per student. However, that is the method still in use in many states, including Florida.

What is needed instead is a method which builds upon the curriculum to be taught in the vocational program. This methodology uses the curriculum as a guide to help determine the activities which the learner should master, and, from that, to identify the equipment needed by the student to master the skills in the curriculum. The equipment lists, in turn, can then be used to determine the size of any instructional area, together with the need for auxiliary spaces, particularly storage areas. This approach facilitates other tangential facility planning considerations, such as the needs of handicapped students or of women entering vocational programs that have historically been dominated by men. And, perhaps most important of all, the approach taken by this new methodology focuses attention on the skills to be imparted to the learner and incorporates those skills into the facility planning process. As more and more vocational programs convert to competency-based curricula emphasizing the job-related skills which the student must master in order to be successful in the chosen vocational specialty after graduation, the importance of the curriculum takes on added significance. In today's society, the curriculum should determine the equipment that is necessary, and the space needs of the equipment should guide the determination of the floor space required by a vocational program.

It is this need that the present project addresses. This report describes the development and field testing of a facilities planning methodology that first determines the curriculum to be taught, and then uses that curriculum to identify the equipment needed, and, finally, uses both to estimate the floor space needed for a given vocational program. The facility planning methodology presented in this report is preliminary. Through its use, it can be further refined to meet the needs of the State of Florida.

Failure to accept this challenge--to design facilities based upon the nature of the instruction to take place in them--will leave Florida's vocational education system in the amorphous situation of trying to deliver modern, competency-based curricula through the use of facilities planning methods adopted in an era when the curriculum was defined by the minimum number of contact hours of instruction. Florida cannot meet the challenges of tomorrow, nor even the problems of today, by using the facility planning methods of yesterday.

Review of Literature

Most states take seriously their responsibilities to plan complete and comprehensive vocational-technical education programs that meet the needs of their citizenry. Many such studies have been funded, each with a varying utility for other researchers about to embark on a similar task. The more important of these studies are reviewed here.

Studies of 15 or 20 years ago emphasized specific "ingredients" in the vocational program, much as a cookbook lists the ingredients in a recipe. Kishkunas (1966a) published a survey of space standards for vocational programs of every state in the nation. At that time, it was particularly common for state education departments to specify standards incorporating minimum floor areas, with little or no regard for the content of the curriculum to be taught.

Following passage of the Vocational Education Act of 1963, a gradual shift occurred away from the specification of cookbook-style standards. Instead, alternate methods were substituted which first identified the principal elements of the curriculum and then tailored the facility to meet the needs of that program of instruction.

This literature review examines both the cookbook-oriented and the curriculum-oriented approaches to facility planning. Both have a role in a carefully constructed facility plan, and neither is an end in itself. The first section of this review examines important concepts in the planning of vocational education facilities. Before we begin such plans ourselves, it is important to know what constitutes a good facility plan.

Following this, we examine the methods used by others to prepare facility plans. While each method purports to address the same topic, the actual content varies widely. Some facility plans attempt to present specifications for system-wide planning for an entire state vocational education program. Others were prepared for the purpose of planning a particular program or site-specific facility. Our intent here is not to attempt to determine which are more complete or more appropriate for its intended purpose. Indeed, that is beyond the scope of this report. Instead, we identify the common core elements of a vocational facilities plan, as well as important elements that are unique to one or another planning methodology, but which also have particular relevance to the present model for determining building space requirements of vocational programs.

In a third section, we summarize those studies which present standards identifying floor space requirements. As has been mentioned above, studies which emphasize this "cookbook" approach often have limited utility. However, when they are viewed as a resource, rather than an end in themselves, they can have value to the vocational facility planner.

One important consideration in the planning of vocational education facilities is the equipment to be housed in the facility when it becomes operational. Identification of the equipment required for a given program is an exhaustive and time-consuming process. Because many previous studies have prepared equipment lists for vocational programs, they become another resource for the vocational facility planner. Of course, the equipment required for any present or future program can be expected to vary from the equipment identified as being necessary for any previously designed program. However, the use of equipment lists from previous studies can provide a starting point for present-day studies that require the specification of equipment for a given program.

Information Required for Planning Vocational-Technical Education Facilities

In this section of the literature review, the various kinds of information required by architects and other building design professionals before they can prepare construction details for a particular vocational program are examined. Unfortunately, there is no common terminology for this program-specific information. The terms, "guidelines", "specifications", "standards", and "design criteria" are used almost interchangeably from one study to another. But, what we are talking about is, "the written outline of the vocational and technical education program and the facilities needed to accommodate that program" (Wisconsin State Board of Vocational, Technical, and Adult Education, 1964, p. 16; Chase, et al., 1965, p. 20).

The relationship of the instructional facility to the program of instruction is an important one. The Council of Educational Facility Planners explains why:

> Expressed in another way, 'the buildings should serve the program.' The facility should not be planned until the groups to be served and the curriculums to be provided are finalized. There is little wisdom in approximating the square footage, student capacity and equipment budget until these basic questions (concerning the curriculum) have been answered. (Nerden, 1970, p. 14)

Regardless of how much authors agree that the needs of the program should guide the design of the facility, there is less agreement on the specific content of manuals designed to facilitate that process. For example, Valentine and Conrad (1967, p. 79) state:

> Although planning manuals can get very specific, the manuals should also be open-ended. The planning guide is not intended specifically and primarily to help the architect; it is to help the educator do his planning before the architect begins to come up with a design solution.

This stands in sharp contrast to the view championed by Stallsmith (1974, p. 6):

> After the desired instructional program has been defined, it becomes necessary to begin the more detailed aspects of the planning sequence. Educational specifications are detailed descriptions and standards which may serve as a basis for facility planning decisions....Educational specifications are a critical part of the planning process. The more detailed and complete they are, the more likely they will serve as a useful tool to the architect.

The architect will be able to transfer these specifications into a preliminary layout with a minimum of design changes.

But, the problem of the content of facility standards involves more than the "general vs. specific" discussions by itself. Kishkunas (1966b, p. 7) presents several other factors which often tend to limit the utility of standards:

> A number of usable standards, which provide recommendations for total space, total equipment, and even environment, are available for facility planning. However, these standards, many of which are recommended by state departments of public instruction, have qualities which tend to make them inflexible and out of date the minute that they are put down on paper. Some of the qualities are:
>
> 1. Standards are based on the apparent success of existing facilities to meet the needs of courses written in the past.
>
> 2. Recommendations are made for single courses conducted in single rooms.
>
> 3. Locations of perimeter walls are assumed to be unchanging.
>
> 4. Sizes of classes are assumed to be unchanging.
>
> 5. The possibility of making new equipment arrangements is assumed not to exist.

Other authors have identified additional aspects of the facility plan which do not receive sufficient attention. Gildan and Buckner (1981, p. 5), writing for the Florida Department of Education, state: "Facilities are very important to equipment selection. The size and type of equipment needed should determine the nature of the facilities. Too often it is the other way around." Stallsmith (1974, p. 8) elaborates on this point:

> It is essential that equipment lists and equipment layouts become a part of the specifications so the architect has some idea of proposed mechanical requirements and design layout features to be desired in the preliminary layouts. While it is not necessary to list hand tools and pieces of equipment which will be stored in cabinets, it is necessary to list all those items which require floor space. The equipment list should be separated by rooms and by fixed or movable categories. Information needed for each piece of equipment is the floor space required and utilities required.

