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The Development & Study of a Competency-Based Vocational Education Drafting Program

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THE DEVELOPMENT AND STUDY OF A COMPETENCY-BASED VOCATIONAL EDUCATION DRAFTING PROGRAM

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DEVELOPMENT AND STUDY OF A

COMPETENCY-BASED VOCATIONAL EDUCATION

DRAFTING PROGRAM

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Kenneth Mussnug July 1982 87 pages

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The purpose of this curriculum project was to develop, revise, and field test a competency based vocational drafting program which was accomplished in four phases. An existing CBVE drafting program, developed by this author, was revised prior to the field test. New modules and audio visual presentations were developed, the program was tested in two vocational programs, and the program evaluated again after the test.

Twelve modules were revised and one new module developed. Nine new slide tape presentations were developed to supplement the modules and existing slide tapes.

The program was tested at the Russellville Vocational School, Russellville, Kentucky, and the Allen County Scottsville Vocational School, Scottsville, Kentucky. Involved was a total of 45 students. The students were high school juniors and seniors in their first year of drafting.

The field test was conducted during the 1980-81 school year. An evaluation instrument was used to assess the

student reactions to the CBVE program. Ninety five percent of the students rated the program as superior to other lecture based programs they had experienced. Ninety eight percent of the students rated the slide tape presentations as excellent or good.

THE DEVELOPMENT AND STUDY OF A COMPETENCY BASED VOCATIONAL DRAFTING PROGRAM

I. INTRODUCTION

Vocational Education began in 1917 with the passage of the Smith-Hughes Act which provided a continuing appropriation for vocational education in Agricultural, Trades and Industrial and Home Economics Education (Roberts, 1971). The law was in response to the country's demand for trained workers during a time of industrial expansion. The educational system in existance was not meeting these industrial demands. The premise of vocational education was taking experienced workers from their trade areas and placing them in charge of the classrooms.

Vocational Education contains one inherent quality for teaching a trade: competent tradespersons are the teachers. Since he/she has first hand experience, a tradesperson can identify the specific skills and abilities necessary for success in a trade area. However, expertise in an area may not ensure the ability to transmit information to others. The new vocational educator has been working at the advanced levels of his/her trade and long ago intern-

alized the entry level skills which beginners need to learn. What the vocational educators need is an organizational system which does not require extensive training or experience to use. The Competency Based Vocational Education (CBVE) system, in use by the State of Kentucky, provides the organizational base and the simple-to-complex arrangement of the tasks which these instructors need.

As the first step in the CBE curriculum development process, it was necessary to identify the competencies needed by occupational workers. These competencies became the tasks in the program. The term "competence" does not refer solely to specific knowledge and skills, but may also include more complex abilities such as being able to think logically, organize work and appreciate workmanship (Faradig, 1975, chap 1).

Competency-based vocational education programs are programs in which the performance objectives are specified, and agreed to, in rigorous detail in advance of instruction. Consequently, students know what standards of workmanship will be demanded of them before they begin the program. Each student is held accountable for attaining at least a given minimum level of competency in performing the essential tasks of the occupation. The student must demonstrate his/her competency by performing the task while the instructor rates the performance, using a checklist or other objective measure (Faradig, 1975).

Traditional instruction patterns of group demonstration, group testing, and unit organization do not work well in competency-based education. Because students have a range of abilities, learning styles and motivation, they will vary in the amount of time required to achieve the competencies. To allow each student to progress at his/her own rate, individualized instruction is desirable. In fully individualized programs, the amount of time students are enrolled in a vocational program is not the standard by which they are certified as being ready to enter an occupation. The students will be certified as having successfully completed the program when, and only when, they have demonstrated their ability to perform the competencies that have been identified for their career goals (Fardig, 1975).

Individualized instruction can be effectively achieved by devising student learning packages called modules. The module provides the student with the objectives and lists a sequence rated performance that will demonstrate proficiency. Competency-based education, then, is not simply a collection of instructional modules for students, but a total system for successful job performance.

The Kentucky Bureau of Vocational Education and the Curriculum Development Center for Kentucky have made a serious commitment to the concepts of competency-based education (CBE) and to the belief that CBE can make a significant contribution toward the improvement of vocational

education in the Commonwealth. The CBE effort began with the selection on an initial group of occupations that were considered to be of high priority in terms of the manpower training needs of the State. Drafting was not selected as one of the original high priority areas. However, the Department of Vocational Education, Kentucky State Department of Education, recently mandated that all Vocational Education Programs will be competency based by the 1983 school year. It was, therefore, important that a program for the area of Drafting be developed and tested. The competency-based drafting program, developed by this author and used for the last two years, was the subject of this curriculum project.

II. PURPOSE OF THE STUDY

The purpose of this study was to develop, revise, and field test a competency-based vocational drafting program. This process was accomplished in four phases:

1. CBVE drafting modules were developed and revised prior to the field test.

2. New slide tape presentations were developed for the modules and several existing slide tape presentations amended.

3. A field test of the program was conducted to consider the student and teacher reactions to the modules and audio-visual presentations.

4. The field test information was used to further revise the program.

Group development with input from several sources is an excellent method of producing a valid, dynamic curriculum. This field test provided additional instructor input.

III. OBJECTIVES OF THE STUDY

The objectives of the study were as follows:

1. To revise the modules prior to the field test, based on suggested revisions from the modules used during the 1979-80 school year.
2. To develop new slide tape presentations in several of the module areas.
3. To conduct a field test of the first 13 modules in mechanical drafting.
4. To revise the program based on the findings of the field test.

In order to get the CBVE drafting program into use in 1978, this author used commercially available filmstrip presentations for the audio-visual portion of the program. These were replaced by slide tape presentations during the development process. They cover the following areas:

a. Introduction to Drafting
b. Lettering
c. Visualization
d. Sections
e. Auxiliaries

f. Isometrics

g. Dimensioning

h. Using the Drafting Machines

i. Obliques

During the initial development stages, this author conducted an occupational analysis of drafting to develop the tasks required for the modules. The survey, which was conducted in the Bowling Green, Kentucky, area, questioned many engineers and draftsmen working in industry.

A recent state list of tasks for drafting was obtained from Mr. Pat White, Director of Industrial Education, Kentucky Department of Vocational Education. Many of the tasks were the same as those developed during the occupational analysis. Some of them required revision, and several module objectives were rewritten to assure coverage of the new state tasks.

Additional revisions accomplished were as follows:

1. The addition of one new module covering the drafting machine.

2. Rewording of some of the instruction sheets and student self checks.

3. Evaluation of the practice problems.

4. An evaluation of each module for content and coverage of the objectives and job tasks.

The final set of modules resulting from the field test will be submitted to the State Department of Vocational Education. It is anticipated that these modules will become the nucleus for the State's drafting programs.

DEFINITION OF TERMS

AFFECTIVE OBJECTIVE: A statement which specifies an affective characteristic (value, attitude, commitment, response) that a student is expected to acquire and demonstrate.

COMPETENCY: A skill, either cognitive or psychomotor, which is required in the vocation and which the student is expected to learn and demonstrate in the educational program.

COMPETENCY-BASED EDUCATION (also called performance-based education): An educational program in which the competencies (or skills) to be acquired and demonstrated by the student, as well as the criteria to be applied in assessing the competencies, are made explicit. The student is held accountable for meeting those criteria.

FAST LEARNER: For the purposes of this study, a fast learner is a student who is able to complete more than 11 modules in the first semester.

FEEDBACK (or knowledge of results): Procedures by which the student is informed of his/her progress, areas of weakness, or his/her level of success in demonstrating the desired competencies.

FINAL ASSESSMENT PROCEDURES (also called check-out activities): Measuring processes which are used to determine the student's level of mastery relevant to a specified objective or set of objectives following instruction intended to facilitate his/her achievement of mastery.

INSTRUCTIONAL MODULE: A set of learning activities in organized physical form intended to facilitate the student's acquisition and demonstration of a particular competency or group of related competencies.

LEARNING ACTIVITIES (also called learning experiences): Activities or experiences which are made available to a student to help him master an objective or set of objectives.

LEARNING PACKAGES: Instructional modules which are combined with other learning resources in order to provide complete experiences and to facilitate acquiring competencies.

PERFORMANCE OBJECTIVE: A statement which specifies a competency a student is to acquire and demonstrate.

PREREQUISITES: Those competencies a student is expected to demonstrate before he begins to work on a particular instructional module.

SLOW LEARNER: A student who has problems visualizing and requires additional practice problems. A slow learner, for purposes of this study, is one who completes seven or less modules in the first semester.

STUDENT SELF CHECK: A diagnostic feedback procedure with the modules used to allow the student to evalute his/her own progress. The answers to the self check are provided within the module.

CHAPTER II

SURVEY OF THE LITERATURE

Studies have shown competency based vocational education is an effective method of teaching a trade. The following are the most commonly listed (Oen, 1980):

1. All entry jobs are not the same.

2. All students do not have the same interests or abilities.

3. Students entering vocational programs have varied training and experience backgrounds, so they should enter programs at all levels.