The need for storage, mentioned above by Stallsmith, is itself an important consideration. Valentine and Conrad (1967, p. 3) state, "Storage is the most overlooked factor in designing an educational facility." The result of inadequately planned storage is that valuable laboratory work space is often sacrificed, frequently resulting in additional safety hazards (Stallsmith, 1974, p. 8).

There is one final consideration in planning vocational-technical education facilities which has not yet been mentioned. Myron Bender (1978, p. 23), in summarizing the task of the educational facility planner, reminds readers that:

> The goal of environmental design is to provide facilities that will support and enhance the curricular programs and instructional actions. The model of an environmental system...includes four components: (1) physical facilities; (2) instructional equipment; (3) laboratories supplies and materials; and (4) the learner. The latter is the most important of the four components since our objective is to prepare individuals for the future.

Elements of the Facilities Design Process

The previous section of this literature review examined the types of information required in planning vocational education facilities. But, once the necessary information has been identified, it still remains to be determined how that information will be applied to the actual process of planning the facilities. This was not a problem in the "old days", when the cookbook approach was used. One simply counted students into groups of the desired class size, assigned one teacher to each group, and put the groups in classrooms having a specified minimum floor area. Stanford University, in designing a vo-tech center with several unique features, used this method in Richmond, Virginia:

> In order to determine the number, kind, and size of the educational spaces which will be required to house the pre-technology program in the Richmond Unified District, the following procedures were employed:
>
> A. The number of students that could normally be expected to enroll in each of the elective and required courses were determined for approximately 360 students. This prediction was based on previous program experience (1961-1966) in the existing high schools.
>
> B. The information thus obtained was translated into the number of periods required to meet an enrollment of 360.
>
> C. Based on the number of periods needed for each subject area, the number of teaching stations was determined. (Plutte, 1965, p. 17)

Today the problem of designing vocational education facilities is compounded by the trend toward competency-based individualized instruction and by the increasingly recognized need for flexibility in the facility once it has been built and put into service. Louis Kishkunas (1966b, p. 1) calls everyone's attention to this:

> Creating flexible facilities does not relieve educators of the necessity of careful planning. Furthermore, existing space standards upon which facility planners now depend do not provide solutions to problems created by new developments in education. Some of the new developments are: dynamic relationships between different subject areas and resultant efforts to share subject material, space, and equipment; small, medium, and large group instruction; and new courses involving the use of new equipment types.

So what, then, is the best way to proceed in attempting to plan the amount of space required for a vocational program? Again, there is no consensus in the field. Different authors use different methods with varying degrees of success. But, the different methods, in turn, often highlight unique elements in the design process--elements that may have had particular significance to those authors at those points in time. We now examine the unique aspects of the many studies which continue to have relevance to today's facility planner.

Seldom do studies by different authors agree so completely as the 1964 study for the Wisconsin State Board of Vocational, Technical, and Adult Education and the 1965 study for the United States Department of Health, Education, and Welfare. These two studies present the following detailed planning specifications which the authors suggest should be part of any study to allocate space to vocational programs:

> Statements of the philosophy and objectives of each of the subject offerings.
>
> Space requirements, numbers, and kinds of rooms needed for each subject field.
>
> Special utilities and service needs in shops and laboratories.
>
> Relationships of spaces required or preferred.
>
> Environmental factors needed or desired. (Wisconsin State Board of Vocational, Technical, and Adult Education, 1964, p. 16; Chase, et al., 1965, p. 20)

The Michigan Department of Public Instruction (1964), in a bulletin prepared to help designers of industrial education facilities, called for greater attention to be given to the size and type of equipment required for the program being planned. A similar, but later, study for the Wisconsin Department of Public Instruction elaborated on this need:

After the desired instructional program has been defined and scope and sequence of courses planned out, it becomes necessary to begin estimating space needs....

There are three basic space requirements which should be considered. They are: (1) station allowances--space for basic machines, teaching systems, work areas for students around the machines, and a minimum of safety clearance; (2) station circulation burden--general circulation allowance within that area of the laboratory containing stations, such as aisle space and traffic patterns; (3) general circulation--space allowance for general support facilities, such as clean up and future expansion. This last space category usually amounts to about 25 percent of the total of (1) and (2). (Stallsmith, 1974, p. 6)

Other authors call attention to additional design criteria, which they suggest are important to a facility plan. The planning guide developed by the Council of Educational Facility Planners suggests the importance, among other things, of the need to specify whether the curriculum is to emphasize "practice exercises" or "customer work" (Nerden, 1968, pp. 36-38). A study for the Maryland Department of Education by the Council for Exceptional Children suggests the need for enormous detail in the educational specifications, even to the point of identifying floor and counter work surfaces, lighting brightness, and accoustical characteristics, in addition to the other, more common, facility planning guidelines (Abend, et al., 1979). Stallsmith (1974) calls for educational planners to include a floor plan for each laboratory showing the location of each piece of equipment. And, lastly, Sledge, et al., (1980), and the United States Department of Health, Education, and Welfare (1968), state that it is essential to provide access for handicapped and disabled students when planning today's vocational education centers.

Ultimately, the question of "balance" must arise. Infinite detail in developing specifications for educational facilities can only occur when there are infinite resources. And, in education today, resources are not infinite. In fact, they are constricting. In the preparation of the model for facility planning presented in this project, an attempt has been made to emphasize a select number of criteria which, from our perception of the current state of the art, seem to be crucial to the facility design process, while still attempting to keep the process as simple and straightforward as possible.

<u>Floor Space Requirements</u>

In the previous sections of this literature review, we noted that the specification of minimum floor areas--apart from other considerations associated with a given curriculum--should be avoided. However, one frequently encounters facility planning guides which do, in fact, emphasize minimum floor areas to the exclusion of all (or almost all) other design criteria. When this occurs, it may come as a result of a carefully developed plan which was not presented with the study listing suggested floor areas.

Sometimes the floor areas are incorporated into state law, administrative rules, or local regulations. This is the present situation in Florida (Florida Board of Education, 1978), as well as in many other states. Kishkunas (1966a) found 75 percent of states responding to a nationwide survey of space requirements for vocational facilities were then using methods which incorporated minimum square footage standards. But, Kishkunas (1966a, pp. 4-5) recommends care in the use of tabulations of square feet per student:

> A note of caution must accompany the presentation of this material. At best, space standards can be no more than a very general guide in facility evaluation and planning. Although many states provide specific space recommendations, no respondent provided information about the curricula of the course for which these areas are recommended. It is probable that the activities included in the curriculum for a certain class in one state will vary considerably when compared to the activities for the same course in another state. Obviously, no evaluation of the space provided for a subject is meaningful without a clear picture of the activities that are carried on in the subject.

Caveats such as the one above, however, do not deny the utility of such studies. They simply reinforce the important concept that the application of simple measures of the ratio of students to instructional (and other) floor space must be used cautiously when they are applied to situations other than the ones for which they were originally developed. Most researchers agree on this point, and many manuals have been written which apply this general principle to numerous vocational specialties. Many of them followed closely behind the passage of the Vocational Education Act of 1963, but in recent years the number of such studies has declined. The following paragraphs describe some of the more noteworthy facility studies.

Agriculture. Most of the facility guides for agriculture and agribusiness programs use the "cookbook" approach, as was done for Florida's vocational programs in agriculture (Flotida Department of Education, 1968). That is also the case with North Carolina's counterpart, now badly outdated (North Carolina State Department of Public Instruction, 1962). A study done by the State of West Virginia is different only in that it includes exploded diagrams and materials lists for such furniture items as cabinets for storage of student projects, magazine display racks, and other similar items (West Virginia Board of Education, 1967). It does not indicate whether the instructor is responsible for building those classroom items nor whether those designs are the "approved" designs. A better reference, largely because it is newer, is the guide published by the Wisconsin Department of Public Instruction, "Buildings and facilities for vocational agriculture/agribusiness departments" (Sledge, et al., 1980).

Home economics. One of the two sources identified for planning home economics programs was prepared by the Ohio Department of Education

(1967), and, while it is now somewhat dated, it is both a well-written and comprehensive treatment of its subject. It discusses nine different types of activity centers that are generally found in home economics departments, including: child care, clothing and textiles, and food and nutrition. It addresses storage needs and furniture and equipment required by the program. It also includes a number of miscellaneous features not often found in facility planning guides, such as program options with respect to lighting, floor and counter surfaces, and wiring.

The other home economics facility planning guide was one of a series prepared by the Center for Vocational and Technical Education at The Ohio State University, (Meckley, et al., n.d.). It presented a complete methodology for conducting a facility study, including all forms required to determine floor space and equipment needs. The forms identify the major components of the instructional program and, using that information, identify the different types of instructional areas required by the program. Other volumes in this series are discussed later in this section of the literature review.

Industrial education. Several facility planning guides for industrial arts education programs were identified in the course of this literature review. The most far-ranging report is one prepared for the Wisconsin Department of Public Instruction (Stallsmith, 1974). It suggests a planning methodology and includes samples of the data collection forms to be used in determining facility needs. Most topics in any other similar studies are also discussed in this publication. Further, it includes such esoteric topics as financing the vocational facility and an analysis of Occupational Safety and Health Act requirements for industrial education programs.

Another good source was prepared for the Virginia Department of Education (Hughes, et al., 1978). It presents a methodology for determining lab floor space requirements and equipment needs keyed to the industrial equipmemt lists for eight different types of industrial arts labs.

Two other studies are of less utility to the facility planner. The first, by the Michigan Department of Public Instruction (1964), includes discussions of the more common topics such as space and equipment needs, plus such topics as dust collection by the heating and ventilation system, soundproofing requirements, and safety requirements. But, the discussion is far too brief to be more than a very general guide. The second study, by Bender (1978), is altogether too brief.

Labs and shops. Of all the different elements of a vocational program, laboratory and shop facilities are often regarded as the most important. This has resulted in the publication of a variety of guides for planning shops and labs. Of those identified in this literature survey, the Mississippi Department of Education (1967) prepared the most comprehensive. It discusses a variety of lab-oriented programs. Emphasis is placed on safety, particularly as it relates to other program elements, such as equipment needs, storage, and floor space requirements. Never is there a reference to any ratio of square feet per student, but instead the report discusses the contents of the curriculum of twelve types of shops and how that, in turn, affects facility needs.

Another good discussion of laboratory space needs is that of Mehallis (1970), presented as part of a workshop on facilities and equipment planning for vocational programs held at Colorado State University. Doctor Mehallis discussed the general requirements of labs, together with suggested data collection forms to be used in identifying floor space needs and necessary equipment.

The Ontario Department of Education (1968, 1969) prepared two studies on shop requirements which are somewhat traditional in their approach, but which also address a wide range of issues in shop planning. They are somewhat unique in that they present elevation drawings of shop facilities along with suggested floor plans.

Other facility guides. The Ohio State University Center for Vocational and Technical Education was very active in the late 1960s preparing facility planning guides for a number of programs. Each used a similar format, often including identical wording for standardized sections of each report. All of the Center's reports applied a uniform methodology to the problem of identifying facility needs. Sample forms were included with each study. This literature review located six such studies: automotive service trades (Adams, 1969), data processing (McIntosh, 1968), electrical technology (Sitterlee, 1969), home economics (Meckley, et al., n.d.), laboratory animal science technology (Collins and Farnsworth, 1969), and machine trades (Larson, 1968).

Equipment Needs of Vocational Programs

Identifying equipment needed for a vocational program is a painstaking process. Perhaps that is why so few studies include equipment lists with their recommendations of the necessary amount of floor space for vocational programs of a given type. In addition, earlier studies generally do not discuss the curriculum content of the vocational program when presenting lists of instructional equipment. For example, a study on vocational facilities and equipment for agricultural programs written by the West Virginia Board of Education (196?, p. i) states:

> This publication...has been developed to assist county boards of education, school administrators, and teachers of vocational agriculture in providing facilities for departments of vocational agriculture in West Virginia. The bulletin can...be used as a guide for established departments to expand program (sic) and provide the necessary facilities and equipment for effective vocational education.

Compare the above study, which includes no reference to the curriculum, with the following report prepared for the Wisconsin Department of Public Instruction (Stallsmith, 1974, p. 22):

> The only real basis for selecting equipment is the educational program to be offered within the facility.... Activities determine the choices of equipment. It is critical that the selection committee be aware of the curriculum and the activities which will be experienced.

One recent publication which does include better information concerning the curriculum than is normally encountered is Sledge, et al., (1980). This document, prepared for the Wisconsin State Department of Public Instruction, discusses equipment not only in terms of the amount of space required for that equipment, but also in terms of the amount of space that is required for access around each piece of equipment.

Perhaps one of the better available methods of keeping the curriculum in mind when working with equipment lists for a vocational program is to use the V-TECS catalogs, which incorporate curriculum tasks with the equipment required by the student to complete the tasks. In fact, that is the method used in the present study to prepare a methodology for determining building space requirements for vocational programs in Florida. No other studies were discovered in this literature review which used V-TECS catalogs for any similar application.

Purpose and Objectives

As was previously stated, a need exists to expand present methods used to identify facility requirements of vocational programs to include an examination of the curriculum and of the equipment needed to support that curriculum. This project serves as a point of beginning in this process.

But, it should be kept in mind that there is no single "best" method for determining building space needs for vocational programs. Furthermore, the model presented as part of this research will, no doubt, be subjected to review and possible revision by numerous other individuals in the field of vocational education before it is adopted for general use in planning vocational education facilities in Florida.

Thus, it is the purpose of this research to develop an alternative methodology which incorporates a detailed examination of the curriculum in determining the building space required by vocational instruction programs in Florida. The specific objectives by which this project attains its stated purpose are as follows:

1. To identify the important elements of a curriculum-oriented facility planning methodology which are keyed to the instructional content of competency-based vocational programs;

2. To develop a facility determination model that permits building space standards to be identified for competency-based vocational programs in Florida;

3. To field test the facility determination model on selected vocational programs in Florida; and

4. To evaluate the facility floor space standards obtained in the field tests: a) through input obtained from advisory committees formed for the purpose of assisting with the field tests, and (b) through a comparison of the results of the field tests with floor space allowances prescribed by the state board of education.