4. Student's progress should be dependent on performance objectives, not instructional materials.

5. Disadvantaged, handicapped, and learning disabled students are more easily accomodated and can, therefore, be mainstreamed more easily.

6. Students are evaluated more objectively.

7. There is an increase in congruity between objectives and tests.

8. Course content is identified more systematically.

To be competency based, the program must be more than mastery learning alone, and it must have the following

elements according to Blank (1980):

1. It must be based solely on precisely worded tasks verified as essential to entry level employment in the occupation.

2. The learning activities must lead the student toward mastery of the tasks.

3. Each student must be provided with sufficient time, within reason, to fully master each task before moving on to the next.

4. The student's evaluation and exiting from the program is based primarily on the individual's ability to perform each task as it should be performed on the job.

The current system in use by the State of Kentucky has been designed by the State Department of Education in co-operation with sixteen other states which make up a Southern Consortium of States. They have developed modular based vocational education curriculum in many of the vocational areas.

The procedure to establish the job tasks is an important one, since the tasks are vital to the success of the program. Six (6) steps are used to achieve a competency based program (Briscoe, 1979).

1. Determine the specific jobs in an occupational program for which training will be provided. This can be done through work with advisory committees and reviewing local manpower needs.

2. Define each job for which training is to be offered in the occupational cluster. Information from the Dictionary of Occupational

Title and Craft or Advisory Committees can provide assistance with this step.

3. Identify the tasks done by an employee in each job title. Once the job titles and their definitions for a program are established, a task analysis or survey of inumbent workers in each job title is necessary to determine the specific skills and knowledge that should be taught. Tasks may vary from one locale to another, therefore, it is a good idea to review the work and discuss it with craft or advisory committees and employees in the area to add, deete, or change the tasks as necessary to meet local needs.

4. Convert each task to a performance objective so that the student knows what is expected. The performance obective includes the conditions and standards of achieveent expected by future employers.

5. Develop a learning plan for each performance objective. The learning plan should provide the student with the actvities which will enable him/her to achieve the objectives. It should be structured with a variety of activities that will provide the content necessary as well as practice. Kentucky has developed learning packages and objectives in some occupations; however, materials from other sources can be used and/or adapted to the objectives.

6. Develop an evaluation that will measure each student's achievement as specified in the performance objective. The student is evaluated against the standard rather than against another student's achievement. The evaluation provides teachers with the knowledge they need to specify that a student can or cannot do a specific task.

Modules are guides that a student follows as he or she works toward mastery of the tasks. Each module is a set of learning activities designed to help the student acquire and demonstrate a particular occupational competency. Org-

anizing the instructional program in modular form increases possibilities for student self-pacing and individualization. It also aims the instruction toward specific competencies and ensures relatively objective evaluation of performance.

Each module encompasses the learning of a single identified objective or a small group of related objectives. All of the activities outlined in the module are directed toward achievement of these objectives. Progress toward subsequent objectives depends on the student's demonstration of achievement. Though basically linear in instructional design, the modules provide for individualized learning-activity options and for by-passing learning activities in cases where students have acquired the competencies through previous experience.

The first page of the module includes the title, introduction, directions and objectives developed from the tasks. In this way, the objectives are specified in advance of the instruction (Bruce, 1979).

The introduction statement is a brief overview of the material in the module. The directions serve two purposes. First, they provide the student with the opportunity to check out the unit if he/she knows the material. Second, they direct him/her toward the learning activities.

The second page of each module is the learning activities. These learning activities are organized to enable

the student to achieve the objectives and include experiences for acquiring cognative knowledge and skill development. The learning activities help the student to achieve the stated performance objectives and promote the affective goals of the teacher. While not precluding traditional group instruction or teacher-dominated modes of learning, the activities are largely self-instructional and individual. The student is instructed to follow the learning activities in the order in which they are written--from the simple-to-complex operations.

The modules present the information to the student in a three time concept. The information is provided in a slide tape presentation, in a reading assignment from the text, and then highlighted in the form of student self checks or information sheets. The information sheets are one page long and summarize the material from the text and slide tape lessons.

The student self checks are diagnostic tests. They provide the student with the opportunity to recall the material. Feedback to the student is ensured by the inclusion of these self tests. They are not graded; instead, the answers are provided for the student at another location in the module.

The modules rely on slide tape presentations to present the "lecture" portion of the program. These tapes provide a well planned lesson for the student and provide

the opportunity to view the lesson as many times as needed. An advantage for the instructor is that they free him/her from many routine teaching jobs such as lesson plan preparation or lecturing. This extra time when devoted to individualizing the instruction can greatly benefit the students.

Practice problems are provided within each module. The problems provide the student opportunities to prepare for his/her demonstration of the tasks which he/she must demonstrate on the check out activity. The instructor provides the student with a two-part check out activity which consists of a psychomotor and cognitive element. Levels of acceptable performance must be met by the student in order to complete the module. If the student cannot demonstrate mastery of the tasks, he/she is required to review the parts missed until he/she can demonstrate competency.

A program used in El Paso for the last seven years listed the following positive outcomes to a Competency Based Drafting Program (Ingram, 1980):

1. The student becomes more self-reliant.
2. Students are more likely to master the content.
3. Students master prerequisite material before advancing to new material.
4. Students are not competing against each other but are trying to master a defined level of performance.
5. Students know exactly what to expect.

6. Students have more personal contact with the instructor.

7. The burden of learning is placed on the students.

8. Instruction is student oriented.

9. Time is a variable within reason.

10. The student can receive credit for the same competencies previously mastered.

Several cautions were also listed (Ingram, 1980):

1. The system is more difficult to implement on a larger scale than are traditional methods.

2. More and better instructional materials are required.

3. More initiative and persistence is needed on the part of the students.

4. Too many students fall victim to self-pacing if allowed to do so.

5. The system requires more work on the part of the instructor and student if the principles are retained.

6. Competency based instruction has several advantages, but it is not a cure-all.

7. Some students need deadlines and a more instructor oriented class.

8. The quality of any instructional system depends on the performance and effort of the instructor.

The concept of competency based instruction originated with the military. In a recent article, Blank (1980) reported results of some of the military findings. In one study a thirty seven (37%) percent increase in training

time was found, with fifty-three (53%) percent of the trainees finishing in less than standard time. Forty (40%) of the subjects felt that the individualized instruction methods were more favorable, while only nine (9%) rated them as less favorable (Blank, 1980).

Similar findings were reported in regionalized studies. For instance, in Kentucky Thomas (1976) measured student attitudes toward CBVE and found that most students have a positive attitude toward the program. Although the statistical evidence is not clear, it appears that attitudinal differenences were not due to any difference in the quality of the modules or other program aspects, but rather due to individual differences. For the most part students who scored high in attitude, also scored higher than their peers in student interest, readability, solving problems, and student self checks.

Two other findings of the Thomas (1976) study suggest the success of CBVE programs. First, the number of modules completed was not a significant factor in the formation of attitudes toward CBVE. Second, there was no significant correlation between students' grade point averages and their attitudes toward CBVE which counters the argument that CBVE works only for faster, smarter students (Ky. Dept. of Ed., 1978).

The selected literature indicated the value, validity and appropriateness of module development and use.

CHAPTER III

METHODOLOGY

This study involved the development, revision and field testing of a CBVE Drafting program. The original drafting program, written by this author, was revised prior to, and after, the field test. The test was conducted in two high school vocational drafting programs during the 1980-81 school year. Mr. Jim Norman, drafting instructor at the Allen County-Scottsville Vocational School, and Mr. Kenneth Mussnug, drafting instructor at the Russellville Vocational School, Russellville, Kentucky, conducted the field test.

Program evaluation forms were used to assess student reactions to the program. The results of these surveys are summarized and reported in Chapter IV. The evaluation forms assessed the student's reaction to the various parts of the modules, the slide tape presentations, and the overall CBVE approach to teaching drafting.

At the conclusion of the field test, this author and Mr. Norman appraised the program. A review of the modular material and slide tape presentations was made and the final revisions to the program determined. Both instructors maintained records on the number of check out test

items missed during the year. Utilizing these data, the check out tests were revised.

The following is a description of the subjects, procedures, limitations, and use of the data for the study:

A. SUBJECTS: The subjects were junior and senior high school students in Vocational Drafting. Two schools were involved. The Allen County-Scottsville Vocational School, Scottsville, Kentucky, and the Russellville Vocational School, Russellville, Kentucky. The students were in their first year of drafting, and attended for three (3) hours per day.

B. PROCEDURES: The students were introduced to Competency Based Vocational Education, using the same format developed by the State of Kentucky for the other CBVE programs. They worked primarily at their own pace with the instructor acting as a manager for their progress. The modules were printed in the same style as the other state modules and encased in plastic folders. The slide tape presentations were presented to the students using a Singer Caramate slide tape machine in a designated study area. The entire program presented to the students was a close as possible to other completed state CBVE programs.

C. LIMITATIONS: This was a curriculum development project. The main goal was to get a second opinion on the competency based curriculum. The study evaluated the CBVE drafting program and made recommendations for changes. One major limitation was the number of modules to be tested. The author decided to limit the project to the first thirteen modules, thus, allowing a significant number of students from both classes to use the modules. A minimum of eight students was required before evaluations were made.