METHODOLOGY: DEVELOPMENT OF THE MODEL

Important Elements of a Facility Planning Methodology

The review of literature, discussed in an earlier section of this report, pointed out numerous important aspects associated with the determination of floor space estimates. Many of those features were incorporated into this facilities planning model. However, some design considerations that were specifically oriented to a particular vocational program had to be omitted. This was, in large part, due to the fact that this facility planning methodology was to be sufficiently flexible to permit its application to any vocational program.

The Curriculum Should Determine Building Space Needs

The most frequent comment recurring throughout the professional literature is that the curriculum should guide the design of the instructional facility. The amount of floor area allotted to a given vocational program should not be determined by some fixed standard that is uniformly applied to all vocational programs. Nor should it be determined by comparing the floor space allotments of a given vocational program to the allotments of other programs, even closely related programs.

The overriding consideration is that the floor space allotment in a given program should be designed to support the instructional activities of that program. Seldom will two separate and distinct vocational programs have sufficiently similar curricula to justify, on that consideration alone, the same floor space allotments. But, when this rare situation does occur, the allocation of identical amounts of building space should be justified by the results of a careful investigation.

Perhaps the greatest advantage associated with the use of a facility planning methodology derived from the curriculum to be taught is that input from instructional personnel will almost certainly be required. Many of the disadvantages associated with more traditional methods, methods which allocate building space based on some specific formula that identifies floor area per pupil, do not permit input from instructional personnel. As the formula becomes more and more outdated, the need for adjustment in the formula becomes greater. The only appropriate remedy is to provide a mechanism whereby the advice of instructors is made an integral part of the facility planning process.

The Importance of Storage

While it is important that the instructional areas be of a sufficient size to permit the desired learning to take place, it is also important that the vocational program have adequate storage space.

Many authors cited in the literature review commented that storage facilities are frequently inadequate to support the needs of the program.

Furthermore, the lack of adequate storage, or of appropriately designed storage areas, often results in unnecessary equipment remaining in instructional or shop areas. This, in turn, can result in an increased likelihood of theft, perhaps resulting in greater insurance or equipment replacement costs.

In addition, the storage of equipment in shop, instructional, or other nonstorage areas can increase the chance of accidental personal injury. In extreme situations, such personal injury could result in a lawsuit which might involve both expensive litigation and, in cases where the school board does not prevail, even more expensive settlements due to negligence on the part of the school. And, even though the probability of such a situation ever occurring is small, the consequences could be very large when that remote event happens.

The Identification of Necessary Program Equipment

Facility plans of 15 or 20 years ago seldom gave any attention to the equipment to be housed in a given vocational program. They, instead, mentioned only the floor space allotment per student. Or, when equipment needs were taken into account in determining minimum floor areas per student, the final floor-space-per-student ratios often did not provide a discussion of the rationale or methodology by which the equipment space needs were integrated into the minimum floor areas.

The result was a method for determining floor space for a given vocational program that obscures the relationship between the instruction and the equipment necessary for that instruction to occur. As technological advancement results in changes in a given vocation, the equipment needs may also change. However, the tendency to use the same ratios of floor area per student often persist for years after the program's equipment needs have changed, with the vocational instructor constantly having to "make do" with outdated space allowances.

The problems with the above-described approach to planning space requirements for a vocational program are well known in the professional literature. The thrust of recent research indicates a clear need to provide greater visibility for the equipment used in a vocational program when the program's floor space allotment is being determined.

Key Steps in This Model

Once the important elements of a sound facility planning methodology had been determined, it was then necessary to incorporate them into a workable methodology suitable for use in the State of Florida. To do this, the overall facility planning process was divided into a sequence of five separate tasks, as shown in Figure 1. The following sections discuss each task, illustrating how the essential elements of a facility plan are incorporated into the present methodology.

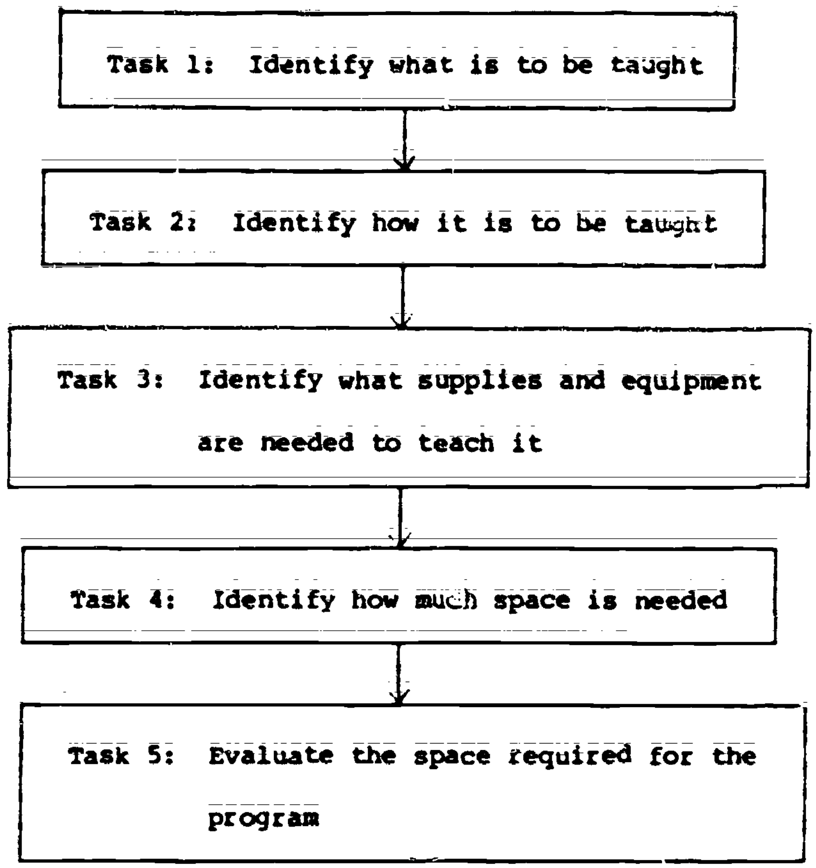

Figure 1. Overview of the Model for Establishing Facility Standards for Vocational Programs.

Identification of What Is To Be Taught

The curriculum should guide the design of the educational facility. This concept forms the backbone of the present facility planning methodology. Because the model prepared as part of this research project was to address a broad range of vocational programs, it had to have flexibility by design. But, it also had to permit attention to be focused to the specific needs of each particular vocational program.

To balance these two objectives, the model calls for an advisory committee to be formed for the planning of each vocational facility. Their job is to oversee the transformation of the curriculum into floor space estimates for the program. Their input guides the process through each of the steps in the model.

While it is simple to state that vocational facilities should be designed based upon the needs of the curriculum to be taught, the actual implementation of the process is complex. V-TECS catalogs (catalogs of uniformly structured performance objectives prepared by the Vocational-Technical Education Consortium of States) were used to identify the principal tasks to be included in the curriculum of the program for which facilities were being designed.