D. USE OF THE DATA: The results of this field test prouced a set of modules and slide tape presentations for an introductory CBVE drafting program. The completed modules and slide tape presentations will be submitted to the State Department of Education, Bureau of Vocational Education for their evaluation. It is anticipated that they will become the nucleus of the state's vocational drafting program in the future.

CHAPTER IV

THE MODULE DEVELOPMENT

I. REVISIONS PRIOR TO THE FIELD TEST

The original modules were developed according to the procedures used by the State of Kentucky. The tasks used are those obtained from the State Department of Education, and this author's industry survey. The purpose of this project was to develop and revise the modules and accompanying audio visual presentations.

These first draft modules were used for two years and minor cosmetic revisions made during that time. Prior to the field test of the program revisions of the first thirteen modules were conducted. The following is an explanation of this revision work by module number. The objectives listed are a summary of the teacher objectives for the student, not the student objectives listed on the modules.

MODULE NUMBER 1

TITLE: DRAFTING, AN INTRODUCTION

OBJECTIVES: This module is designed to introduce the stu-

dent to the field of drafting. It presents the types of careers available, how to achieve a career in drafting, and a brief introduction on how a draftsman works.

Several secondary objectives are also important in this module. The module is designed to acquaint the student with module structure. In working through the module, the student is exposed to the various module parts and thier use. It is, therefore, important that Module One contain all of the various features used in the modules. An information sheet, student self-check, instructor's final checklist, and check-out activity are included. The learning activities page also directs the student to the slide tape machines and both textbooks used in the program.

Information Sheet 1-1, DRAFTING, THE NATURE OF THE WORK, was revised. The main thrust of the revision work on this sheet was to change the rhetoric making it easier to read. It was decided some of the words were too technical for beginning students. These terms were replaced with some more applicable to the high school level. The textbook assignments were also assessed and several changes made in the reading assignments.

The Check-Out Activity was revised making the questions more relevant to the new slide tape presentation. The new slide tape presentations will be discussed in the next chapter.

MODULE NUMBER TWO

TITLE: DRAFTING EQUIPMENT

OBJECTIVES: The purpose of this module is to introduce the student to the drafting equipment. Tne student becomes familiar with the equipment names and where it is used. The module is not designed to make the student proficient in the use of the equipment. However, the student is required to demonstrate the correct procedure for sharpening the lead holder pencil and compass points.

The original module included a unit on the drafting machine which is the most common piece of equipment used in the field. It was decided that a separate module be developed for the drafting machine. All instructions on the parts of the drafting machine were removed from module two and a new module, module 2-A, was developed. Module 2-A illustrates the parts of the drafting machine and its elementary use. Module 2-A will be discussed in the next section.

As mentioned in module one, one of the major revisions to the program was the new slide tape presentations which replaced the old filmstrips. Two slide tapes are included with module two.

The four features of Drafting, listed in Module One, were added to the student self check. The equipment iden-

tification on student self check 2-1 was modified to include a space on the sheet for the student responses.

Student Self Check 2-3, LINES AND ANGLES, which requires the student to draw straight lines and lines at several angles, was revised to give clearer instructions on what lines to draw and on spacing. A sheet to draw the lines on was provided for the student. In the original module, the student was asked to measure and draw an 8 1/2 x 11 sheet. This requirement was amended as the student had not been instructed on the use of the drafting scales; therefore, the student should not be required to measure the sheet for this assignment.

Instruction sheet 2-2, was changed to direct the student to the procedure of taping down the paper if he has a parallel rule on his table. The student then works student self check 2-3. If the student's desk assignment has a drafting machine, he is instructed to check out and work module 2-A.

MODULE NUMBER 2-A

TITLE: USING THE DRAFTING MACHINE

OBJECTIVES: This new module written prior to the field test is designed to introduce the student to the parts of a drafting machine. The module illustrates some of the basic adjustments and care of a drafting machine. The students

whose desk assignment contains a drafting machine are required to complete this module before working the drawing lines and angles assignment in Module Two. The assignment is then completed using the drafting machine.

A new slide tape presentation was required for this module. The module was developed for two types of Drafting Machines, the Bruning Module and Vemco Model. These are two types of machines common in vocational schools. The student learns the parts of the drafting machine; how to adjust and install drafting machine scales, and general care of the equipment. The student is required to demonstrate these competencies after completion of the module. Students who move to a desk with a drafting machine later in the year are instructed to ignore the drawing lines and angles assignment and concentrate on learning the machine parts and operational procedures.

MODULE NUMBER 3

TITLE: USING THE DRAFTING SCALES

OBJECTIVES: The original module on the scales included a section on the metric scale. The metric scale was moved to a later module as the student would not be using the scale in the first thirteen (13) modules. The module was redrafted to emphasize the architects and engineer's scales.

An information sheet, REVIEWING DECIMALS, which had

been used in module five, was moved to this module. The students are being asked to measure with the engineer's scale; therefore, they should be instructed on the decimal system prior to the instruction on the scale. A student self check on the decimal system was added to supplement the instruction sheet. A more thorough student self check was included on the standard scale as this scale will be the one most commonly used.

It was discovered that the measuring with the scales exercises was inaccurate due to the type of printing procedure used. Printing the measuring assignments on a photo style printer can cause the drawing to change in size. The measurements which the students make will then not agree with the answers supplied to the student self check. The only solution to this problem would be to have the sheets printed with a regular printing procedure. Instructors using the module with a Xerox style printer should be aware of this possibility.

MODULE NUMBER 4

TITLE: LINES AND LETTERING

OBJECTIVES: The objective of this module is to give the student the opportunity to practice correct lettering techniques, and learn correct procedures in using the lettering guide. The module demonstrates two styles of let-

tering.

The module contains several practice sheets. Two for vertical and two for inclined lettering. It also has an information sheet on the correct lettering strokes and the use of the lettering guide. The module sheets were kept basically the same as those used before the revision. However, it was decided to move the instruction and practice on the lettering guide to the front of the module prior to the lettering practice. In the older module, the student was required to draw guide lines in the exercises. This procedure was incorrect as the student should have the instruction on what guide lines are and how to draw them before the practice sheets.

The information sheet on the ALPHABET OF LINES was amended. The authors found that the lines shown on the old sheet were not clear. A new information sheet describing the lines used in drafting was also developed.

MODULE NUMBER 5

TITLE: GEOMETRIC CONSTRUCTION

OBJECTIVES: This module was designed to give the student practice in the use of the equipment. It introduces him/her to the procedures on drawing basic geometric shapes, and allows practice time in constructing tangent points and locating centers.

The practice problem sheet DR-5 was revised to closely follow the slide tape presentation. This sheet contains descriptions of how to do the drawing assignments, and the slide tape shows the procedure on the screen. They had to be aligned together on the assignments.

MODULE NUMBER 6

TITLE: MAKING ONE VIEW DRAWINGS

OBJECTIVES: The objectives on this module are to have the student join together all of the skills he or she has accomplished up to this point. The instructor can alter the assignments to fit the student's needs.

The Information Sheet 6-1, MAKING ONE VIEW DRAWINGS, was revised to include the procedure for finding a center point. This procedure is covered in module five, (5), however, it should be emphasized more at this time.

Lines were added to information sheet 6-2 to provide the student a place to practice drawing arrows. In addition, several of the problem assignments were revised. The final module problem list has four one-view drawing assignments.

MODULE NUMBER 7

TITLE: LEARNING TO VISUALIZE

OBJECTIVES: This module is one of the most important in the program. The first six modules have presented the basic information and allowed the student to practice the skills. This module on visualization is the heart of any drafting program. The objective is to introduce the basic skills of visualizing an object, and the location of the views, but most important to provide the student time to practice the skills of visualizing in making the drawings.

Two information sheets were added to the unit. One dealing with identifying the views, and another entitled, "Visualization." This new information sheet gives six of the most common rules, or hints for the student when visualizing a drawing, and provides a ready reference for the student.

All of the problem assignments were analyzed carefully. Attention was given to each problem and what particular skill of visualizing it was using. The order of the problems was re-structured to provide for the best simple-to-complex arrangement.

Discussion was given to moving the section on sketching from module nine (9) to this module. However, in the interest of time, it was decided to conduct the field test without sketching in module seven (7). This approach was monitored by the teachers involved in the field test, and a decision will be made at a later date.

MODULE NUMBER 8

TITLE: LEARNING DIMENSIONING

OBJECTIVES: This module was designed to continue the student on problems involving visualization while adding the features of dimensioning a drawing. Several changes were made on Information Sheet 8-1, DIMENSIONING RULES. The wording of several of the items was changed to make it easier to read. Two items were added to the dimensioning rule list. The first was on the extension line extending to within 1/16 of the corner of the object you are describing. The other helped to clarify the rules on placing a leader line on a circle.

The problems were again evaluated carefully. Attention was given to the order of the problems, to assure that they were proceeding from the simple to complex as far as visualization of the object is concerned. They were also appraised as to the difficulty and process of dimensioning they contained, and their order in the module.

MODULE NUMBER 9

TITLE: MAKING AND DRAWING FROM SKETCHES

OBJECTIVES: In this module, the student is introduced to sketching, given practice in sketching three-view problems, and isometric views. The main thrust of the module is to

encourage the student to make drawings working from a sketch or pictorial illustration of the object. This is not the same as solving for a missing view, as is accomplished in both module seven and eight.

Discussion was given to transferring the sketching portion, or part of it, from this module to module number seven (7), as discussed in the evaluation for module seven. Some instructors prefer to use sketching prior to visualization. The reasoning on using it at this point is to make the modules more applicable to a real industrial setting. Modules seven and eight have problems solving for missing views. Two views are given, and the student solves for a third missing view. This situation never occurs in industry. The more probable occurance is when an engineer, or architect, gives the draftsman a sketch and requires the draftsman to make a working drawing from it. This module is an attempt to bring a realistic situation into the program. The authors decided to leave the sketching here, and at a later time give consideration to moving it, or part of it, to module seven. The drawing problems were also evaluated and several added to the module.

MODULE NUMBER 10

TITLE: SECTIONS

OBJECTIVES: This module introduces the process of drawing

sections. The module uses full, half, offset, revolved, removed, partial, and broken out sections. Several of the conventional rules of drawing these problems are included.

The module was acceptable. Only minor changes were made to the Information Sheet 10-1, SECTIONS. These were primarily wording changes. The problems were changed after consideration to their order and to using all of the types of sections covered in the lesson. A new slide tape presentation was developed, and the reading assignments from the test revised.

MODULE NUMBER 11

TITLE: DRAWING AUXILIARIES

OBJECTIVES: This module is designed to introduce the concept of drawing an auxiliary view of an object. The module involves primary auxiliary views only. Secondary auxiliary views are introduced in a later module.

Five problems were added to the first part of the drawing assignment. These problems are basic auxiliary views. No dimensioning is required. The problems were needed to provide more practice in solving the auxiliary view before the student moves to the more complex drawings. The assignment receives one grade for the five exercises. The reading assignment was revised to provide a relevant order to the reading, keeping it in line with the type of

problem being drawn. In addition, a new information sheet was written. It is a reference style sheet which the student can keep at the drawing table to review as he is drawing. A new slide tape presentation was also developed.

MODULE NUMBER 12

TITLE: MAKING ISOMETRIC DRAWINGS

The purpose of this module is to introduce the student to drawing isometric problems. It is the first part of learning to draw axonometric problems. The student is also introduced to the field of technical illustration, although no shading is required in Module 12.

A new slide tape presentation was developed for Module 12. The problems were evaluated, several moved, and two added to the problem list. The information sheet was amended to include a description on how to center a cylindrical object on an 8 1/2 x 11 sheet.

MODULE NUMBER 13

TITLE: MAKING OBLIQUE DRAWINGS

This module is the second pictorial style drawing module. It is designed to give the student the fundamentals of drawing obliques and provide practice.

The module was evaluated, however, no changes to the

paperwork of the module were found necessary. The major revision was the development of a new slide tape presentation.

II. DEVELOPMENT OF THE SLIDE TAPE PRESENTATIONS

As part of the revision process on the modules, prior to the field rest, it was necessary to develop new slide tape presentatons. These slide tapes replaced filmstrips used with the original modules. Initially, the filmstrips were a time-saving step. However, they were inadequate in their scope. If the modules were to be used by the State of Kentucky, the filmstrips would need to be replaced by original slide tape presentations.

These slide tape presentations present the lecture portion of the program to the student. They are an important feature of the program in the attempt to make it individualized. The slide tape presentations are shown using Singer Caramate projectors. The student sits alone with earphones on, views the slides and listens to the tape. The students appear to pay more attention to an individuaized lesson on a video screen than than they do to the typical group lecture type. The second major advantage of audio visual lessons is that the student can repeat the lesson as many times as required.

The following is a description of the new slide tape presentations developed as a part of the module revision process. Most of the other slide tape presentations, already in use with the program, were not changed in the

interest of time. They were evaluated during the field test, and revisions will be made at a later date.

SLIDE TAPE TITLE: DRAFTING, AN INTRODUCTION

MODULE: NUMBER 1

This slide tape presentation was designed to show the student several things. First, it introduces the student to the job of a draftsman. Second, it shows the process of designing an object, sketching the rough draft, and drawing the object. It then demonstrates how this object is manufactured working from the drawing made by the draftsman.

The slide tape presentation describes several types of jobs available in drafting. It illustrates drawing for industry, drawing a house as representative of architectural drafting, electrical schematics, technical illstration, civil drafting and die designing.

The last presentation on the slides was a description of how a student can achieve a career in drafting. Several slides on industry, the Bowling Green Vocational School, and Western Kentucky University are shown to illustrate apprenticeship, vocational training, and a college degree program.

SLIDE TAPE TITLE: USING THE DRAFTING MACHINE.

MODULE: NUMBER 2-A

This slide tape presentation accompanies the new module "USING THE DRAFTING MACHINE." This module and slide tape were developed as a part of the revision work, when the need for a separate unit on the drafting machine was realized.

This presentation illustrates two types of drafting machines, the Vemco and Bruning models. The presentation begins by showing the upper and lower areas of the drafting machines and naming the parts. Then a close up of the heads on both modules was presented. Colored arrows point out names and locations of all parts. Their names are given and mentioned on the tape.

Another section of the presentation illustrated the procedure for removing, replacing, and resquaring the two scales on the machine. At the conclusion of the slide tape, the student was instructed to practice removing and re-squaring the scales at his desk.

MODULES: NUMBERS 2 AND 3

Several slides were added to the slide tape "USING THE DRAFTING EQUIPMENT" one slide tape presentation with module two. This was necessary due to the addition of the new module on the drafting machine. Several slides from the old presentation were removed allowing several minutes

of time. New slides were then added to reinforce the presentation.

On module number three, "USING THE DRAFTING SCALES" several slides covering the metric scale were removed, as metrics were no longer presented in module three. Then close-ups of how to read the Architect's and Engineer's scale were added. Both of the tapes were revised to accommodate the revisions.

SLIDE TAPE TITLE: LETTERING

MODULE: NUMBER 4

This slide tape presentation was designed to show the types of strokes used in engineering lettering. It begins with a discussion of two types of lettering, inclined and vertical, then presents lettering styles and the use of guide lines. Each letter was shown on a slide and the procedure of forming the letter numbered with different colors. Single stroke letters were covered first then curved stroke letters presented. While the student watches the slide the tape brings his attention to the colored arrows indicating the strokes. Near the end of the presentation a discussion on the use of the lettering guide was shown. The student was instructed to try the lettering guide at his desk then proceed with the next step in the module.

SLIDE TAPE TITLE: ORTHOGRAPHIC PROJECTION

MODULE: NUMBER 7

This slide tape presentation demonstrates the procedures of visualizing an object. It shows the name and locations of the standard views and viewing an object through a picture plane.

A traditional way of illustrating the process of viewing an object through a picture plane is to use a plastic box. The objects being discussed are placed in it and views shown through the clear plane. The first object contains only flat surfaces and square corners. Views were shown by painting one of the surfaces a color. Then straight pieces of lead were placed from each corner of the object to the plane being discussed. A series of slides show this plane being revolved into position and the resulting view of the object.

Another object was used to present a disussion of an inclined surface being projected onto a picture plane. The same procedure was used to illustrate the forshortening of the surface onto the plane. Again, colors were used to bring the student's attention to the correct part of the object.

At the end of the slide tape, several objects were shown on a three view drawing. The object was placed on

the same slide, in front of the drawing, at an angle. The student can see the three surfaces of the object and relate them to the drawing.

Three slide tape presentations were used with module seven. This one was the only new one developed. However, its use allowed for several revisions in the other two presentations.

SLIDE TAPE TITLE: DIMENSIONING

MODULE: NUMBER 8

This slide tape was designed to present the rules for dimensioning an object. It begins with validating the need for dimensioning. The presentation illustrates that a part can never be made from a drawing without dimensions. It then presents a discussion of how to locate the dimensions and conventional practices.

This presentation required a large number of drawings. Each was made to illustrate a particular rule of dimensioning. Colors were used extensively to bring the student's attention to a particular point being discussed on the tape. Dimensioning procedures require that the student memorize the material and put it into use on the drawings. The slide tape presents all of the procedures, then the module emphasizes them again in the information sheets, reading assignments and student self checks. A series of

slides at the end of the presentation are given to review the procedures.

SLIDE TAPE TITLE: SECTIONS

MODULE: NUMBER 10

This slide tape presentation introduces the concept of drawing sectional views. It covers full, half, offset, broken out, partial, removed and revolved sections. Drawings and actual objects were used in the slide tape presentation.

Several objects were obtained, and photographed, before and after being cut in half to reveal the inside area. It is this area which is drawn in a sectional view. The cut-away areas were colored where necessary to accent the photograph. Drawings were made of the object before and after being cut. These were photographed on the same slide with the object. This provided the student an opportunity to compare the drawing and object.