The use of the V-TECS catalogs for the purpose of identifying the content of the curriculum for a given vocational program seemed sensible, since the catalogs: (a) include only those tasks that have direct relevance to a student's successful performance on the job; and (b) include for each task the tools, materials, and other instructional resources that are to be given to, and used by, the student in mastering the program. Without the use of the V-TECS catalogs, each of these curriculum-related activities becomes a formidable undertaking. In view of this, it remains a surprising fact that there has been no previous mention in the professional literature of the use of V-TECS catalogs for either of these purposes.

Identification of sequences. This methodology continues beyond the identification of the content of the program curriculum. Once those tasks that comprise the curriculum have been identified, the advisory committee is then asked to identify related groups of tasks that should be learned as part of an instructional sequence. As used here, a "sequence" refers to a series of tasks that should be learned in a 1-2-3 order, one task directly following the next.

For example, in an automotive mechanics program, the advisory committee may decide that two performance objectives pertaining to a car's alternator--one on diagnosing the malfunction and the other on repairing the malfunction--should be learned in sequence.

The purpose of identifying sequences of instruction is to call attention to closely related tasks so that in later facility planning activities, when the method of instruction is being determined for a given instructional task, the advisory committee will be able to examine each task in the sequence to see whether or not a common method of instruction can be used for all tasks in the sequence. Where this can be done without compromising the delivery of any of the tasks included in an instructional sequence, then a cost savings may occur in the overall program. Of course, if the nature of the tasks comprising the sequence suggest that a common method of instruction is not sufficient, then the more appropriate methods should be recommended, however varied they may be.

Identification of prerequisites. In a manner similar to that used for instructional sequences, this methodology also identifies instructional prerequisites for each of the tasks in the curriculum. Instructional prerequisites are tasks (or performance objectives associated with those tasks) which develop knowledge or skills that are necessary for the students' successful completion of later, and generally more complex, performance objectives and which are thus required to be successfully completed prior to the students' attempting the later performance objective.

For example, in the automotive mechanics program mentioned above, the two tasks associated with the alternator might have as a prerequisite another task pertaining to the removal and replacement of the fan belt, since the fan belt would normally have to be removed before the alternator could be repaired.

While prerequisites may never present a problem in the instructional curriculum, that sometimes is not the case. Vocational programs that have many prerequisites early in the course of instruction may need more of the instructional materials and the occupation-related tools associated with those prerequisite tasks than might otherwise be the case if there were no (or few) prerequisites. The possibility of such bottlenecks occurring is diminished when the prerequisites are more evenly spread throughout the curriculum or when there are relatively few prerequisites.

Identification of How It Will Be Taught

After the content of the curriculum has been determined, the advisory committee must recommend an appropriate method of instruction for each of the tasks in the curriculum. The possible choices include: (a) instruction in either large or small groups, (b) learning activity packages used in individualized instruction, (c) carrels equipped with a movie or slide projector or with a television and video cassette player, or (d) laboratory work, either instructional exercises or actual work.

It is important to identify an appropriate instructional methodology for each task in the vocational program. The V-TECS catalogs provide a relatively complete inventory of the occupation-related tools, machines, and materials required to complete a given task. But, they do not address the means whereby the knowledge or skill pertinent to a given task is to be cultivated in the student.

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Nevertheless, some type of instructional support may be required. Some methods of instruction affect facilities planning more than others. For example, learning activity packages or other workbook-oriented instructional materials will require relatively little storage space, perhaps a few linear feet of shelf space. On the other hand, specially equipped carrels will require substantially more floor space. But, whether the instructional resources associated with a particular task are space-consuming or not, they are important in any comprehensive examination of floor space requirements.

Identification of What Is Needed to Teach the Program

The third step in determining the floor space requirements of a vocational program involves specifying which supplies and equipment are needed to teach each task in that program. The V-TECS catalogs usually provide a complete inventory of the occupation-related tools and equipment required for the student to learn each task. Instructional supplies and equipment are identified from the V-TECS catalogs and from the advisory committee recommendations on appropriate methods of instruction.

Based on the number of students to be serviced by the vocational program and the number of tasks requiring a particular item, the total number of each separate piece of equipment can be calculated.

Identification of How Much Space Is Needed

Two separate activities comprise this step in the facility planning methodology. The first is to have the advisory committee identify where each item is to be located in the instructional facility. Large machinery will remain in open areas of the lab or shop, whether they are in use or not. Other smaller items will be stored when not in use. But, where? Beneath counters and work tables in the shop area? In cabinets? Hanging on a wall? Or, possibly, on shelving? It is the advisory committee's task to determine where each item in the program is to reside when not in use.

The second activity involves calculating the amount of each type of space required for all items in the program. To do this, the size of each item in the program must be determined. Large pieces of equipment must either be measured directly or estimated from manufacturer supply catalogs. In addition, space must also be included aroumd each large equipment item to permit its safe use and to allow pupils to view the instructor demonstrating its operation.

If items are to be stored when not in use, the amount of storage must be estimated, and that, in turn, must be translated into some measure of floor area. For example, workbooks requiring six linear feet of shelving may require only about one square foot of floor area, assuming that six one-foot shelves can be installed one above the other.

After this has been completed for the entire program, the necessary floor area for the vocational program can be estimated by adding all previously identified floor areas. Additional floor space allowances must also be included to permit access to storage and equipment, for trafficways through the instructional area, for restrooms, for student lockers and dressing rooms, and for fire exits. The state board rules (Florida Board of Education, 1978) provide guidance with respect to what amount of floor space is necessary for these purposes.

The result is a preliminary estimate of the building space requirements of the vocational program.

Evaluation of the Space Required for the Program

The final step in this facility planning methodology involves the advisory committee reviewing the preliminary floor space estimates prepared for the program. The committee is charged with the task of reviewing the final result to verify the reasonableness of the floor space estimates. Where modifications are warranted, they are presented to those persons coordinating the facility planning effort so that appropriate adjustments can be made in the total recommended floor areas. Once these adjustments, if any, have been made, the final estimates of building space required for the vocational programs are now complete.

Field Testing of the Model

Any new method for determining the floor space required for a vocational-technical education program must be tested prior to its adoption and further use. Without thorough field testing, it is impossible to know whether the model does, in fact, provide usable information about the building space needs of a given program. This section of the final report discusses the procedures used in field testing this model and the results of those field tests.

Field tests were initiated for a total of six vocational programs. Those programs, and the schools which participated in the field tests associated with those programs, are shown in Table 1.

The Advisory Committees

Each field test included an advisory committee composed of at least one vocational educator and at least one practitioner of the occupation. The actual number varied from six people, three educators and three practitioners as outlined in the proposed methodology, to two people, i.e. one educator and one practitioner. Table 1 includes the number of advisory committee members used for each field test. For the convenience of the volunteer participants on the advisory committees, the project field test coordinator worked individually with many of the committee members at his/her place of employment.