Section drawing involves several conventional practices also. Some of these are revolving features into the sectional view and offsetting the cutting plane. These conventions were covered in the presentations. A review slide and discussion was provided at the end on the slide tape.

SLIDE TAPE TITLE: AUXILIARIES

MODULE: NUMBER 11

This slide tape was designed to present the procedures for viewing an auxiliary view. Two methods of projecting an inclined surface onto the auxiliary view are shown.

Drawings were the main ingredient of the presentation. Colors were used to accent the particular parts of the drawings to direct student's attention to a particular location. Several slides were made using the glass box to demonstrate views on which an inclined surface appears as a line.

SLIDE TAPE TITLE: ISOMETRICS

MODULE: NUMBER 12

This slide tape presentation demonstrates the procedures for drawing isometrics. The procedure was introduced and examples given where isometrics, and pictorial drawings, are used in the drafter's work.

The slide tape presentation uses drawings to demonstrate the sequence of steps used in laying out the "block in" method of drawing isometrics. Photographs of the drawings and objects together were used. A summary slide of the main points on drawing isometrics was also included.

SLIDE TAPE TITLE: OBLIQUES

MODULE: NUMBER 13

This slide tape presents the procedures for laying out an oblique drawing. The concepts of obliques was introduced and procedures demonstrated on laying out obliques. As in the isometric module, drawings are the main medium for presenting the material, although several actual objects were also used. The presentation was designed to allow a student who has not completed the module on isometrics to be able to work through this module, thus, allowing students the choice of skipping a module if they can demonstrate the competency. Therefore, the slide tape for obliques is similar to isometrics but does not rely on it as a prerequisite.

III. THE FIELD TEST OF THE CBVE DRAFTING MODULES

The preceding two sections described the development of the slide tape presentations and the revisions to the first thirteen modules in the study. Twelve of the modules had been used by this author for several years. The revisions accomplished prior to the field test, brought them to an acceptable level of efficiency for the study. One new module was developed and tested, "USING THE DRAFTING MACHINE," Module 2-A.

The field test evaluated these modules and the slide tape presentations. The purpose of the study was to correct any remaining deficiencies. The test was conducted during the 1980-1981 school year at two vocational schools. The Russellville Area Vocational School, Russellville, Kentucky, and the Allen County Scottsville Vocational School, Scottsville, Kentucky.

Twenty-four students at Russellville and twenty-one at Scottsville used the modules. These students were in their first year of drafting. None had any prior drafting experience. One had a high school level drafting program prior to the vocational program. A high school program was defined as a drafting program which meets one hour per day and generally uses "T" squares rather than drafting equipment of the industrial type. Vocational drafting programs

are defined as those meeting for 2 1/2 to 3 hours per day and using professional drafting equipment. The students were high school juniors and seniors.

The teacher at the Scottsville Vocational School had no prior experience with a CBVE program. He was involved in the revision of the modules and the development of the slide tape presentations. The author is the instructor at the Russellville Vocational School and has used the CBVE program for the past two years.

One indication of a successful curriculum will be a variation in student achievement. The visually orientated students will achieve more than those with less visual ability. This variation can be accomplished if the program provides for individual differences, allowing the students to move at their own pace -- one of the expectations of the CBVE drafting program.

Spatial ability can be measured. A section of the GATB (General Aptitude Test Battery) measures spatial ability. Research has suggested that spatial ability is genetically linked (Conger, 1977, pp 155-156), an indication that one with the genetic ability for spatial visualization would move further than a student with lower levels of spatial ability. There are no data on these students to evalute the difference between fast and slow learners. Our definition of fast and slow is based on the number of modules accomplished in the school year. Whether a student

has more "genetic" spatial abiity or not, is of little consequence to the results this study was seeking. The real test of the program is whether or not it can provide for the needs of all the students when some move more rapidly than others.

The fast learners were indeed found to be successful. All of the regional winners in the Vocational Industrial Club of Americas' (VICA) regional drafting competition were either from the Russellville Vocational School or the Allen County Scottsville Vocational School. The contestant who won the regional competition in mechanical drawing, in competition against five other schools, went on to place second in the Kentucky State competition. This state competition was against 50 other drafting programs and included second year drafting students. The winner from the Russellville school was a first year student under the CBVE program. He succeeded because the program allowed him to move at his own pace.

In both programs, it was found that the faster students were able to take charge of their own learning. By using the slide tape presentations when they needed them, instead of waiting for the next lecture by the instructor, they were able to move at an extremely fast pace. In the first six-week grading period, a separation of fast and slower students was noticed by both of the instructors. The gap widened as the year progressed.

Individualization of the program is closely tied to the student's ability to move at his/her own pace, one of the main objectives of the CBVE approach. The faster students needed only guidance to keep on course. The instructors acted more as managers, correcting the students mistakes along the way.

The slower students needed more instructor time. This individualization was one of the main advantages of the CBVE approach. It provided the teacher more time to devote to these students. The two teachers were able to spend more time with the slower students demonstrating drawings, doing some of the layouts as examples, and generally providing this needed individualization.

Many of the students adapted their own teaching method to their program. After an adjustment time, the students began to use the program in the way they felt most comfortable. For example, some of the faster students were able to view slide tape presentation then only skim read, or omit parts of the reading assignments. They had learned the task from the slides and were able to proceed to the drawing faster. Some found it helpful to create a note-book. This idea was mentioned as a possibility by the instructor, but not stressed as manditory. However, the students would watch the slide tape--stopping the tape at times to take notes, and then proceeding. This feature -- being able to concentrate on or skip a particular part of

the lesson, or review a part already learned further individualized the program.

The individualization of the program was beneficial to the instructors as well. The slide tape presentations removed all lectures to the group. No lesson plans were needed. Lessons were given at the drawing boards as the students needed them. Both instructors also reported feeling a closer rapport developing between the teacher and student.

The slide tapes provided other advantages. It was observed that the students paid more attention to the lesson presented on the audio visual machines than to lessons presented to the whole group. The video screen seemed to hold their attention longer.

A reading test was given to all of the drafting students by the vocational school guidance counselors. This test was an attempt to check the reading level of the subjects. The text used in the program was "TECHNICAL DRAWING" by Geisecke, Mitchell, Spencer, Hill. It is widely used in colleges and universities. Although the problems are excellent, the level of the vocabulary is high. Some of the students evaluated were found to have low reading levels. These students were encouraged to use the alternate text "MECHANICAL DRAWING" by French, Svensen, Helsel, Urbanick for the reading assignments. It was observed that these students seemed to rely heavily on the

slide tape presentations. Several expressed the belief that they could not have done the work at all without the benefit of the slides.

The slides have another positive feature. They can be used an many times as needed by the student. This practice was encouraged by both instructors. If a student asked a question, which was covered in the slide tapes, the instructors suggested reviewing the presentation. Another way of using the slides was for the instructor to use the slides to explain a particular problem to a student. Although there was no evidence to substantiate it, both instructors believed that the students had a better retention level due to their increased level of attention to the slide tape presentations.

Prior to the field test the instructors discussed the implications of the student successes on completing a unit. It was anticipated the students should feel a sense of accomplishment as they completed a module and moved on to the check out procedures. This phenomenon was observed during the study. Students were heard at several times, in both classes, expressing pride in finishing a module. They would ask one another "Which module are you on?" "Oh yes, I just finished number nine, etc." This sense of accomplishment on completing a project is a strong motivator and gives the student a sense of pride.

The student's completion of a module provides other

opportunities for the teacher. It provides the opportunity to reward or recognize the student achievement. This recognition can be a compliment on the grade achieved or on the speed at which the student accomplished the module. However, completion of the module itself seemed to be the strongest motivator. Often a student can finish a module before the end of the class. If the teacher gives him/her the remainder of the period off, (assuming this is a reasonable amount of time) the student's feelings of accomplishment are reinforced.

No program is a panacea. It was not expected that the CBVE program would be a cure-all for the problems in the teaching of drafting. Several anticipated problems were noticed and ways of dealing with them had to be determined.

While it is true that the slower student's problems surfaced faster with CBVE, because of closer teacher student contact, it was difficult for a slower student to see another student moving faster than he. Some of them felt intimidated. The instructors discussed this problem and attempted to provide more recognition to these students. There was success in some of the cases.

The best solution was to modify the program to suit the individual student. The student who could not succeed on solving missing view problems might be able to draw a house. If this were where his/her interest lay, he/she would succeed much easier. Both instructors experimented

with moving the slower students over to the section on architecture, after half of the program was completed. Here again was one of the advantages of individualizing the program to the student's needs and interests.

Another negative expectation was that some of the students might fall victim to the self pacing. The students do have more responsibility under the CBVE program. For some of them, it is more responsibility in the school setting than they have had before. Mentioned earlier was an example of the student who began to take her own notes without being told. This student was able to adapt to the idea of self pacing. However, some have problems and are not sure of what to do next. They seem to be so conditioned to the teacher playing the role of the leader that they sit and wait for the next order.

This situation can be managed if the teacher remains alert to its occurance. The effect seemed to present itself more in the first few weeks when the students were unfamiliar with the modules. In the Russellville class, there were second year students who were familiar with the program. This instructor overheard some of them giving to the new student direction on what to do next. This approach is acceptable. However, the teacher needs to be alert to the student who uses the completion of a module or drawing as an excuse to take a rest and not start another unit.