The Field Test Methodology

Except as noted above, the field tests themselves were meticulous replications of the facility determination model. As the

Table 1

Vocational Programs and Educational

Institutions which Participated in Field Tests

Program	School	Vocational Consultant	Business/ Industry Consultant
Architectural Drafting	Gulf Coast Community College	1	1
Automotive Mechanics	Santa Fe Community College	2	2
Diesel Mechanics	Orange County School District	3	3
Licensed Practical Nursing	Santa Fe Community College	2	2
Printing	Lively Area Vocational-Technical Center	1	1

participants in each test completed each set of forms, project staff would collect and process them. The information thereby obtained would be incorporated into the next set of forms, and copies of the new forms would be delivered to the advisory committee members.

Despite the schools' willingness to cooperate, the field tests involved a considerable commitment of time on the part of the participants. Since participation in the field tests was voluntary, the participants were neither paid for the service they provided, nor relieved from any of their other day-to-day duties. Because the field test activities required hours to complete, they often presented a dilemma to the volunteers who could not complete both the field tests and the other duties associated with their respective occupations--the duties for which they were paid.

Results of the Field Tests

Architectural Drafting

The facility determination study for the Architectural Drafting program was the first field test to be completed. Architectural Drafting also had the shortest V-TECS catalog, and that fact may account for its swift completion. The longer, more intricate curricula required correspondingly longer times to permit advisory committee members to complete each set of forms.

A notable omission occurred in the V-TECS catalog for the Architectural Drafting program. It did not include a drafting table as one of the items to be provided to the learner. Understandably, drafting tables are one of the most common pieces of equipment in use by the profession (Schurter, et al., 1981, p. 63).

The results of the field test suggest that architectural drafting programs warrant a smaller amount of space than would be prescribed by draft administrative rules now being refined by the Department of Education. Table 2 summarizes the building space needs suggested by the model, comparing it with the floor space allocations proposed in the draft rules. The model provides only one-half of the floor space allotment recommended by the draft rules. The largest difference between the two floor space tabulations is in the instructional area. The model recommends a total of 1,017 square feet of space in the instructional area: 796 square feet for active instruction, 9 square feet for active storage, and 200 square feet for access and circulation. This compares with 1,620 square feet in the draft rules.

Printing Occupations

As was the case in the field test for architectural drafting, the facility determination model recommended less floor space for a printing program than is required by either current state board rules or proposed revisions to those rules. Table 3 compares the square footage allotments of the present methodology, the current state

Table 2

Results of the Facility Determination for Architectural Drafting Programs as Compared with Floor Space Allowances of Draft State Board Rules

Areas	Facility Determination Model	Draft State Board Rules
Instructional	796 Sq. Ft.	1520 Sq. Ft.
Storage	9 Sq. Ft.	100 Sq. Ft.
Noninstructional:		
Entrance, Traffic and Safety	200 Sq. Ft.	Included Above
Reproduction Room	Included Above	270 Sq. Ft.
Sink	20 Sq. Ft.	N/A
Student Project Storage/Lockers	100 Sq. Ft.*	100 Sq. Ft.
Office Space	100 Sq. Ft.*	100 Sq. Ft.
Model Shop	--	540 Sq. Ft.
Total Space	1225 Sq. Ft.	2630 Sq. Ft.

*From Office of Educational Facilities, Worksheet: 6A-2 Rules. Draft of July 9, 1981.

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Table 3

Results of the Facility Determination for

Printing Programs as Compared with Floor Space

Allowances of Draft State Board Rules

Areas	Facility Determination Model	Draft State Board Rules
Instructional	1709 Sq. Ft.	6515 Sq. Ft.
Storage	242 Sq. Ft.	250 Sq. Ft.
Noninstructional:		
Entrance, Traffic and Safety	488 Sq. Ft.	Included Above
Office Space	150 Sq. Ft.	150 Sq. Ft.
Student Lockers	50 Sq. Ft.	50 Sq. Ft.
Total Space	2609 Sq. Ft.	6965 Sq. Ft.

board rules, and the most recent version of the proposed revisions to the state board rules.

Most of the difference in the facility space allotment between the model and the state board rules (both the present and the proposed rules) is associated with the amount of active instructional space allotted to the printing program. The model suggests the need for only 33 percent of the amount suggested by the present rules and only 26 percent of the amount suggested by the proposed rules. Even after noninstructional space for entrances, traffic, and safety (488 square feet) are added to the instructional area allotted by the model, the new square footage is still only 43 percent of the instructional area given by the present rules, and only 34 percent of the area given by the proposed rules.

Automotive Mechanics

The facility determination model for automotive mechanics recommended a similar amount of space for this program as that which was recommended by the State Board Rules or the proposed revisions to those rules. Table 4 summarizes the building space needs suggested by the facility determination model, comparing it with the floor space allocations in the proposed State Board Rules.

The percentage difference between the facilities determination model and the proposed State Board Rules is only 1.4%. For this particular program, similar space needs were identified by the facility determination model and the proposed State Board Rules.

Licensed Practical Nursing

For the licensed practical nursing program, the facility determination model recommended less space than did the proposed State Board Rules. Table 5 compares the square footage recommendations of the facility determination model with the proposed Board Rules. In this program, no change has been recommended in the proposed State Board Rules.

The difference between the recommended space allocations using the model and the space allocations recommended by the proposed State Board Rules is 68 percent, with the lesser amount of space being recommended by the facility determination model.

Evaluation of the Field Test Results

After the space estimates had been calculated, the vocational educator on the advisory committee evaluated the overall adequacy of the floor areas suggested by the model. The evaluation covered the following topics:

a) the instructional area,

b) storage areas,

Table 4

Results of the Facility Determination for Automotive Mechanics Programs as Compared with Floor Space Allowances of Draft State Board Rules

Areas	Facility Determination Model	Draft State Board Rules
Instructional	4457 Sq. Ft.	3945 Sq. Ft.
Storage	163 Sq. Ft.	740 Sq. Ft.
Noninstructional:		
Entrance, Traffic and Safety	Included Above	Included Above
Office Space	105 Sq. Ft.	105 Sq. Ft.
Student Lockers	50 Sq. Ft.	50 Sq. Ft.
Total Space	4745 Sq. Ft.	4810 Sq. Ft.

Table 5

Results of the Facility Determination for

Licensed Practical Nursing Programs as Compared with Floor

Space Allowances of Draft State Board Rules

Areas	Facility Determination Model	Draft State Board Rules
Instructional	280.3 Sq. Ft.	2421 Sq. Ft.
Storage	26.7 Sq. Ft.	200 Sq. Ft.
Noninstructional:		
Entrance, Traffic and Safety	488.0 Sq. Ft.	Included Above
Office Space	105.0 Sq. Ft.	105 Sq. Ft.
Student Lockers	135.0 Sq. Ft.	135 Sq. Ft.
Total Space	1035.0 Sq. Ft.	2861 Sq. Ft.

c) non-instructional areas, and

d) the total space suggested for the facility as a whole.

Each of the above areas proposed for the Printing program was considered "adequate" by the instructor participating in the field test. There was no further amplification of those ratings on the evaluation form (Form 5B) that solicited "comments" on the adequacy of the proposed space.

The instructor evaluating the proposed space for the Architectural Drafting program rated the instructional area as "more than adequate," but the amount of space beneath counters was considered to be "inadequate."