One anticipated problem was that the teachers work load would increase. This situation is a question of management. Both of the instructors in the field test anticipated such a problem and each made different types of preparation for it. If the instructor is not prepared to handle the increase in grading student check-outs, and drawing problems, he will indeed have a problem. The most efficient way to deal with this situation is to handle the grading of problems daily and the checkouts as soon as possible during class time.

If the instructor intends to use the additional time gained by not lecturing, etc., to the benefit of the students, he will not always be able to grade a check-out activity as soon as the student completes it, particularly in the first few weeks. During these weeks, the students can complete a module in one or two days. The result is that the teacher is constantly checking out a student. This procedure is an important feature of the CBVE approach. As the student completes a module, he gets the check-out procedures, and MUST demonstrate them to the teacher, BEFORE he is allowed to move on to the next unit.

If the instructor is to hold strictly to this procedure, he/she will have a line of students waiting to be checked out in these first few weeks. Again, the solution is one of management. The later modules which have critical job related competencies with them should be accom-

plished before the student is allowed to move on. However, in these earlier modules, and in the interest of time and keeping students motivated, both instructors found it easier to take a brief look at the check-out and tell the student to go on to the next module. The instructor would then grade the check-out at his/her convenience. After the fourth week, the modules require more time for completion and that problem is no longer present.

The positive expectations discussed prior to the field test and the negative expectations were both found in the program. Both instructors believe the program met the needs of the students, and the problems with the program could be handled through planning. A discussion of the solutions to some of the problems encountered, and the suggestions for changes to the program, will be presented in a later chapter.

IV. REVISIONS SUGGESTED FROM THE FIELD TEST

After the conclusion of the field test, the instructors discussed the results of the project. The following is a summary of the changes implemented.

The main problem discovered was the check out activities. It was agreed the psychomotor elements of the modules should receive more emphasis than the cognitive elements and new drawing problems were found. The cognitive check outs, on the average, were one page long. These one page check outs are easy to remember and many of the questions were identical to those on the student self checks. The instructors agreed to develop a series of new check out tests for each module.

An evaluation of all of the current test items was conducted at both schools in an attempt to give the tests more internal validity. The results will be used to rewrite the original check out questions.

The drawing check out tests were considered acceptable. They will be expanded some to provide the instructor with more choices of problems for the check out drawing assignment.

A second major area discussed during the program evaluation was teacher preparation. A teacher's manual will need to be developed to assist first time users. The

problem of managing the program was alluded to earlier. This management concern must be addressed through the manual as new users can have management difficulties. The first few weeks are of particular concern as they require a great deal of instructor time in check out activities.

The check out activities provide the student with a sense of accomplishment and a positive feeling toward the program and his/her own abilities. The early check outs do require more teacher time and effort. However, they are also providing the student with the skills of using the modules, thereby saving instruction time later. The teacher is also assured that the student is developing correct habits and using the program correctly. The check out activities are serving two functions.

The CBVE standard approach is to grade check out assignments immediately -- a positive feature, but difficult in the early modules. The entire class is working together at this point, and many students need the check out at the same time. The solution discussed was to have the student take the check out, put it in an "in" box, and allow the instructor to grade it later. Many of the skills being demonstrated in the earlier modules are elementary. A brief glance at the check out will usually be sufficient to see if the student is close. If the student did not achieve a rating of fully accomplished, the teacher can meet with him/her the following day and discuss the parts

needing repetition.

Another teacher concern discussed was the management of the paperwork of the modules. Instruction should be provided in the teacher's manual as to the best methods of storing modules prior to use, in use, and after use. This instructor found the "pigeon" hole system superior to storing modules in a file cabinet. In a file cabinet they tend to fall over. In the pigeon hole system, the teacher can glance up to see which modules need to be printed, and so on. In addition, the shelves take care of themselves. When the student removes a module, no straightening of the remaining modules is required.

SUGGESTED REVISIONS TO THE MODULES

MODULE NUMBER 1

TITLE: DRAFTING, AN INTRODUCTION

This module was in acceptable condition during the field test. The paperwork seemed adequate and the slide tape was excellent. Students scored high on the check out activity and generally were able to complete the module in one class period.

When a student is finished with module one, the instructor should ask if he/she understands how to use the audio visual equipment and where the classroom supplies are

located. The teacher should also ask if the student has any questions on the fields of drafting, or achieving a career in the field.

Several changes were suggested on the check out activity. These were wording changes and were corrected in the new tests developed prior to the 1981-82 school year.

MODULE NUMBER 2

TITLE: DRAFTING EQUIPMENT

Module number two was also acceptable. The slide tape presentations are good, however, the instructors found several slides needing to be re-photographed to improve their quality.

Teachers should be aware of the procedure for a student on a drafting machine as compared to a student on a parallel rule. This will require a different procedure as they near the end of the module. Those on a machine will not complete the lines and angle assignment, but instead, move on to module 2-A and finish the assignment there. Teachers should stress the four features of drafting: speed, accuracy, neatness and legibility. It is recommended that these be presented in a group lecture, or written on the black board, etc.. The student is required to identify these features, and the instructors recommend that added emphasis be presented outside of the module.

MODULE NUMBER 3

TITLE: USING THE DRAFTING SCALES

Student self check 3-1, on using decimals needs to be expanded. It should include more interpretations of worded decimals and require the student to look up fractions and convert them to decimals. The two scale identification drawings are inadequate. The instructors found both of these should be redrawn and made to the normal size of the scale. The problems with printing of the measuring assignments has already been mentioned in an earlier chapter. This may be resolved by having the measuring sheets printed on a regular printing process.

The instructors decided the slide tape presentation should be expanded. More slides showing how to read the scales are needed. Close up photography showing the scales should be added. The check out activity was found to be adequate, but an additional check out was needed to provide for students who fail to demonstrate competency on the first attempt.

MODULE NUMBER 4

TITLE: LINES AND LETTERING

Several practice exercises will be added to the in-

struction sheet 4-2, on "Using the Lettering Guide." This would provide the student with the opportunity to use the lettering guide prior to doing the actual lettering exercises he/she will be evaluated on. The four lettering exercises also need to be redrawn. The instruction sheet on lines was found to be inadequate. A new sheet with clearer lines and descriptions was needed.

The instructors also advise teachers using the program to give a group lecture on line types sometime during the period when the students are involved in module four. This group lesson would supplement the module, and enable students to understand why there are different types of lines, rather than simply requiring rote memorization. Group lectures are possible during these early modules since the students are working relatively close together during the first weeks.

MODULE NUMBER 5

TITLE: GEOMETRIC CONSTRUCTION

This module is a very important one since it develops the use of the equipment and instructs the student on locating center points and tangents. The instructors believe this may be another place a teacher could give a group lesson. A lesson should be provided on the geometric definitions along with the module. Some of the students have

problems with the terms and this should help to eliminate that situation.

It was also decided that the slide tape presentation should be re-photographed. Several of the slides were not clear enough. New slides focusing on the steps in the process were developed.

MODULE NUMBER 6

TITLE: MAKING ONE VIEW DRAWINGS

The only change in module number six was to the instruction sheet 6-1, "Making One View Drawings." It was decided that this sheet be changed to include the procedure for locating an arc intersecting two other arcs. There is no check out activity with this module. If a teacher wanted one, he/she could easily require an additional problem. This should be suggested in the teacher's manual to be developed later. The instructors did not use a formal check out activity as the objective of this module was to review all the procedures learned up to this point in the program.

MODULE NUMBER 7

TITLE: LEARNING TO VISUALIZE

The instructors suggested that the drawings in the

beginning of the module, which instruct the location of the views, be expanded. The students seem to need more practice with this activity. Several questions on student self check 7-2, and the check out activity are poorly worded and required revision.

The slide tape presentations were adequate with only several slides requiring changes for clarity. The students should be encouraged to make use of the slides while they are working through the module. Teachers should be conscious that, at this point in the program, some students are moving rather fast. They become involved in the speed of finishing a drawing, etc., and have a tendency to skip vital steps on the learning activities sheets. The instructors suggest that this situation should be included in the teacher's manual.

MODULE NUMBER 8

TITLE: LEARNING DIMENSIONING

Only cosmetic changes were suggested to this module. Several items on instruction sheet 8-1 needed to be written for clarity and an item added to the sheet. The same type of correction is required to the student self check in the module. The slides were found to be in excellent condition and the problems within the module adequate.

MODULE NUMBER 9

TITLE: MAKING DRAWINGS FROM SKETCHES

This module was in excellent condition. The authors discussed moving part of the sketching requirement to module seven. Since all teachers should adapt the program to their own use, it was decided to leave the module as it is and make a suggestion in the teacher's manual about the sketching.

MODULE NUMBER 10

TITLE: DRAWING SECTIONS

The instructors decided that an additional module was necessary to cover the subject of sections. A new module will be developed entitled, "Advanced Sections." This new module will begin where module ten ends. Several changes will be required in module ten to accomodate this new module. One of these will be to remove the different material type requirements. The slides were doing an excellent job of covering the material. Quality of the slides was also excellent.