Other storage areas had "adequate" amounts of space, with the exception of storage on shelves, which was considered to be "inadequate" for the needs of the program. Written comments pointed to the need for sufficient shelving for a small library of trade journals and professional books. It was also suggested that the program would also need additional cabinet storage, especially for large map-size architectural drawings.

Space recommended nor noninstructional programs in the Architectural Drafting program was considered to be "adequate" or "more than adequate," with one exception. The amount of office space was considered to be "inadequate." Comments concerning these noninstructional areas pointed out that the diazo blueprint copy machine had to be located in a separate room with positive ventilation to the outside of the building.

Overall, the space suggested for the Architectural Drafting program was considered to be more than adequate by the vocational instructor. He commented that a well-designed program should have a lecture room, as well as a continuously available drafting lab, a storage room, a sink/diazo room, and an office for the instructor.

The evaluation of recommended space for the automechanics program was noted as follows. The instructional space was rated as more than adequate. Storage space for tools and equipment was rated as being adequate.

It was suggested that more space be allotted to cleanup, as cleanliness is an important aspect to teach to automechanics students.

The evaluation of the proposed space allocations identified by use of the facility determination model for the licensed practical nurse program made by the advisory committee indicated that space for the instructional area was adequate. The evaluations of the other storage areas indicated that they were barely adequate. The advisory committee pointed out that more wall space was needed for displaying teaching aids and for storage of small items. It was also noted that more cleanup space was needed in the lab. The total space recommended was rated as barely adequate.

FINDINGS AND ANALYSIS

This section of the project report is a discussion of findings associated with the model in general, as opposed to findings relevant to a particular field test. Where limitations associated with the facility planning methodology have an identifiable remedy, that is discussed in the section on recommendations. Where limitations to the general use of the model are found that do not have an apparent remedy, that is reported with conclusions concerning the model and its use.

The Model Provides Minimum Space Requirements

It is the opinion of the project staff that the facility determination methodology provides realistic estimates of the minimum floor space required for the necessary instruction. This is because of the process involved in the model's methodology. It aggregates each item necessary for the program in an incremental fashion and, consequently, provides scant opportunity for any unwarranted room to be included in the final space requirements for a given program.

Use of the Model Is Time Consuming

The facility determination model is a very involved undertaking which requires a large cadre of people to complete hundreds of pages of forms. When examined individually, none of the forms is difficult to complete. However, in many of the activities associated with the model, there are as many forms as there are performance objectives in the program. All these forms require constant attention to detail. That becomes increasingly difficult as the level of fatigue increases, and as the level of participant interest decreases.

V-TECS Catalogs and Their Limitations

V-TECS catalogs (or other sources of performance objectives) and the information they contain form an indispensable part of the facility determination model. But, V-TECS catalogs were not originally designed for purposes of planning floor space required by vocational programs. As a result, certain limitations to the use of the V-TECS catalogs for facility planning purposes were identified as a result of the field tests. They are discussed below.

Some Equipment Is Not Listed

The V-TECS catalogs were prepared by different curriculum writing teams. And, while a common format is follows from one V-TECS catalog to another, the level of detail in those catalogs varies.

The catalog of performance objectives for the automotive mechanics program submerges all commonly-used hand tools under the caption "proper tools and equipment," and only itemizes special tools required for a given performance objective. Many of the other catalogs refrain from this approach, instead itemizing each equipment item used in each performance objective. The catalog for architectural drafting notes whether or not the student is to have use of a scale, a triangle, pencils, pens, or some combination of these items. These frequently-used items are a part of any architectural drafter's "toolbox," just as wrenches and screwdrivers are a part of an auto mechanic's toolbox.

In addition to the problems associated with a V-TECS catalog not specifically identifying frequently-used items, they sometimes omit important items which should be included in the performance objective. For example, in the architectural graphics V-TECS catalog, there is never any mention of the student being provided with a suitable drafting table, and the nursing catalog never mentions an examining table. Where this occurs, it may go unnoticed by the facility determination manager. Of course, it should not go unnoticed by members of the advisory committee, but that did occur in the field test of the architectural graphics program.

Equipment Location Is Not Specified

While the V-TECS catalogs generally identify all, or nearly all, of the equipment required to perform tasks in the curriculum, the catalogs do not mention locational requirements associated with that equipment. The V-TECS catalog for architectural drafting, for example, identifies a diazo (blueprint) copy machine as being required by the program. But, it does not mention the need for the copier to be located in a specially vented room designed to exhaust the ammonia fumes which result from the machine's operation. In a similar manner, the V-TECS catalog for printing trades identifies equipment that must be located in rooms apart from those for the majority of the equipment. This includes the platemaking and darkroom facilities, as well as the camera room.

As long as the facility determination manager, the person coordinating the building space study, is aware of this limitation in the V-TECS catalogs, it should not present any serious problems. But, failure to recognize this limitation could result in unrealistic space estimates for a particular program.

No Indication of Instructional Materials

The final limitation of the V-TECS catalogs involves materials which the instructor may need to use in order to develop the desired competencies in the student. For example, in the V-TECS catalog for automotive mechanics, the instructor may introduce a complex repair activity with a film that demonstrates the task to be mastered. Then the student may attempt the repair procedure using a cut-away model of the mechanism being repaired. Finally, the student would try the procedure using an automobile.

But, the V-TECS catalog only mentions the tools and equipment required for the final step in the learning process. That equipment, which has instructional value only, is ignored in the V-TECS catalog. And, perhaps, that is how it should be. The V-TECS catalogs were not designed to describe the learning process. They were only designed to illustrate how tasks should be performed once they have been mastered.

CONCLUSIONS

The conclusions resulting from this research address several different issues. First, there are conclusions associated with the facility determination methodology and the degree to which the objectives of the project were attained. Conclusions are also discussed concerning the utility associated with the use of V-TECS catalogs for the purpose of planning vocational facilities, conclusions of possible importance to the profession as a whole. And, finally, conclusions concerning the relative costs and benefit of curriculum-oriented facility planning are presented.

Realization of Project Objectives

The objectives for this research project were attained: The important elements of a curriculum-oriented facility planning methodology were identified and used in the design of this model. The completed model was field tested, and the results of those field tests are included in this report. And, an evaluation of the facility planning methodology was conducted, both by using input from the field test advisory committees and by comparing the field test results with the building space allowances presently in use by the Florida State Board of Education.

Not only was the model designed as stated in the project objectives, but it also gave a good account of itself when it was tried in field tests. The advisory committee generally understood its role in the facility planning process, and the activities incorporated in the model did build upon one another, resulting in floor space recommendations which could be supported based upon the instruction occurring in the vocational program. In other words, the model works as planned. And this is in no way diminished by the fact that there are several improvements recommended in the next section of this report.

Closely related to the conclusion that the model worked smoothly is the conclusion that the model provides usable answers concerning the amount of floor space required by a given vocational program. This conclusion, of course, must be independently verified by educators on the staff of the Division of Vocational Education. However, it is the contention of the authors of this study that the model provides reasonable floor space estimates which are suitable for a point to begin planning educational facilities.