MODULE NUMBER 11

TITLE: DRAWING AUXILIARIES

The same changes were applied to this module as were applied to module ten. A new module needs to be developed. The new module will be entitled "Advanced Auxiliaries" and will introduce the process of drawing secondary auxiliary views. This allows module 11 to concentrate on primary auxiliaries.

MODULE NUMBER 12

TITLE: MAKING ISOMETRIC DRAWINGS

When the authors evaluated this module, no changes were required. The slides are excellent and the module is doing an acceptable job of developing the competencies required in isometric drawings. Teachers using the program may want to use individual lessons, or group lessons if enough students need it at the time, to instruct the procedure of converting angles into linear measurements.

MODULE NUMBER 13

TITLE: MAKING OBLIQUE DRAWINGS

This module is in very good condition. Changes suggested were to the tape and some slides on the audio visual presentation. No changes were required to the module.

V. STUDENT EVALUATION OF THE CBVE PROGRAM

In order to get program feedback, an instrument was developed and administered to the students involved in the test. A copy of the instrument is included in Appendix "A." The instrument was administered during the last month of the school year, May 1981. The questionnaire was multiple choice and no names or any other student identification was on it. This was done in order to maintain anonymity. The purpose was to obtain the student's feedback on the program in general, the text book used, the drawing assignments, and each individual part of the module structure.

The following is an item analysis of the questions and the student responses. First the question is presented and the student responses given. There were a total of 45 students in the CBVE field test. Percentages shown are based on that number.

1. OVERALL, HOW DO YOU FEEL ABOUT THE CBVE DRAFTING PROGRAM OF INSTRUCTION AS COMPARED TO OTHER LECTURE BASED COURSES YOU HAVE TAKEN?

A. Much better
B. Better
C. About the same
D. Not as good
E. Much worse

59% of the students responded much better
35% responded better
6% rated it about as good

There were no responses to not as good or much worse. In general, the students rated the CBVE approach as superior to other lecture based courses.

2. DO YOU LIKE THE IDEA OF STUDENTS BEING ALLOWED TO WORK AT THEIR OWN PACE, OR DO YOU PREFER THE WHOLE CLASS STAYING TOGETHER?

A. Self paced is much better
B. Self paced is slightly better
C. No real difference
D. Prefer if the whole class stays together
E. Class staying together is much better

87% of the students responded they felt self paced instruction was much better.
7% felt that self paced instruction is slightly better
4% responded no real difference.
2% responded they preferred the entire class staying together.

These results were a resounding vote for the concept of individualized instruction. The students preferred self pacing to being held to a pace adjusted to suit the entire class.

3. HOW DO YOU LIKE THE SLIDE TAPE PRESENTATIONS?

A. I like them, they are really better in helping me understand.
B. They are okay; I get some information from them.
C. I do not think they helped me very much.
D. I do not like them at all.

62% felt that the slide tape presentations really helped them to understand.
36% felt that they were acceptable and got some information from them.
2% felt they did not help much.

These results were also expected by the researchers. The slide tape presentations were commented on many times during the year by the students in both Russellville and Scottsville. Both of the instructors reported favorable comments on the presentations.

4. HOW DO YOU FEEL ABOUT THE READING ASSIGNMENTS?

A. They are acceptable, but could be longer.
B. They are about right in length.
C. They are a little too long for me.
D. They are not good at all, too long for me to read.

18% of the students felt they were acceptable in length, but could be longer.
47% of the students felt they were about right in length.
27% felt that they were a little too long.
8% felt that they were too long to read.

5. HOW DO YOU FEEL ABOUT THE TEXT BOOK, "TECHNICAL DRAWING"?

A. It reads okay for me, no problems.
B. It reads about right, but is a little hard sometimes.
C. It was hard for me to read.
D. It was difficult for me to read, so I did not read it.

37% of the students responded that it read okay to them and they had no problems.
58% felt that the book read about right, but was a little hard sometimes.
9% felt that the book was hard to read.

The responses to this item were as expected. However, some of the students were reading another book part of the time and may have misunderstood the question. They may

have responded thinking of the book they were most familiar with. The instructors believe the text book may be written above the vocabulary level of some of the high school students.

6. EVALUATE THE DRAWING PROBLEMS IN THE MODULES.

A. They were too difficult for me.
B. They were about right in difficulty for me.
C. They were relatively easy for me.
D. They were too easy for me and should be made more difficult.

82% of the students felt the problems were about right.
18% felt that they were relatively easy.

It is interesting to note that none of the students rate the problems as being too difficult, and none of them rated them as too easy. The problems all came from the same text book, "Technical Drawing", which was evaluated in the previous questions.

7. THE NUMBER OF DRAWING PROBLEMS ASSIGNED IN THE MODULES.

A. Could have been more problems in each module, for more practice.
B. Seemed to be about enough problems in each module.
C. Needed to be less problems in the modules.

7% of the students felt that there could have been more practice problems.
80% felt that the problems seemed to be about right.
13% rated the modules as needing less problems.

Some of the modules have more problem assignments than

others, due to the number of practice exercises the writers felt was necessary for that particular unit. Although most of the students did feel the amount was acceptable, it is possible that some may have become accustomed to the success at the end of the module and felt the longer ones were too long. In future revisions, this point may need further evaluation.

The next section of the instrument was devoted to analyzing the features of a module. The student was asked to rate each feature of the module as excellent, good, fair or poor.

A. Excellent
B. Good
C. Fair
D. Poor

8. THE INTRODUCTION: A BRIEF DESCRIPTION OF THE MATERIAL IN THE MODULE. WHAT IS COMING, AND WHAT IS IMPORTANT TO THE LEARNER.

51% rated the introductory statements as excellent.
49% rated the introductory statements as good.

9. THE OBJECTIVES: WHAT THE STUDENT IS EXPECTED TO BE ALBE TO DO WHEN FINISHED WITH THE MODULE.

53% of the students rated the objective statements as excellent.
42% rated them as good.
5% felt they were fair.

10. THE LEARNING ACTIVITIES PAGE: A GUIDE FOR THE STUDENT TO FOLLOW SO THAT LEARNING PROCEEDS FROM THE SIMPLE TO THE MORE COMPLEX TASKS. SHOULD BE FOLLOWED STRICTLY IN THE ORDER IN WHICH IT WAS WRITTEN, EXCEPT FOR VIEWING OR READING ASSIGNMENTS WHICH MAY BE REVERSED IF NECESSARY.

53% rated the learning activities page as excellent.
31% rated the learning activities page as good.
15% rated the learning activities page as fair.

11. THE INFORMATION AND INSTRUCTION SHEETS: ARE BRIEF ONE OR TWO PAGE SHEETS OF INFORMATION WHICH GIVE THE INFORMATION NOT INCLUDED IN THE READING OR VIEWING ASSIGNMENTS, OR ACT AS A REVIEW SHEET OF THE INFORMATION COVERED IN THESE PRESENTATIONS.

53% rated the information sheets as excellent.
38% rated the information sheets as good.
9% rated the information sheets as fair.

12. THE STUDENT SELF CHECKS: ARE DIAGNOSTIC TYPE TESTS WHICH ALLOW THE STUDENT TO CHECK HIS/HER OWN PROGRESS ON THE MATERIAL BEING STUDIED. THE ANSWERS ARE ALWAYS PROVIDED IN THE MODULE AND THE STUDENTS CHECKS THEIR OWN TEST.

57% of the students rated the student self checks as excellent.
32% rated the student self checks as good.
11% rated the student self checks as fair.

13. THE RESEARCH SHEETS: ARE FILL IN THE BLANK STYLE COMPLETION EXERCISES DESIGNED TO PROVIDE THE STUDENT WITH THE OPPORTUNITY TO WRITE DOWN IMPORTANT DEFINITIONS, ETC., TO TECHNICAL TERMS WHICH ARE BEING STUDIED.

39% rated the research sheets as excellent.
45% rated the research sheets as good.
14% rated the research sheets as fair.
2% rated the reserach sheets as poor.

14. THE CHECK OUT TESTS: ARE TO BE ONE PAGE OR TWO PAGE TESTS OVER THE KNOWLEDGE ASPECT OF THE MODULE.

47% rated the check out tests as excellent.
51% rated the check out tests as good.
2% rated the check out tests as fair.

15. THE CHECK OUT DRAWINGS: ARE TO BE EXAMPLES WHERE THE STUDENT DEMONSTRATES, WITHOUT THE TEACHERS HELP, THEIR ABILITY TO DRAW THE STYLE OF PROBLEM BEING STUDIED. (USED ONLY WITH MORE ADVANCED

MODULES)

57% rated these drawings as excellent.
34% rated the check out drawings as good.
9% rated the check out drawings as fair.

No attempt has been made to draw a comparison between the two clases. The Scottsville teacher was using the program for the first time, and encountering management difficulties. This teacher at Russellville had used the program before and was more familiar with the procedures.

In addition, the teacher at Scottsville was on sick leave for one month during the second semester. The program was being taught by the school coordinator, who was unfamiliar with CBVE. This situation may have accounted for the fact that as a group the Russellville students rated the program higher in almost every item. Their evaluations ran mainly on good and excellent. The Scottsville class rated the program excellent on many of the points but gave more good and fair evaluations than the Russellville group.

It is interesting to note that both groups combined rated the overall program as good or excellent. Ninety-five percent of the students felt the program was superior to other lecture based programs they had taken. Ninety-four percent preferred the idea of self paced instruction. The slide tape presentations received a rating of 98% in the excellent and good columns. There were very few fair, and on only one item, one student rated the item as poor.

No space was provided on the forms for the students to express comments. However, several of the students voluntarily commented. All of these were favorable expressions toward the CBVE program.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this project was to develop, revise and field test a competency based vocational drafting program. The program concentrated on the introductory areas of drafting covering thirteen modules. The modules were revised prior to and after the test. These modules, and their accompanying audio visual presentations, are now a valid curriculum for the teaching of drafting at the vocational level.

Competency based vocational education is a very logical approach to the teaching of a trade. It is an attempt to assure that the curriculum contains the kind of tasks workers perform on the job. The methods used to establish the tasks for this program have been discussed. This method was not exactly the same procedure as used by the states in the V-TECS consortium. However, it is this author's belief that this introductory area will contain the same tasks regardless of how they are validated. This program is based on a well developed group of actual job tasks, which have reciprocity within the states.

It is the relevance of any program which builds stu-

dent motivation. Motivation is achieved when the student perceives the program as containing what is needed to be successfully employed. When one knows the objectives of the program were developed from real job tasks, the relevance of the program is easily seen.

Another objective of the CBVE approach is to make the program individualized. The modules accomplish this goal. The slide tape presentations allow a student considerable freedom in using the lessons. They also allow the instructor freedom from preparing and presenting lectures. Therefore, he/she can spend more time at the drawing boards, giving small group lessons, or individual help.

As mentioned earlier in this report, the original plan of vocational education was to take an experienced tradesperson and make him/her the teacher. In addition to allowing the tradesperson to individualize the program, and more one-on-one contact with the student, the CBVE system provides other advantages. It provides a planned organizational system for the program which aids the teacher, student and the administration.

The audio visual presentaions are a very strong feature of a CBVE program. Considerable time and effort goes into the development of these presentations. When complete, they are free of errors in delivery and content. It must be a near impossibility to stand before a group even with the best rehearsed lesson plan available, and not omit

at least one important point you had intended to make. The slides allow you to edit the script and approach a perfect lesson. When you consider that the student also has the opportunity to view this lesson as often as needed, the presentation can indeed be successful.

The modules are designed using established teaching techniques. They are providing the student with the information in a three time concept. The informaton is presented in the audio visual presentations, the reading assignments and again in the instruction sheets. The modules contain diagonistic tests in the form of student self checks. The drawing problems, the heart of any drafting program, can be modified to fit individual needs, and provide adequate practice to allow demonstration of competence.

In the area of drafting, individual ablities can make a strong difference. Different spatial ability levels affect student achievement. Higher level spatial ability students can move at a high rate of speed and achieve higher technical levels. The material in the program is identical to that presented at many universities. These students in high school can master this material to a much greater depth than the college students due to the individualized program and class time. Several of this instructor's former students have demonstrated this effect when attending college, by being able to skip university

courses in drafting due to their knowledge of the subject.

For those people who do not have a high level of spatial ability the program also offers some learning possibilities. One of the things industry spends a great amount of money and time on each year is training workers in blueprint reading and the use of precision instruments. The people with lower spatial ability levels may not succeed as a draftsman, but leave the program with these marketable blueprint reading and precision instrument skills. The individualization of the program also provides these people additional teacher time and thereby allows them to succeed further than would be possible under more traditional programs.

This is not to suggest that one cannot fail the program. Since the program is also based on job skills, the student's completion of the program must be based on the demonstration of competence in performing job tasks. Some will achieve more than others. In fact, grading is the main problem this author has encountered with CBVE.

Ideally the grading process should be as simple as pass-fail. Either a student has or has not mastered the tasks. However, the problem comes in with high school students who must receive a letter grade. How does one grade a slower student down for his/her speed when he/she is working at his/her own pace? One cannot ignore it and grade the drawings the same as would be the case with the

student who turns in three times as much. Since the drawing grades, which make up a large part of the total, are purely a subjective teacher judgement, the slower student may ultimately be penalized for his/her speed or lack of it. All CBVE teachers should be aware of this problem. The conflict can be more complicated by the fact that speed is one of the four features a draftsman should possess. One possible solution would be to make the entire drawing program easier. However, this action could be the worst possible solution.

We live in a very technical society. If one took all of the knowledge which existed in the world at the year One and placed it in a library, it would have taken 1750 years for it to double. It would then have doubled again in 1900, 150 years later. After World War II, the total world knowledge began expanding at a phenomenal rate. It doubled again in 1950, 1960, 1968, and 1975, and is almost ready to double again. High school students have seen the total knowledge of the world double since they began school. Herein lies the problem in education today. We have so much more to teach and yet have only the same amount of teaching time we had 100 years ago. You simply cannot get two dozen eggs into a single carton without something breaking.

We have to hold to the traditional courses as long as they are still important to the lives of our students.

Beyond that, the curriculum must be constantly challenged. If a high school diploma or vocational certification is to be meaningful to an employer, it must represent a person prepared for the world of work. The technical nature of courses, such as drafting, which have a direct job application must be kept current.

Even current may not be enough. Our students do not need an education for today. By the time we finish writing a curriculum for today, it may be obsolete. We have to possess enough foresight to predict accurately what they will need tomorrow and teach toward that goal. The CBVE approach has made an attempt to validate tasks and made provisions to keep these tasks current, a procedure that will go a long way toward helping with the problem of our ever expanding technological society. If there is a problem with the CBVE concept, it may be in keeping the program up-to-date.

The material this author has developed does not even scratch the surface of what is needed in this one area. When it is all finished and we as vocational educators become comfortable with the system its logical base and organization, and settle back and breathe easy at the conclusion, our technical society may have left us in its dust.

Competency based vocational education is no panacea. It was never intended as a teacher replacement. It is

designed only to serve the teacher just as any other teaching tool. Any teaching system is a tool for the teacher to use and adapt to their own situation. CBVE can serve the students, teachers, and the administration by helping the teachers to do a more effective job.

APPENDIX "A"

INSTRUCTIONS:

COMPLETE THE FOLLOWING QUESTIONS DO NOT PUT YOUR NAME ON THE FORM.

1. Overall, how do you feel about the CBVE drafting program of instruction as compared to other lecture based courses you have taken?

A. Much better
B. Better
C. About as same
D. Not as good
E. Much worse

2. Do you like the idea of student's being allowed to work at their own pace, or do you prefer the whole class staying together?

A. Self paced is much better.
B. Self paced is slightly better.
C. No real difference.
D. Prefer if the whole class stays together.
E. Class staying together is much better.

3. How do you feel about the slide tape presentations?

A. I like them, they are really better in helping me understand.
B. They are okay, I got some information from them.
C. I don't think they helped me much.
D. I do not like them at all.

4. How do you feel about the reading assignments?

A. They are acceptable, but could be longer.
B. They are about right in length.
C. They are a little too long for me.
D. They are not good at all, too long for me to read.

5. How do you feel about the text book, TECHNICAL DRAWING, used in the course?

A. It reads okay for me, no problems.
B. It reads about right, but is a little hard sometimes.
C. It was hard for me to read.
D. It was very difficult for me to read, so I didn't read it.

6. Evaluate the drawing problems in the modules.

A. They were too difficult for me.
B. They were about right in difficulty for me.
C. They were relatively easy.
D. They were too easy, should be made more difficult.

7. The number of drawing problems assigned in the modules:

A. Could have been more problems in each module for more practice.
B. Seemed to be about enough problems in each module.
C. Needed to be less problems in the modules.

Below is a listing of the various parts of a module, and a brief description of its intended purpose. Do they fulfill the purpose? Evaluate each according to the following scale:

A. Excellent B. Good C. Fair D. Poor

8. The introduction: a brief description of the material in the module, what is coming and why it is important to the learner.

9. The objectives: what the student is expected to be able to do when finished with the module.

10. The learning activities page: a guide for the student to follow so that learning proceeds from the simple to the more complex tasks, should be followed strictly in the order in which it was written, except for viewing or reading assignments which may be reversed if necessary.

11. The information or instruction sheets: are brief one or two page sheets of information which give the information not included in the reading or viewing assignments, or act as a review sheet of the information covered in these presentations.

12. The Student Self Checks: are diagnostic type tests, which allow the student to check his/her own progress on the material being studied. The answers are always

provided in the module and the student checks their own test.

13. The research sheets: are fill-in-the-blank style completion exercises designed to provide the student with the opportunity to write down important definitions, etc, to technical terms which are being studied.

14. The check out tests: are one page or two page tests over the knowledge aspect of the module.

15. The check out drawing: are examples where the student demonstrates, without the teacher's help, their ability to draw the style of problem being studied. (used only on the more advanced modules)

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