Contributions to the Field

Another conclusion which this research supports is that the V-TECS catalogs are a valuable tool which the educational planner can use to provide an instructional facility that is more in tune with the needs of the curriculum. Insofar as the project staff could determine, no previous studies in the field used the V-TECS catalogs or any other source of performance objectives for this purpose.

Overall Utility of the Model

One of the reasons that more traditional facility planning methodologies have dominated the field is the ease with which they can be used to generate the floor space required by a vocational program. One simply multiplies the number of students by some specified floor area allotted for each student. The methodology developed in this project uses a much more complex procedure to obtain floor space estimates.

It should be noted that the procedure does not provide for space for an instructor to accommodate materials or supplies not associated with teaching the tasks required to teach the occupation. Nor does it allow for space to store large quantities of supplies.

Whether or not the facility determination methodology presented in this research attains a wider degree of acceptance and use will depend upon conclusions made by vocational educators in Florida concerning the overall costs and benefits of this methodology. This is a more complex and costly methodology than those commonly used today. The cost of using this methodology, however, must be weighed against the utility of the floor space recommendations it provides.

The vocational education profession must balance the higher costs associated with this methodology against the use of some other methodology which is less responsive to the content of the curriculum. But, there are costs other then those directly associated with the use of this or that facility planning model. We live in an age of rapid technological change, and the impact of that technology will be increasingly felt in vocational education. If curriculum-oriented facility planning models do, in fact, provide more realistic answers, then the costs associated with not using them should also be considered. Facility planners must recognize the less tangible costs to society at large associated with simpler, but less effective, methods for planning educational facilities.

Here, no conclusion can be reached. If the State of Florida Board of Education finds this method to be an improvement over other, more traditional, methods, it may choose to adopt this method. On the other hand, if the Board concludes that the method presented in this research does not provide sufficient improvement over methods presently in use, then the new methodology is unlikely to achieve wider use. Only time will tell which conclusion will be reached by professional educators.

RECOMMENDATIONS

In the course of developing and testing this facility determination methodology, certain modifications were identified that seemed as though they would improve upon the procedures recommended in the present method. Those "variations on a theme" are presented here. It is the opinion of the project staff that the use of these recommended modifications will result in improvements in the overall functioning of the model.

The Need for a Controlled Setting

Because the field tests were conducted without funds to permit the advisory committee to meet at a central site, the project staff shuttled sets of forms to and from each advisory committee member. This worked, but the process would have been substantially improved if funds had been available to permit the facility determination study to be conducted at a hotel meeting room or some similar facility.

First, all members of the advisory committee would have been removed from the distractions present at their regular place of work. As it was, these competing distractions frequently commanded a higher priority than did the facility field test. This is not surprising, since the advisory committee members participated in the field tests as unpaid volunteers.

Conducting facility determination studies at a hotel meeting room or other "neutral" location would permit the facility determination manager to be available to answer any questions which the advisory committee might have. In the field tests there was some confusion, particularly among the business/industry representatives, concerning the exact meaning of the terms "instructional sequences" and "instructional prerequisites" used in the model. If the facility determination manager had been in attendance while all the forms were being completed by the committee, it would have been unlikely for this confusion to occur.

A final reason for the advisory committee working at a common location is that situations where the committee was not in agreement could be resolved by the facility determination manager and the committee, rather than by the facility determination manager working alone. While these situations did not occur frequently, they are nonetheless important. It is those few areas where the committee is sharply divided that deserve additional attention.

Any recommendation concerning the need to conduct a facility determination study at a hotel conference room would be incomplete without an estimate of the costs associated with it. While the costs may seem sizeable at first glance, they are relatively insignificant when compared with the cost of the instructional facility itself. As Table 6 shows, a total of about $7,000 would be required for each facility determination study.

The Need for Computers

The facility determination model prepared as part of this project was designed so that it was not dependent on the use of a computer. However, the process is involved and requires analysis of hundreds of pages of forms containing data about the instructional program. The use of a computer to assist in the data analysis would speed the process noticeably. Use of a computer would also eliminate many of the presently existing possible sources of human error. As now designed, the facility determination model is ideal for use with a computer.

Recommendations for Revision of the Model

In conducting the field tests of the facility determination model, discrepancies were discovered which need to be corrected in order to insure that the model may be used for the function for which it was designed. The following area suggestions which will help to correct the deficiencies which were discovered. There is also a section which discusses more efficient usage of some of the forms included in the manual.

Equipment Lists

It is essential that equipment lists for performance objectives be complete. In using the V-TECS catalog for architectural drafting, a drafting table, essential for most of the performance objectives, was omitted. In the automotive mechanics program, even though 77 of 223 performance objectives specified the lifting of the vehicle or lifting the front of the vehicle, a car lift was not listed on the equipment list. In the practical nursing program, there was no provision for the use of the new prepackaged items which are used in most of the performance objectives. Students no longer assemble the items for use because of the prepackaging which insures the use of sterile equipment.

The model makes no provision for consumable items such as forms which would be used by each student, or the above-named prepackaged items. There is also no provision for locked storage of certain items to assure security of the items, or for the storage of items which must be secured for safety reasons.

In the licensed practical nursing program, even though it is competency based, there is a time limit on attaining the performance objective, and so most students would be doing the same things at the same times. The facility determination model formula for determining the number of pieces of equipment needed should be revised to allow for this phenomenon.

Table 6

Cost Estimate of a Facility Determination Study Conducted at a Hotel or Other Similar Facility

Activity or Expense Item	Cost Estimate
Advisory Committee:	
6 people x 5 days @ $100/day	$3000
Facility Determination Manager and Assistant:	
2 people x 6 days @ $40/day	600
Advisory Committee per diem:	
6 people x 6 days @ $50 day	1800
Travel Costs:	
8 people @ $100/person	800
Supplies and Copy Costs in the Field:	
4 days @ $100/day	400
Conference Room Cost:	
5 days @ $100/day	500
Total:	$7100

Note: Salaries for the facility determination manager and for the assistant manager are not included in this itemization.

Suggestions for the Use of the Forms in Section 3

It may not be necessary under Section 3 (Determine Necessary Instructional Materials and Equipment) to place equipment into the categories of hardware, software, and tools/machines/materials. The equipment to be used in a competency-based instructional program could be listed on one form: "Equipment Required for the Program." Thus, forms 3B (for hardware), 3C (for software), and 3D (for tools, machines, and other occupation-related materials) could be reduced to one form--Form 3B. This form would then be used to record items which have been rated by the advisory committee as being necessary for a student to use for the stated performance objective.

The following step would then also require only one form--Form 3C (Equipment Necessary for the Program)--on which could be recorded each piece of equipment needed in the program, and space for recording the number of performance objectives in which each piece of equipment was used. Next, the calculation would be done to determine the total number of pieces of equipment needed. The total, then, would be placed on this form.

Suggestions for the Use of the Forms in Section 4

After the advisory committee has indicated where the various pieces of equipment should be stored, On Form 4A, and the facility determination manager has indicated the most appropriate storage space for each item, it is necessary to determine how much space will be needed for storage of the necessary pieces of equipment. The forms to be used for calculating the amount of storage space needed should include space for recording the size of each piece of equipment. This would eliminate the need for constructing a list of items and recording the size, then using this list in combination with the forms (Forms 4C-4G) to calculate space requirements.